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List of Abbreviations

APQP	Advanced Product Quality Planning
AATCC	The American Association of Textile Chemists and Colorists
AB Cotton	Absorbent Bleached Cotton
ACW	American Cord & Webbing
CAN	Acrylonitrile
ADD	Anti-Dumping Duty
ADL	Acquisition Distribution Layer
ADRDE	Aerial Delivery Research and Development Establishment
AFFOA	Advanced Functional Fabrics of America Institute
AFRPCDC	Advanced Fibre Reinforced Polymer Composite Development Centre
AGM	Absorbent/Absorbable Glass Mats
AICTE	All India Council for Technical Education
AIIMS	All India Institute of Medical Sciences
AL	Artificial Lung
ALC	Automatic Level Control
ALF	Acute Liver Failure
AMD	Advanced Materials Division
APE	Apparel Parks for Exports
ASFI	Association of Synthetic Fibre Industry
ATIC	Advanced Textile Innovation Center
ATIRA	Ahmedabad Textile Industry's Research Association
A-TUFS	Amended Technology Upgradation Fund Scheme
BAL	Bioartificial Liver Device
BBA	British Board of Agreement
BCI	Better Cotton Initiative
BFL	Buffered FET (Field Effect Transistor)
BIS	Bureau of Indian Standards
BOPET	Biaxially-Oriented Polyethylene Terephthalate
BOPP	Biaxially-Oriented Polypropylene
BPJ	Bullet Proof Jackets
BRO	Border Roads Organisation
BSCI	Business Social Compliance Initiative
BSDM	Bihar Skill Development Mission
BTRA	Bombay Textiles Research Association
CAGR	Compound Annual Growth Rate
CBC	Carpet Backing Cloth
CBR	Continuous Bleaching Range
CE	Conformitè Europëenne
CEP	Continuing Education Programmes
CII	Confederation of Indian Industries
CMTA	Cluster Management Technical Agency
CoE	Centres of Excellence
CPC	Chemical Protective Clothing

CSIR	Centre for Scientific & Industrial Research
CSR	Corporate Social Responsibility
CST	Central Sales Tax
CTRM	Composites Technology Research Malaysia
CUMI	Carborundum Universal Ltd.
DBMR	Data Bridge Market Research
DEBEL	Defence Bioengineering & Electro Medical Laboratory
DITF	Deutsche Institute für Textilund Faserforschung Denkendorf
DGFT	Directorate General of Foreign Trade
DMF	Dimethylformamide
DMP	Dot Matrix Printer
DMSRDE	Defence Materials and Stores Research and Development Establishment
DRDO	Defence Research & Development Organisation
DSR	Demand Signal Repository
DVT	Deep Vein Thrombosis
ECMO	Extra Corporeal Membrane Oxygenation
EDC	Entrepreneurship Development Cell
ELS	Extracorporeal Liver Support
EOU	Export Oriented Unit
EPC	Engineering, Procurement and Construction
EPS	Expanded Polystyrene
ETP	Effluent Treatment Plants
FCI	Fixed Capital Investment
FDI	Foreign Direct Investment
FDP	Faculty Development Programmes
FIBC	Flexible Intermediate Bulk Containers
FIC	Focus Incubation Centres
FICCI	Federation of Indian Chambers of Commerce & Industry
FICTT	Focus Incubation Centre in Technical Textiles
FPIS	Focus Product Incentive Scheme
FR	Fire Retardant
FR	Flame Resistant
FRP	Fibreglass Reinforced Plastic, Fibre-Reinforced Plastic
FTA	Free Trade Agreement
GCL	Geosynthetic Clay Liners
GEN	Global Ecolabelling Network
GI	Geographical Indicator
GMP	Good Manufacturing Processes
GSE	GundleSLE Environmental
HAIs	Hospital Acquired Infections
H&V	Hollingsworth & Vose Company
Hazmat	Hazardous Material
HDPE	High-Density Polyethylene
HEPA	High Efficiency Particulate Air
HMPSA	Hot Melt Pressure Sensitive Adhesive
HS	Harmonized System

HSN	Harmonized System of Nomenclature
HTHP	High Temperature High Pressure
HUL	Hindustan Unilever Ltd.
HVAC	Heating, Ventilation, and Air Conditioning
IAC	International Automotive Components
ICAR	Indian Council of Agricultural Research
ICT	Institute of Chemical Technology
IDY	Industrial Yarn
IIT	Indian Institute of Technology
IJIRA	Indian Jute Industries' Research Association
IMS	Integrated Management System
IoT	Internet of Things
IPA	Investment Promotion Assistance
IRC	Indian Road Congress
IRRI	Indian Road Research Institute
ITAMMA	Indian Textile Accessories and Machinery Manufacturers Association
ITC	Indian Trade Classification or Indian Tariff Code
ITP	Integrated Textile Park
ITTA	Indian Technical Textiles Association
ITUFS	Integrated Software for Technology Upgradation Fund Scheme
JATC	Joint Advanced Technology Centre
JPM Act	Jute Packaging Materials (Compulsory Use in Packing Commodities) Act, 1987
JV	Joint Venture
KITECH	Korea Institute of Industrial Technology
LDPE	Low-Density Polyethylene
LLDPE	Linear Low Density Polyethylene
LRTM	Light Resin Transfer Moulding
MANTRA	Man Made Textiles Research Association
MDB	Medical Disposable Baggage
MDR	Medical Device Rule
MEIS	Merchandise Exports India Scheme
MIPL	Megaplast India Private Limited
MMF	Manmade Fibre
MoT	Ministry of Textiles
MP	Medical Packaging
MPIDC	MP Industrial Development Corporation
MSMEs	Micro, Small and Medium-sized Enterprises
MTPA	Million Tonnes Per Annum
MTPM	Metric Tons Per Month
MTUFS	Modified Technology Upgradation Fund Scheme
MV	Mechanical Ventilation
NAL	National Aeronautical Laboratory
NBC	Nuclear Biological and Chemical
NCSU	North Carolina State University
NDT	Non-Destructive Testing
NE	Northeast

NIOSH	National Institute for Occupational Safety and Health
NITRA	Northern India Textiles Research Association
NTCF	Nylon Tyre Cord Fabric
NTPEP	National Transportation Product Evaluation Program
NTTM	National Technical Textiles Mission
NVH	Noise, Vibration and Harshness
OTB	Over the Back
P&G	Procter & Gamble
PA	Polyamide
PCB	Printed Circuit Board
PE	Polyethylene
PEN	Polyethylene Napthalate
PES	Polyester
PFL	Printed Fabric Label
PLI	Production-Linked Incentive
PMGSY	Pradhan Mantri Gram Sadak Yojana
PMU	Project Management Unit
PP	Polypropylene
PPAP	Production Part Approval Process
PPE	Personal Protective Equipment
PPP	Public Private Partnership
PPY	Polypyrrole
PSF	Polyester Staple Fibre
PSU	Public Sector Undertaking
PU	Polyurethane
PVA	Polyvinyl Alcohols
PVC	Poly Vinyl Chloride
PVDF	Polyvinylidene Fluoride
QC	Quality Control
QCO	Quick Change Over
QCR	Quick Curve Ruler
R&D	Research and Development
RDSO	Research Design & Standards Organisation
RIL	Reliance Industries Ltd.
RR-TUFS	Revised-Restructured Technology Up-gradation Fund Scheme
RTM	Resin Transfer Moulding
RTUFS	Restructured Technology Upgradation Fund Scheme
SAC	State Administrative Council
SASMIRA	Synthetic & Art Silk Mills' Research Association
S-CAP	Scheme for Capital Assistance
SCBTS	Scheme for Capacity Building in Textile Sector
SCM	Supply Chain Management
SD	Surgical Disposable
SDOs	Standard Development Organisations
SEZ	Special Economic Zone
SF	Safety Factor

SFEAA	Singlet Fission via Extended Aromaticity of Azacenes
SGDTT	Scheme for Growth and Development of Technical Textiles
S-IP	Scheme for Infrastructure Support
SITP	Scheme for Integrated Textile Parks
SITRA	South India Textiles Research Association
SMBS	Sodium Metabisulphite
SMEs	Small and Medium-sized Enterprises
SOR	Schedule of Rates
SPV	Special Purpose Vehicle
STP	Science and Technology Parks
SUP	Single Use Plastic
SWL	Safe Working Load
TAF	Thai Acrylic Fibre Co Ltd
TAML	Tata Advanced Materials Limited
TASL	Tata Advanced Systems Limited
TEI	Textile Engineering Industry
TFIC	The Textile Focus Incubation Centre
TFOS	Tear Film and Ocular Surface Society
TIFAC	Technology Information Forecasting and Assessment Council
TMAC	Technical Advisory and Monitoring Committee
TMMA	Textile Machinery Manufacturers Association
TMTT	Technology Mission for Technical Textiles
TPACC	Textile Protection and Comfort Center
TPU	Thermoplastic Polyurethane
TQM	Total Quality Management
TRAs	Textile Research Associations
TT	Technical Textiles
TTB	Technical Textiles Business
TUF	Technology Upgradation Fund
TUFS	Technology Up-gradation Fund Scheme
TUL	Technical University of Liberec
Type O	Off Road Apparel
Type P	Public Safety Sector Apparel
Type R	Roadways and Temporary Traffic Control Zone Apparel
UHMWPE	Ultra High Molecular Weight Polyethylene
ULPA	Ultra Low Penetration Air
UN	United Nations
USA	United States of America
USKRC	US Kidney Research Corporation
VAM	Vinyl Acetate Monomer
VOCs	Volatile Organic Compounds
VSSC	Vikram Sarabhai Space Centre
WITS	World Integrated Trade Solutions
WRA	Wool Research Association

1. Executive Summary

Technical textile industry has been identified as the sunrise industry by the Ministry of Textiles, Government of India. The National Technical Textile Mission (NTTM) with an outlay of Rs.1,480 Crores aims to place India as one of the leaders in the global technical textile market and enhance the domestic market at the same time. This Baseline Study 2020 entitled 'Technical Textile Industry in India: Opportunities and Challenges' has been carried out by IIT Delhi on behalf of Ministry of Textiles, Government of India. The report of the study encapsulates various aspects of technical textile industry in India. An attempt has been made to capture all the important elements of the technical textile ecosystem and suggest measures to put this industry on an accelerated growth trajectory that is aligned with the goals of NTTM of Government of India.

1.1 Methodology and Approach

A mixed method approach has been adopted in this study. As a part of primary research, primary surveys (using semi-structured questionnaires), workshops with all sections of industry stakeholders, interviews of industry practitioners, experts, members of the academia and policy makers and other professionals were conducted. Secondary research involved drawing useful information by referring to existing databases, reports, articles and information that is available in public domain. The primary basis of analysis is the technical textile application segment. The 12 application segments considered are, Agrotech, Buildtech, Clothtech, Hometech, Indutech, Geotech, Meditech, Mobiltech, Oekotech, Packtech, Protech, and Sportech.

1.2 Technical Textile Ecosystem

1.2.1 Introduction to Technical Textiles in India

As per the estimate by IIT Delhi, the size of Indian Technical Textiles industry is estimated at US$ 18.89 billion in FY 2019-20 and it is approximately 8.7% of US$ 217.81 Billion global technical textiles market. The level of penetration of technical textiles in India is at 5-10% as compared to 30-70% observed in developed countries. The aim of NTTM is to grow the domestic market at the rate of 15-20 percent per annum and take the market size to US$ 40-50 Billion by the year 2024. The NTTM aims to facilitate market development, market promotion, international collaborations, investment promotion and 'Make in India' initiatives. The mission also aims to increase the annual value of exports of technical textiles from approximately Rs. 14,000 Crores at present to Rs. 20,000 Crores by year 2021-22 and ensure that exports grow at an average annual rate of 10 percent up to 2023-24.

1.2.2 Exhaustive list of Technical Textile Products

The field of technical textiles is in its nascent stage and therefore, the rate of innovation and change is very rapid. It is difficult to keep pace with changes, emerging typologies, categories and classification. Comprehensive discussions among industry experts were carried out to prepare an exhaustive list of technical textile products.

The same has been presented in this report. The products have been classified into their respective application segment and marked for their being produced, consumed, exported and imported in India.

1.2.3 Institutional consumers of Technical Textiles in India

The important role played by institutional buyers in promoting the use of technical textiles in India has been documented. The guidelines issued by Government of India which make it mandatory for 10 central ministries and departments to use technical textiles in 92 application areas is a significant step to increase consumption. The analysis of procurement information of Government institutions suggests that they have been active in procurement of products such as fishnets, agrotextile kits, tarpaulins, tents, posters, uniforms, sports jersey, geogrids, geomembranes, other geotextile products, floor carpets, vinyl coated upholstery, filter fabric, air and oil filters, conveyor belts, surgical items, kneecaps, tyres, canal lining, jute bags, HDPE bags, bullet proof jackets, flame retardant fabrics, fibre glass boat etc. in the recent past.

1.2.4 Investments in Technical Textile Industry in India

There has been an increase in investments in India's technical textile industry. The segments that have attracted relatively higher investor interest are Meditech, Protech, Mobiltech and Geotech. Production of technical textiles for use in sustainable and eco-friendly products is receiving attention of investors. The available information suggests that highest value of foreign investments has been routed through Mauritius; other prominent countries of origin for investment in India include Belgium, USA and Singapore. The maximum investments have been made in Gujarat followed by Maharashtra, Andhra Pradesh and Telangana.

1.2.5 Employment potential of Technical Textiles in India

India's textiles and apparel industry contributes is the second largest employer in the country and provides employment to about 45 million people. This figure is likely to have touched 55 million by the end of 2020. As per the earlier figures stated by Ministry of Textiles, the Indian technical textile industry is estimated to be employing about 12 lakh people directly and 3-4 times more indirectly in 2019-20. According to a fairly safe and conservative estimate arrived at as part of this study, direct employment in 2019-20 is expected to be around 12.16 lakhs. The Packtech segment is characterised by employment of a different kind where an additional workforce that is involved in converting the technical textile into final products is deployed. Anecdotal accounts of industry professionals peg the number of people involved in convertor industries at around 1.75 lakh. The technical textile material that such converter industries make are Jute and hessian bags, FIBC bags, Canvas tarpaulins and HDPE tarpaulins. The converter industry does the fabrication and stitching from these specified technical textile fabrics.

The primary survey of product manufacturing enterprises carried out by IIT Delhi as a part of the present Baseline survey (2020) has yielded that skilled manpower constitutes 51% of the manpower employed in the industry. The skilled workforce will continue to form a significant part of total workforce in future. The survey indicates that the overall growth in employment in technical textiles has been at a rate of around 7 percent. The deployment of skilled workforce increased at the rate of 5 percent annually, semi-skilled workers increased at 12 percent per year and unskilled workers at 8.5 percent in recent years. The semi-skilled workforce is around 21 percent and unskilled workforce 28 percent of the total workforce.

The interventions of Government of India and various State Governments to support the growth of Technical Textile industry have generated employment. The two textile parks (SITPs) associated with technical textiles that are partly operational (Mundhra and Vraj Textile Parks) will provide employment to around 20,000 people once these are fully operational. New employment for 26,536 people has been generated just on account of the impact of Amended Technology Upgradation Fund Scheme (ATUFS). Samarth (Scheme for capacity building in textile sector) aims to train 10 lakh persons over a period of 3 years (2017-20). Figures for technical textiles are not available separately. Arrangements have been made under the National Technical Textiles Mission (NTTM) for skill development of 50,000 people in the field of technical textiles. It will not be unreasonable to assume that a growth rate of 4 percent can be safely assumed for projection of employment generation from 2019-20 onwards and upto year 2024-25. Based on those projections, the employment in India's technical textiles industry is projected at 14.78 lakh persons by 2024-25.

The names of the main organisations which recruit professionals frequently for their technical textiles operations are Supreme Nonwoven Industries Pvt. Ltd. as well as other firms of 'Supreme Group', Century Enka Ltd., Techfab India Industries Ltd., SRF Ltd., Bombay Dyeing Ltd., Arvind Ltd. as well as other firms of Arvind group, Welspun India Ltd. as well as other firms of Welspun Group, Alok Industries Ltd. and Premier Mills Pvt. Ltd. as well as other firms of Premier Mills Group. The major concerns pertaining to manpower are lack of adequate seats of ITIs and Polytechnics related to textile technology leave alone technical textiles and qualified textile engineers switching industry from textiles to other than textiles.

1.2.6 Major Technical Textile firms in India

Delphi technique involving expert opinion was used to identify major firms of Indian technical textile industry. The ten firms from the ones identified that finally agreed to be profiled were Arvind Ltd., BMD Private Ltd., Garware Technical Fibres Ltd., Kusumgar Corporates Pvt. Ltd., SRF Ltd., Strata Geosystems (India) Private Ltd., Supreme Nonwoven Industries Private Ltd., Tata Advanced Systems Ltd., Techfab (India) Industries Ltd. and Welspun India Ltd. Important information about these firms has been obtained from reliable sources including the respective firms themselves. The information has been lucidly presented for each of these firms so that industry analysts, observers and others who are interested can get information about these firms.

1.3 Market and Trade Analysis

1.3.1 Domestic and Global Markets of Technical Textiles

A detailed market analysis of technical textile industry and various segments has been done as a part of this study. The sources of information for determining the current market size and developing the forecast include primary survey of a sample of Indian technical textiles product manufacturers, raw material suppliers, machinery manufacturers, interviews with industry experts for their assessment and opinions, study of various national and international reports and referring to market research reports by leading industrial market research agencies of the world. In addition to the relevant product, segment and industry-based research reports published by the market research agencies, the reports and documents prepared by Ministry of Textiles, Government of India, ICRA Management Consulting Services Limited, KPMG-FICCI, Invest India, Exim Bank of India, Wazir Advisors-FICCI, World Bank, US Department of Commerce, BCC Research, CII have been accessed for obtaining valid information. The valuable assessments made by industry associations such as Indian Technical Textiles Association (ITTA), Confederation of Indian Industry (CII) and Federation of Indian Chambers of Commerce & Industry (FICCI) have also been incorporated in the analysis.

As per the latest estimates of IIT Delhi, the global Technical Textiles market is expected to grow at a CAGR of 5.06% between 2020 and 2025 whereas the market in India is likely to grow at a CAGR of 8.25% during the same period. The forecast arrived at by the research team suggests that the market for technical textiles in India will grow in value from Rs. 122,943 Crores (US$ 18.89 Billion) in 2019-20 to Rs. 1,82,742 Crores (US$ 28.06 Billion) in 2024-25. The market size of the textile industry in India is Rs. 7,11,409 Crores while that of technical textiles is Rs. 1,22,943 Crores during 2019-20. Even as it currently contributes a relatively modest portion i.e. 17% of the total textile market in India. The size of the technical textiles market in India is a small proportion (8.7%) of the market size of technical textiles in the world in 2019-20. It is expected that by 2024-25, the value of consumption (calculated at constant foreign exchange rates) of technical textiles in India is likely to be 10.1% of global consumption of technical textiles in 2024-25.

The share of technical textiles in the total textile industry in India is expected to reach 28% by 2024-25. The segments likely to grow at the fastest rates (at rates faster than a CAGR of 10%) in the Indian market are Oekotech, Protech, Mobiltech, Geotech, Indutech, Agrotech and Buildtech. Packtech, which has been a mainstay of the domestic technical textile market is expected to experience a moderated rate of growth. The extent and nature of the success of India's National Technical Textile Mission is likely to change these forecasts depending on the response of the market to interventions made under the Mission.

At the global level, Oekotech, Geotech, Buildtech, Meditech, Protech and Sportech are the six segments that are likely to grow at a relatively higher rate (CAGR > 5%) in terms of the value of technical textiles consumption during the period 2020-25. Mobiltech, Indutech, Meditech, Packtech and Sportech will constitute a major share of the value of the global market for technical textiles.

The market analysis of technical textiles has been presented at the level of products in each technical textile segments except Oekotech because its products have an overlap with products of Geotech segment. The products identified for detailed market analysis have been chosen because of the perceived moderate to high possibility of success for Indian industry. Some of these products currently have a small domestic market but a large global market and therefore present opportunities for India's technical textiles manufacturers.

The production of Agrotech products (Rs. 2,244 Crores in 2019-20) in India exceeds their consumption (Rs. 1,890 Crores in 2019-20). This presents India with the possibility of exporting its surplus of production over consumption. Fishing nets constitute the largest share of the Indian Agrotech market in 2019-20, followed by Shade nets. Mulch mats, Anti-hail & Anti-bird nets and Crop covers individually hold small shares of Indian market by value.

Consumption of Buildtech products exceeds their production. India is a net importer and the gap between production (Rs. 4.196 Crores in 2019-20) and consumption (Rs. 5,008 Crores in 2019-20) is expected to remain almost the same in value terms for the next five years. HDPE tarpaulin constituted the largest share (by value) of the market of Indian Buildtech industry in 2019-20, followed by Hoardings & signages.

The consumption (value estimated at Rs. 8,205 Crores in 2019-20) of Clothtech products exceeds the production (estimated value Rs. 7,680 Crores). India is currently an importer and is going to remain one even though the gap between production and consumption is likely to remain almost the same in value terms.

Label and badges constituted the largest share of the Indian Clothtech market in 2019-20, followed by the share of elastic narrow tape.

Geotextiles form the biggest portion of the domestic market of Geotech segment at a share of 37.32% and Geonets, Geogrids and Geostrips at 25.12% have the second largest share. The consumption (value estimated at Rs. 2,050 Crores in 2019-20) of Geotech products exceeds the production (estimated value Rs. 1,958 Crores). India is currently an importer and is likely to become a net exporter due to expected higher rate of increase in production despite increase in consumption over the period of coming five years (till 2024-25).

India’s production of Hometech products has an estimated value of Rs. 13,231 Crores in 2019-20. It is higher than the consumption which is valued at Rs. 12,352 Crores. This gap is likely to increase which indicates good opportunities for Hometech producers to address new export markets. Fibrefill (Polyester staple fibre) comprises the biggest portion of the domestic market and furniture fabrics and other coated fabrics have the second largest share.

The consumption of Indutech products in India exceeds the production (estimated value at Rs. 11,489 Crores in 2019-20). India is a net importer of Indutech and is likely to remain so till 2024-25 except that the trade deficit percentage will be reduced during this period. The highest share of domestic Indutech market in terms of value is comprised of Glass fabric and it is Coated abrasives that make up the next largest share of the Indian Indutech market.

Consumption of Meditech products exceeds the production (estimated value for 2019-20 is Rs. 5,891 Crores). India is a net importer and the gap between production and consumption is expected to increase in the next five years. Surgical dressings constitute the largest share of the Indian Meditech market in 2019-20, followed by surgical sutures.

The consumption of Mobiltech products in India exceeds their production (estimated value Rs. 7,669 Crores in 2019-20) and despite the percentage trade gap likely to become smaller, India will continue to remain a net importer of Mobiltech products for the next five years. However, the rapid expected growth in mobility market will attract significant capacity addition in India’s domestic Mobiltech industry. Tyre cord fabric is the product with the largest share of the domestic Mobiltech market in terms of value of technical textile component.

The production of Packtech items in India is valued at Rs. 57,614 Crores in 2019-20 and it is valued at more than what is consumed (Rs. 50,592 Crores) in India. India is a net exporter of Packtech products as of 2019-20. The largest share of the domestic Packtech products market comprised Polyolefin woven sacks. The product category comprising second largest share is Jute, hessian and other sacks.

Current value of production (Rs. 2,850 Crores in 2019-20) of Protech products in India is lower than their consumption (Rs. 3,148 Crores in 2019-20). At present, India has to import its requirement of Protech items and even though India will reduce its trade gap significantly, it will continue to remain a net importer of Protech items till 2024-25. High altitude clothing and Bullet proof jackets constitute the highest market share product categories.

The value of domestic production of Sportech items in 2019-20 is estimated at Rs. 7,226 Crores which is a little lower than the value of domestic consumption. However, the deficit is likely to increase in the coming years due to increase in popularity of sports and games among the youth. The domestic Sportech market is dominated by the Sports Footwear Components category which make up for more than three-fourths of the segment's share of market. Technical textiles elements in Sports Composites constitute the next large share of the market.

1.3.2 Leading Countries in Technical Textiles

The world's leading countries viz. China, USA and Germany account for nearly 60% of the annual output of technical textiles. A comparison of India vis-à-vis these three leading countries suggests that technical textile industry in India is likely to grow at a rate of around 7% as compared to growth rates that range from 3.5% to 5.6% for the three leading countries. China has a fourth of the share of global export market for technical textiles whereas India has less than 2% of the share. There is a vibrant research and development eco-system in the three leading countries and perhaps that propels the growth of technical textiles. Trade promotion through bilateral trade agreements has been prioritised in these countries.

1.3.3 Future demand and trade expectations in Technical Textiles

China, USA and Germany, the three countries are not only leading countries for production and exports of technical textile but also are its three leading consumers. These three countries put together account for more than 60 percent of the value of global annual output of technical textiles. China is the largest producer country and as per the estimates accessed, China accounts for nearly one-third and USA produces one-fourth of the global production. These two countries also happen to be the two largest consumers of technical textiles. The exports from Chinese technical textile industry comprise products worth $ 27.3 Billion that make up for over 25 percent of world exports. Indian exports have a small share (1.85 percent) of the world exports market.

Annual rate of growth of Indian technical textile industry has been around 7 percent. It is faster than the nearly 6 percent growth rate that China's technical textile industry is clocking annually. A study of the data of India's trade in technical textiles (as specified through 449 ITC HS codes that IIT Delhi is suggesting for adoption) over the last eight years from 2012-13 to 2019-20 reveals that exports have grown for ten out of eleven segments in the eight-year period from 2012-13 to 2019-20.

India's technical textiles exports are mainly to USA, Germany and UK with India's exports to USA comprising nearly one-fourth of India's technical textile exports. India's imports of technical textiles are mainly from China. South Korea and Germany are also significant supply sources for catering to demand of India's technical textiles market. Eight Technical Textiles segments – Packtech, Clothtech, Hometech, Mobiltech, Protech, Agrotech, Sportech, and Buildtech have witnessed trade surplus during 2019-20. Indutech, Meditech, and Geotech segments have witnessed deficit during 2019-20.

1.3.4 Attractiveness of Different States for Technical Textile Manufacturers

Based on the study of economic policies of all the states and union territories of India, there are 17 states that were identified for having announced policies that contain useful provisions for technical textile enterprises. Out of these 17 states, Bihar, Kerala, Madhya Pradesh, Odisha, Punjab and Rajasthan do not have a separate, exclusive textile policy and the provisions of benefits and incentives for textile industry have been mentioned as part of their respective industrial policies. It is also observed that except for three states viz. Kerala, Madhya Pradesh and Uttar Pradesh, policies of all other states have made a specific mention of 'technical textiles' as a distinct area of attention and focus. Some like Telangana, Tamilnadu, Gujarat and Andhra Pradesh have gone a step further and made special provisions for technical textiles. In order to gauge the relative attractiveness of states for technical textiles enterprises, the state policies and incentives of 17 identified states were compared with respect to their respective provisions along specific parameters viz. land cost and infrastructure related support, provision for capital subsidy, interest subsidy, assistance for technology upgradation, quality improvement and R&D assistance, power cost support, stamp duty exemption/reimbursement and employment and employee related support.

The approach adopted for determining the more attractive states of the 17 identified states consisted of a structured process involving five steps as follows:

1. Excluded relatively less attractive states which offer very low levels of support, incentives and benefits. Based on the information available, Bihar, Kerala, Punjab and West Bengal got excluded.
2. Eliminated states with low level support in high value heads such as low level support for land and infrastructure, for capital subsidy, interest subsidy and technology upgradation. Maharashtra and Uttarakhand were taken out of consideration.
3. Remove the states that impose stiff conditions for availing of high value incentives. Based on this criterion, Madhya Pradesh was removed from the list of attractive states.
4. Excluded states having poor industrial infrastructure and Jharkhand got eliminated.
5. Determined the relatively attractive states that remained after the previous steps. These were arranged based on the level of incentives on low value heads. Based on that criterion, Andhra Pradesh, Telangana, Tamilnadu, Gujarat, Uttar Pradesh, Karnataka and Odisha are more attractive and Rajasthan and Haryana are relatively less attractive states.

1.3.5 Analysis of Technical Textiles Trade of India

In order to understand the trade (import and export) of technical textile products in India, a list of 449 ITC-HS codes related to technical textile items were identified through expert opinion. This list includes the 207 HSN codes notified by the Ministry of Textiles Government of India in 2019. After a careful classification of these codes into relevant application segments, data was extracted and analysed over the last eight year period from 2012-13 to 2019-20 to understand the overall trade trends and map the surplus and deficit segments. The findings reveal that India has been a net exporter (if one was to consider 449 HSN codes as technical textile items) over the study period.

In the context of 207 HSN codes, India has been a net importer of technical textile items over the study period with the exception in 2014-2015. The total exports have grown from Rs. 6,338.06 Crores in 2012-13 to Rs. 14,151.81 Crores in 2019-20 at a CAGR of 12.14%. The imports have grown from Rs. 7,665.58 Crores in 2012-13 to Rs. 14,385.44 Crores in 2019-20 at a CAGR of 9.5%.

If 449 HSN code classification for technical textiles is used as the basis of calculating trade performance then India has been a net exporter over the study period. In the eight-year period (2013-2020), average exports of technical textiles were Rs. 61,142 Crores whereas average imports were Rs. 41,410 Crores. Total exports have seen a growth from Rs. 46,215 Crores to Rs. 72,241 Crores at a CAGR of 7%. During the same period, imports have grown from Rs. 31,005 Crores to Rs. 51,597 Crores, at a CAGR of 8%.

In 2019-20, Mobiltech (29%), Packtech (24%) and Indutech (14%) followed by Hometech (13%) and Clothtech (13%) contributed the highest share to India's exports. USA, Germany, UK, Turkey and UAE were the largest importers contributing nearly 40% to total exports from India. In terms of imports, Mobiltech and Indutech were the largest segments with around 72% of total import value. The import dependency is on China, Korea, Germany, USA and Hong Kong.

1.3.6 International Trade of Technical Textiles & India's contribution

IIT Delhi has suggested that the list of 207 ITC-HS codes currently assigned as technical textiles be expanded to 449 ITC-HS codes. Trade data of technical textile items under 63 ITC-HS codes (out of proposed 449 ITC-HS codes) that are widely traded in the global markets have been analysed for documenting trade value in recent years, identifying dominant countries and assessing India's status. It is apparent from the analysis that China is the global leader in the technical textile market and it is followed by USA and Germany.

1.4 Growth and Development Enablers

1.4.1 National and State Policies and Schemes

Many schemes and policies have been introduced by central and state governments in the last few years to give a fillip to the technical textiles industry. The central government schemes which have been profiled in detail as part of the present study are as follows:

1. Technology Upgradation Fund Scheme (TUFS)
2. Modified Technology Upgradation Fund Scheme (MTUFS)
3. Amended Technology Upgradation Fund Scheme (ATUFS)
4. iTUFS: Ministry of Textiles has introduced an online portal iTUFS (Integrated Software for Technology Upgradation Fund Scheme) in 2015, wherein applications for amended TUFS subsidy can be submitted.
5. Scheme for Integrated Textile Parks (SITP)
6. Scheme for Growth and Development of Technical Textiles (SGDTT)
7. Technology Mission for Technical Textiles (TMTT)
8. Scheme for promoting usage of Agrotextiles in Northeast Region
9. Scheme for promoting the usage of Geotechnical textiles in the North East Region
10. Launch of ITC Harmonized System of Nomenclature Code (HSN Code)
11. Focus Product Incentive Scheme (FPIS)
12. National Technical Textiles Mission
13. Concessional custom duty for specific technical textiles machinery
14. Mandatory use of Technical Textiles

15. Standardisation of technical textiles
16. Samarth (Scheme for Capacity Building in Textile Sector)

The state government policies whose aims and main provisions have been presented as part of the present study are as follows:

1. Andhra Pradesh 'Revised Policy for Textiles and Apparel 2018-23'
2. Bihar Industrial Investment Promotion Policy, 2016 for High Priority Sectors
3. Gujarat State Scheme for Assistance to Strengthen Specific Sectors in the Textile Value Chain (2018-23) [Extension to Gujarat Textile Policy, 2012]
4. Haryana Textile Policy 2019
5. J&K Start-up Policy 2018
6. Jharkhand Textile, Apparel and Footwear Policy 2016
7. Karnataka Textile and Garment Policy 2019-2024
8. Kerala Industrial & Commercial Policy 2018
9. Madhya Pradesh Industrial Promotion Policy 2014
10. Maharashtra Textile Policy 2018-23
11. Odisha Industrial Policy Resolution 2015
12. Punjab Industrial and Business Development Policy 2017
13. Rajasthan Special Customised Package for Textile Sector enterprises-2013
14. Rajasthan Investment Promotion Scheme 2019
15. Tamilnadu Integrated Textile Policy 2019
16. Telangana Textile and Apparel Incentive Scheme 2017
17. Uttar Pradesh Handloom, Powerloom, Silk, Textile & Garmenting Policy 2017
18. Uttarakhand Mega Textile Policy 2014
19. West Bengal Textile Policy 2013-2018

1.4.2 Formulation of Indian Standards for Technical Textiles

Inadequacy of globally-aligned quality standards and insufficient enforcement of prevalent standards have been cited as impediments by the stakeholders. The Bureau of Indian Standards (BIS) has published 377 standards for technical textiles. There are 100 new standards that are reported to be under development. Adequate and globally-aligned standards should be developed expeditiously to help India achieve the growth targets for technical textiles.

1.4.3 Status and contribution of Textile Research Associations (TRAs)

The findings of the primary survey of the TRAs indicate that TRAs are in need of support to enable them to meaningfully contribute towards enhancement of international competitiveness of Indian textile industry. The support should be directed towards improving the focus on product and process innovation especially in high value technical textile products, speciality fibres and raw material (for better durability). It is important for TRAs to be able to recruit and retain competent technical staff and continuously augment their research and testing infrastructure.

1.4.4 Status and contribution of Centres of Excellence (COEs)

The information obtained through primary survey of 10 COEs, namely ATIRA, BTRA, DKTE Institute, IJIRA, MANTRA, NITRA, PSG College, SASMIRA, SITRA and WRA has revealed the pattern of revenue generation of the COEs in the last six years especially in Composites, Sportech and Meditech segments. It has also been observed that about 64 percent of the standards that are used in the COEs are international standards. The use of Indian standards is relatively more for testing Agrotech, Packtech, Geotech and Meditech products. The knowledge dissemination methods used by COEs are journal publications, research reports and books. COEs have undertaken many academic research projects (at undergraduate, postgraduate and Ph.D. levels) in the last six years, especially in Protech and Mobiltech segments.

The survey also revealed that the main challenges being faced by COEs are lack of skilled staff for scientific research, low consumer awareness of technical textile products, scarcity of funds, lack of uniformity in processes and standards and lack of international exposure through technical collaborations.

1.4.5 Comparison of practices of Indian COEs and COEs in other countries

Five premier foreign COEs (CLUTEX, Czech Republic, Composites Research Group, University of Nottingham, UK, Nonwoven Research and Innovation Institute, UK, Centre for Nanotechnology and Smart Materials, Portugal and Taiwan Textiles Research Institute, Taiwan) were identified as basis of comparison of their activities and priorities with the activities and priorities of Indian COEs. It has been noticed that the premier COEs are working in contemporary areas such as nanotechnology in textiles, multifunctional textiles, personal protective textiles, biocomposites, composite manufacturing, textile composites, smart materials and nonwoven materials. The study compares and documents the manner in which the premier COEs differ from Indian COEs with respect to their focus, ownership, collaboration, and engagements. It is observed that the outward looking, globally relevant approach of the premier COEs is worth emulating by Indian COEs.

1.4.6 Technical Textiles Education in India

A primary survey of educational institutions and universities offering degree programmes in textiles in India was conducted using a semi-structured questionnaire. Analysis of the responses received from 31 institutions that participated in the survey reveals that even though the textile programmes are offered at B.Tech., M.Tech. and Doctoral (Ph.D.) level, these programmes have failed to attract good and motivated students. It was observed that in a few institutes, 'technical textiles' is being offered as an elective (optional) subject.

None of the institutes offer bouquet of subjects related to technical textiles. The low faculty-student ratio of 1:27 has been observed. It should be a cause of concern and must be addressed. Over the last five years, there has also been a decline reported in the number of students who pursue technology and engineering programmes in the field of textiles. The educational institutions have taken up funded/sponsored projects and supported start-ups in technical textiles during last six years.

The needs reported by the academic institutions are trained faculty and staff, support for introduction of specialised courses (in areas like High performance and functional fibres, Advanced finishing & nanotechnology, Fibre-reinforced composites etc.) and facilities, support for enhancement of industry-academia interaction (projects, internships, placements) and access to resources for increasing in awareness about the programmes (among prospective students and their parents).

The best practices of the five premier institutes/universities (offering textile engineering and technology related programmes across the globe) viz. Donghua University (China), Leeds University (UK), North Carolina State University (USA), RWTH Aachen University (Germany) and Technical University of Liberec (Czech Republic) have been analysed. It is observed that the premier universities permit their students a high degree of flexibility in selecting the subjects. The courses are more focused on research and have a large component of industrial training. These institutes/universities also have innovation centres that foster research, innovation and awareness. These global universities offer student scholarships and exchange programmes. Their quality assurance is ensured due to regular, comprehensive performance audit by external auditors and consultants.

1.4.7 Status and Contribution of Focus Incubation Centres and Integrated Textile Parks

The Ministry of Textiles has set up 11 Focus Incubation Centres (FIC) under the Technology Mission on Technical Textiles (TMTT) to enable entrepreneurs to receive support for setting up technical textiles ventures through plug and play model. The primary survey of FICs indicates that the incubation activities are yet to produce substantive outcomes in most (except DKTE Kolhapur) of the FICs and steps have to be taken to accelerate incubation activities in the FICs.

The establishment of technical textile focused technology parks has been taken up under Scheme for Integrated Textile Parks (SITP) by Ministry of Textiles. Five out of 57 sanctioned parks are dedicated to technical textiles. Information obtained from primary survey indicates that three out of the five technical textile focused parks are functional. The set of hurdles cited by the functionaries of technology parks were common to all of them and these have been documented as part of this study.

1.5 Manufacturing and Technology

1.5.1 Primary survey of Technical Textile product manufacturing firms

A pan-India primary survey of technical textile product manufacturing firms from all the 12 application segments was conducted using semi-structured questionnaire. A large proportion of the respondent firms belonged to the MSME category. Many of the respondent firms cater to the needs of global market in addition to the requirements of domestic market. It was observed that the total revenue of these firms has grown over the reporting period (2017-18 to 2019-20). The findings reveal that private sector enterprises are the major consumers of technical textile products. In terms of raw material, the main consumption is of polyester, nylon, polypropylene, cotton etc. There is a high dependence on imports with around 69 percent of respondents indicating that procurement of raw material is mainly from international markets. China, Taiwan, USA, Germany are the prominent origin sources and Nylon 66, aramids, caprolactam, fabric, flame retardant textiles, etc. are the materials that are mainly being imported from these countries.

Nearly two-thirds of the respondent firms reported heavy import dependence for procurement of machines and equipment installed by them and nearly 60% of their purchases have been sourced from overseas manufacturers. Machine and equipment suppliers from China, Germany, Taiwan and USA are the major source of origin of imports. The respondent firms reported exporting products such as fishing nets, hook and loop tape fasteners and nonwoven geotextiles to the international markets. Based on the sample survey, USA appears to be the largest consumer of Indian technical textile products, followed by Australia, UK, UAE and Europe as other major destinations.

In terms of foreign investments and collaborations, foreign investment has largely been made by investors from Germany, Singapore, Japan, USA and China in the form of FDI, JVs and Strategic Alliances. The utilisation of foreign investment has been for enhancement of capacity, acquisition of assets and technology and easing the supply of raw material. The segments that have been able to attract relatively more investments are Clothtech, Geotech, Hometech, Meditech, Mobiltech and Protech.

The manpower and employment details of the respondent firms revealed that skilled manpower constitutes nearly half of the total manpower in these firms which may be due to higher technology intensity of the industry. A gradually increasing trend in employment generation is also evident across all categories viz. skilled, semi-skilled and unskilled. The respondent firms also conducted several quality related, management related, operations and technical and soft skills related training programmes for enhancing the productivity and performance of their employees.

Nearly two thirds of firms are interested in diversifying in other areas of technical textiles due to growing opportunities that are emerging in the application areas other than they are currently in.

1.5.2 Primary survey of Technical Textile Fibre, filament and technical yarn manufacturing firms

Most of the surveyed firms reported manufacturing of materials such as polyester staple fibre (including recycled), Nylon6, HDPE monofilaments, and polypropylene staple fibre, etc. The cumulative production capacity of the respondent firms has witnessed a marginal growth although the actual reported production has grown by nearly 6.7% over last three years (from 2017-18 to 2019-20) which indicates an increase in capacity utilisation. Some of the respondent firms reported exporting to countries including USA, UAE and Brazil but the majority of their products’ consumption takes place in the domestic market. The respondent firms source raw materials like polyester granules, polyamide (nylon) 66 granules, Titanium Oxide etc. from European nations, USA, China, and Korea amongst others. There seems to be a shortage of capacity for high performance fibres and functional fibres which may be leading to import dependence.

1.5.3 Primary survey of Technical Textile machine manufacturing firms

The core activities reported by the respondent firms are manufacturing of machines, importing them as well as marketing them. Machine manufacturing for technical textiles is at a limited scale in India. The dependence on imports from Germany, Japan, China and other countries for high performance machines is quite evident from the survey.

1.5.4 Contribution of manufacturers' associations

A survey of manufacturers' associations was carried out to elicit important information about their respective industry. Initially, there was a list of 12 such associations that was prepared. Out of these, seven associations found to be active were approached to obtain their individual responses. Eventually, the responses received from four of these associations viz. Association of Synthetic Fibre Industry (ASFI), FRP (Fibreglass Reinforced Plastics) Institute, Indian Textile Accessories and Machinery Manufacturers Association (ITAMMA) and Textile Machinery Manufacturers Association (TMMA) India have been presented in this report.

The survey was followed up by secondary research about the role and contribution of manufacturers' associations in technical textiles industry to assess the current level and effectiveness of their activities as well as document their opinions about various facets of the industry. The information obtained from primary and secondary research has been presented as a part of this report.

1.5.5 Stakeholders' Workshops

Seven workshops were conducted with participation of various stakeholders in Indian technical textile industry; TRAs, CoEs, Academic Institutions, and business leaders from all 12 segments of Indian technical textile industry. The comments, plans, suggestions offered by the participants have been summarised under the headings of resource availability, market and marketing, future developments, and impediments to growth in technical textiles. The main suggestions from these workshops is that there is a critical need to bring end-user awareness about usage of technical textile products, establish enabling mechanisms for the businesses to conduct efficient manufacturing of innovative technical textile products, restructure duties imposed on raw material, intermediate, and final technical textile products. There was a unanimous concern raised about the lack of standards and a demand from the Government to address this concern. Lack of industry-ready skilled manpower came across as a major concern and a need to address the same was articulated. A need was felt for a 'go-to-portal' for improving the access to technical textile industry data (size, players, segment wise opportunity/demand, consumer trends etc.) for businesses, entrepreneurs, and investors.

1.5.6 Emerging technologies and technology trends in Technical Textiles

The emerging technologies in technical textiles mainly in the field of smart textiles, nonwoven manufacturing and textile preforms used in composite manufacturing have been analysed. An attempt has been made to document the research work currently being conducted in the areas of piezoelectric, triboelectric and textile sensors. New energy harvesting products and technologies have been focused upon alongwith documentation of important technologies such as hydrospace, vertical lapping and 3D web linker which is used in manufacturing nonwoven structure. Technologies such as radial braiding, 3D knitting and noobing have also been documented in the section containing textile preforms as reinforcements for composites. Material and machines related technology trends have also been documented.

1.5.7 Impediments to growth of India's Technical Textiles industry

1. Inadequate production of High Performance Fibres
2. Absence of a formal mechanism for regular collection of reliable and comprehensive nation-wide data of production capacity and enterprise level medium and long-term production plans
3. Lack of entrepreneurship-culture and absence of skill-training for entrepreneurship development in the area of technical textiles
4. Deficient supplier-manufacturer and customer-connect and lack of fora for enabling their close collaboration
5. Inadequate number (207) of designated HSN codes for technical textiles
6. Lack of globally-aligned quality standards for technical textiles in India
7. High level of import and export dependence on a limited number of countries
8. Inadequate domestic production capacity of certain products whose consumption potential in India is high such as smart textiles and high-performance sportswear and swimwear etc.
9. Inadequate production capacity for technical textile machinery and components
10. Indian exports having a small share of international trade
11. Inadequate R&D facilities for technical textiles in the country
12. Relative inability of textile industry to attract and retain talent
13. Low level of adoption of latest technologies such as 3D nonwovens, multiaxial braiding, 3D weaving, warp knitted spacer etc.
14. Inadequate testing facilities in the country for technical textiles
15. Prevalence of current inverted duty structure
16. Lack of international exposure for stakeholders
17. Slow pace of development of standards and their adoption
18. Delay in strengthening of educational institutes (textile engineering/technology institutes)
19. Delay in strengthening of the Textile Research Associations (TRAs) and Centres of Excellence (COEs)

1.6 Recommendations

I. Short-Term Recommendations

1. Set up an expert-group to recognise and incentivise products that have good potential for production enhancement across all technical textile segments.
2. Set up a committee to identify those technical textile products for which the domestic market is steadily increasing and to recommend measures to help boost their production in India.
3. Encourage and financially support the designing and conducting of industry-oriented short-term courses and programmes to encourage and support entrepreneurship in technical textile industry.
4. Leverage the existing Focus Incubation Centres (FICs) to foster incubation by identifying, analysing and disseminating successful cases of dissemination.
5. Foster better supplier-manufacturer-customer connect to improve effectiveness of value chain by supporting establishment of platforms and occasions for frequent interaction: Firstly, a pilot project must be launched to have a web-based information sharing portal/section hosted on the MoT website for 3-6 months. Later on, a subscription based model can be considered. Secondly, The MoT must support formal buyer-supplier meets, workshops etc. through online as well as physical mode as regular events with pre-declared six monthly/annual schedule.
6. Continuously expand the HSN Code list of technical textiles to keep pace with the development and emergence of ever newer products in the industry: IIT Delhi has followed a well-defined process and recommends that this list of 207 HSN codes for technical textiles be expanded to 449 codes and Government of India must actively consider notifying these 449 HSN codes and segment-wise classification carried out by IIT Delhi team. MoT must work closely with the Ministry of Commerce to ensure that the exercise of rationalisation and notification of technical textile codes should be an on-going one and a mechanism should be created to update even this list of 449 codes recommended by IIT Delhi regularly.

II. Medium-Term Recommendations

7. Encourage establishment of globally-aligned quality standards and their rapid adoption among all members of the value chain: MoT must initiate the creation of an empowered group of experts from among different stakeholder groups and provide Government's support for this effort. The MoT, the technical institutions, the research laboratories and the industry associations must work in close collaboration with BIS on a continuous basis.
8. Support identification and conducting of trade with more partner countries so as to reduce India's export-import dependence and de-risk operations of technical textiles industry: The de-risking exercise involves finding and engaging with new export destinations and new sources of imports. This task must be taken up by MoT in collaboration with different trade bodies as well as Ministry of Commerce and Ministry Of External Affairs.

9. Actively encourage domestic production of high consumption potential items such as high-performance swimwear and sportswear, smart textiles etc.
10. Actively encourage and financially support indigenous development of technical textile machinery components by active involvement of polytechnics, engineering colleges and institutes of technology.
11. Strengthen the educational institutes: Government of India must identify 3-4 textile engineering/technology institutes from across the country and focus on providing support for strengthening the technical textile education system and infrastructure for these identified institutes. Each of these identified institutions can focus and specialise in 2-3 segments of technical textiles.
12. Establish department/centre of technical textiles in one of the new IITs to function as a hub of latest knowledge.
13. Support and promote faculty development in the area of technical textiles: MoT and Ministry of Education must work jointly to promote and support faculty development in the area of technical textiles.
14. Support development and introduction of new courses pertaining to technical textiles by the technology and engineering institutes/colleges.

III. Long-Term Recommendations

15. Continuously identify and focus on technical textile products and segments to align the support with priorities of Atmanirbhar Bharat (Self-reliant India) and expansion of India's exports.
    i. Agrotech: High quality production and expansion of Fishing Nets, Mulch Mats and Crop Covers should be given special support so that India can increase its exports.
    ii. Buildtech: Focus on incentivising production of Architectural Membranes and Acoustic fabric for import substitution and on Canvas tarpaulin and HDPE Tarpaulin for enhancing India's exports.
    iii. Clothtech: The focus of government's incentives should be beneficially directed towards encouraging production of Elastic narrow tape, Hook and loop fastener, Interlining and Zip fastener tape for import substitution and towards industries producing Labels and Badges and those producing Specialised and Industrial Sewing thread for enhancing exports from India.
    iv. Geotech and Oekotech: It might be better to offer relatively more support to Geomembranes, Geotextile tubes and Geomats for the export markets. The support should be extended to upscaling of production of Geotextiles, Geocomposites, Geonets, Geogrids and Geostrips.
    v. Hometech: Extend relatively more support to the production of Fibre Fill (Polyester Staple Fibre) and Carpet Backing Cloth to enhance India's exports. The support should be extended for enhancement of production of Plush Fabric for stuffed toys, Ticking Fabric for mattresses and Filter Fabric to reduce import bill significantly.

vi. Indutech: Greater emphasis needs to be placed on rapid import substitution by backing the enhancement of textile inputs that go into the making of Cigarette Filter Rods, AGM glass battery separators, Coated Abrasives, Industrial filtration products, Industrial webbings and slings and Glass Fabric (as part of Composites). The export opportunities for Belting fabric and Ropes and cordages need to be exploited.

vii. Meditech: Indian manufacturers have been able to establish their presence in export markets for Surgical and Non-Surgical masks, gloves, PPE kits and other surgical disposables. Disposable linens and Surgical dressings are the other two product categories which should be supported to produce globally acceptable products for export markets. The import reliance on textile inputs required for sanitary napkins, baby diapers, compression stockings and garments, surgical sutures and special dressings needs to be reduced by providing incentives and support to their manufacturers from the government.

viii. Mobiltech: It is suggested that based on the current capabilities of Indian manufacturers, the export markets for Tyre Cord Fabric and Automotive carpets should be exploited. The dependence on imports for textile component of Airbags, Helmets and Seat belt webbing should be reduced by offering support to their indigenous manufacturers.

ix. Packtech: The exports of FIBC (Jumbo) Bags and Leno Bags need to be backed up by encouraging continuous investment in product improvement for global markets. Jute Hessian and Synthetic Sacks, Polyolefin Woven Sacks and Treated/ Coated Wrapping Fabric may need support for meeting domestic consumption needs.

x. Protech: The aim is to ensure that India must not only reduce its dependence on imports but must also become an exporter of defence products. It is suggested that the units which expand production of Bullet Proof Jackets, High Visibility Clothing, and Fire retardant apparel should be given a higher support.

xi. Sportech: The increased focus should be accorded to enhancing the production capabilities of High Performance Swimwear and Sportswear, Parachute Fabric and Sports Footwear Components. The need for imports of Technical textiles elements in Sports Composites should be reduced by removing the bottlenecks.

16. Channelise finances from public and private sources to support upgradation of R&D ecosystem so as to improve innovation opportunities within India: MoT must provide a dedicated forum for interaction between the business organisations which are mandated to spend CSR funds annually and R&D organisations like CoEs, TRAs, FIBCs and engineering and technology institutions. The aim and therefore design of the forum should be such that it is able to help channelise CSR funds to R&D institutions.

17. Financially support and incentivise 'Continuous Learning' initiatives in private and government sectors to attract, nurture and retain the right talent in the technical textile industry from technical to managerial levels: MoT must support establishment of a credible screening mechanism, invite applications from such professionals, assess the applications and offer financial assistance.

18. Increase domestic manufacturing of High Performance Fibres such as aramids, UHMWPE, carbon, Nylon 66 etc.: Multinational Companies who are producers of High Performance Fibres should be

identified and invited to invest in establishing production facilities in India through any of the alternative investment routes.

19. Encourage adoption and penetration of new technologies for a sustainable future: Industry experts suggest that MoT must consider directing the prevailing Technology Upgradation Fund Scheme (TUFS) towards certain identified modern technologies such as those related to 3D nonwovens, multiaxial braiding, 3D weaving, warp knitted spacer etc.
20. Encourage domestic production of Smart textiles and electronic textiles: Ministry of Textiles, Ministry of Electronics and Information Technology and Ministry of Science and Technology must work collaboratively and support interdisciplinary application research and product development projects in the field of smart and electronic textiles.
21. Establish adequate testing facilities: MoT must take steps to support organisations to establish dedicated test centres for exclusive testing of technical textile material and products with proper infrastructure and a trained workforce.
22. Launch increased efforts to change the current inverted duty structure: The Ministry of Textiles must intensify its efforts with the Ministry of Finance to rationalise the duty structure and remove the duty inversion.
23. Support and facilitate international exposure: The Ministry of Textiles must consider enhancing its existing level of support to finance participation in trade shows, exhibitions, workshops, conferences.
24. Expedite the process of development of standards and their adoption: MoT must facilitate the collaborative working of all stakeholders to promote the formulation and adoption of the new standards.
25. Attract and retain talent in the TRAs by bringing the terms of appointment of scientific staff at par with those of DST and CSIR staff.
26. Augment the research infrastructure of the TRAs: it is suggested that MoT facilitates an advisory group that must periodically review the global developments in the field of technical textiles and the research and testing infrastructure in TRAs should be augmented based on the periodic suggestions of the advisory group.
27. Strengthen the COEs: It is suggested that MoT must support and encourage collaboration among Indian CoEs and well-reputed overseas COEs as well as industries. Further, the geographical concentration of COEs in western India needs to be remedied so that the industry has easy access to adequate testing facilities in relatively close proximity.

2. Background and Context to the Study

The textile industry is one of the oldest and largest industries in India. It contributed 2.3% to India's GDP and generated 45 million jobs in 2018-19. The industry is expected to grow at a CAGR of 12% to reach US$ 220 billion by 2025-26.

Technical textiles industry is an emerging and important part of the textile industry. It is expected to reach a size of US$ 28 billion in FY 24-25, increasing at a CAGR of 8.25% over FY19-20. It contributes ~0.7% to India's GDP and accounts for ~13% of India's total textile and apparel market. India is expected to be a key market characterised by growing consumption due to cost-effectiveness, durability and versatility of technical textiles.

It is in this context that the Ministry of Textiles (MoT), Government of India (GoI) along with IIT Delhi has conducted the present study to document and analyse the opportunities and challenges in this 'high potential' part of the Indian textile industry.

The report of the study that has been conducted through the pandemic in the year 2020 and first half of 2021, is organised as follows – The first section deconstructs the objectives of the study, and the second section details the data collection processes and methodology of the study.

2.1 Objectives of the study

IIT Delhi, on behalf of the Ministry of Textiles, Government of India conducted a comprehensive study of the Indian technical textiles industry in terms of the current market landscape, growth areas, opportunities and challenges. The present report meets the objectives of documenting and analysing the opportunities and challenges of the Indian technical textile industry. The contents of the report are summarised below.

2.1.1 Technical Textile Market Analysis

The present report contains a section in which analysis of the domestic and international technical textiles market has been presented. The components of the analysis are as follows:

i. **Domestic Market Analysis:** The size of the domestic market has been estimated for technical textile industry as a whole, as well as for each of the segments. Information has also been presented for key products, production and consumption trends, and market size for individual products for the period starting from financial year 2019-2020 to 2024-2025.

ii. **International Market Analysis:** A comparison between the size of Indian technical textiles market and world market for technical textiles has been carried out. The comparative analysis has been presented on an aggregate basis as well as on product-basis for products that have been identified by the study team for their high potential for Indian industry. A section has been devoted to comparative analysis between India and three leading countries in technical textiles viz. China, USA and Germany regarding their relative strengths, performance characteristics and support mechanisms for the technical textile industry.

iii. **International Trade Analysis:** A view of global trade of some key technical textile products along with the countries that are their main exporters has been presented with the help of data and information of last three years (2018-2020). IIT Delhi has proposed 449 ITC-HS codes for technical textiles as an improvement over the existing scheme of 207 codes. Data of exports and imports of last eight years (2012-13 to 2019-20) for these products (conforming to 449 ITC-HS codes) has been presented along with the data based on 207 ITC-HS code classification (as used by the Government of India at present) for the use of analysts and decision makers. This analysis reveals the identity of those products and technical textiles segments in which India has a Y-o-Y trade surplus as well as those in which India has a Y-o-Y trade deficit.

iv. **Research and Development eco-system:** As part of the present study, the research and development ecosystem of Indian technical textile industry has been documented in detail. The study team has interacted with personnel working in TRAs, COEs, BIS and Academic Institutions offering textile related programmes. In course of these interactions, the study team has gathered information about projects undertaken, testing facilities, latest technologies, research conducted, patents filed, standards followed and other aspects of research ecosystem. Textile COEs from other countries have been identified, some of their practices have been documented and this analysis has been presented in the report.

v. **Emerging technologies:** Emerging technologies in technical textiles have been identified, documented and included in the report so that information about those is made available to entrepreneurs, researchers and policy makers for enabling better, well-informed decisions.

vi. **Investments in technical textiles industry:** Domestic and foreign investments that have been made in technical textiles industry of India in the recent years have been accessed through reports in the mass media. The purpose and nature of these investments, the identity of investors and countries of origin of these investments have been documented and presented in the report.

vii. **Profiling of major firms of Indian Technical Textile Industry:** Profiling of major manufacturers of technical textiles has been carried out to contribute to a better understanding of the different ways in which large enterprises in Indian technical textile industry are configured.

viii. **National and State Policies and Schemes:** The relevant information about the policies and schemes initiated and being implemented by central and state governments for facilitating growth and development of the Indian technical textile industry have been presented in the report in a specially curated section.

ix. **Focus Incubation Centres:** The study documents the current status and contribution of those Focus Incubation Centres (FICs) whose establishment has been approved by the Ministry of Textiles, Government of India.

x. **Technology parks:** The current status and contribution of Technology Parks which have been approved for setting up technical textiles units has been documented in a specially assigned section of the report.

xi. **Employment potential of Technical Textiles:** The data of employment envisaged from current Government schemes has been compiled and analysed for assessment of employment potential of investments planned and expected in Indian technical textile industry in future.

xii. **Technical textiles education:** The report contains detailed information about technical textile education that is being imparted in Indian academic institutions and universities which offer degree programmes. A primary survey of such institutions has been conducted and the survey data analysed to know about the courses and programmes being offered, student and faculty strength, research conducted, projects undertaken, challenges faced, and methods to overcome them. A study of five premier foreign universities that offer education related to technical textiles has also been carried out to understand some of their unique practices which contribute towards excellence in education.

2.1.2 Resource Availability

The availability of resources such as raw materials, manufacturing technology and machinery, manpower (skilled and unskilled), research and development facilities, testing facilities, etc. has been analysed based on primary data obtained from various stakeholders as well as from secondary sources. List of important raw material and fibres being imported by various companies has been prepared. In addition to that, the information about machines being imported and the countries of their origin has been obtained through primary survey of technical textile manufacturing companies.

2.1.3 Future of Technical Textiles

Based on the analysis of the data that has been collected about various aspects of technical textiles market, the forecast about the future of each of the application segments have been arrived at. Yearly growth rates and market size have been forecast for important technical textiles products for the period till 2024-25.

2.1.4 Impediments to growth of India’s Technical Textiles industry

The information obtained from various sources during the course of this study has been analysed and based on that analysis, impediments to the growth of India’s technical textiles industry have been identified. The impediments so identified pertain to government policies, taxes and duties, uncertainty in demand, inadequate information about the export & domestic market, non-availability of raw materials and machinery, inadequate testing facilities, inadequate coating and lamination facilities, non-availability of skilled and qualified workforce/ personnel, quality not meeting the international standards etc.

2.1.5 Recommendations

The identification of impediments makes it imperative to suggest actionable recommendations for Ministry of Textiles, Government of India so that these can help in facilitating the growth and development of technical textiles industry in India. The set of recommendations have been presented distinctively in the report.

2.1.6 Comprehensive information about industry's stakeholders

There has been a paucity of reliable information about stakeholders of technical textile industry in India. As part of this study, for the first time ever, reliable, updated, detailed information about various stakeholders of the industry has been presented in a systematic manner. Comprehensive directories of the following stakeholders have been compiled and are included as annexures to the report so as to serve as a document of reference for users of this report:

1. Annexure 15: Directory of Textile Research Associations in India
2. Annexure 24: Directory of Centres of Excellence for Technical Textiles in India
3. Annexure 28: Directory of Academic Institutions offering Undergraduate and Postgraduate education in Textile Engineering and Technology
4. Annexure 29: Directory of Institutes offering textile relevant Diploma Courses
5. Annexure 30: Directory of Focus Incubation Centres for Technical Textiles
6. Annexure 31: Directory of Technology Parks for Technical Textiles
7. Annexure 32: List of enterprises that participated in the survey conducted by IIT Delhi
8. Annexure 33: Directory of important Manufacturers' Associations
9. Annexure 36: Profiles of Key Technical Textile Firms in India

2.2 Data and Methodology

2.2.1 Data collection and management

Data for the present study was collected from primary as well as secondary sources. The details of data sources, data collection methods, sampling, documenting, organising, analysis and other relevant aspects are highlighted below.

Primary Data: Collection and analysis

Multiple tools were used for collection of primary data:

- **Semi-Structured questionnaires:** Respondent-category specific, detailed, semi-structured questionnaires entailing close- ended and open-ended questions were used to capture quantitative and qualitative information about technical textile industry that was shared by various stakeholders during the survey.
- **Stakeholders' workshops:** Seven workshops of experts, each with a specific focus, were conducted. Views and opinions of expert participants were first recorded and then analysed.

The primary data has been gathered from relevant personnel who belonged to various organisations viz. product manufacturers, raw material manufacturers, machine manufacturers/suppliers, textile research associations, centres of excellence, academic institutions, policy-making institutions, apex industry associations, focus incubation centres and textile technology parks. The features of primary data collection process are explained below.

1. Questionnaire survey instrument used for the survey

Questionnaires were developed on the basis of objectives of the study and inputs received from the domain experts and MoT for each of the stakeholder groups. The Questionnaire based survey instruments were then administered to the following stakeholders:

1. Technical Textile Product manufacturing companies
2. Raw material manufacturing companies
3. Machine manufacturing companies
4. Bureau of Indian Standards (BIS)
5. Textile Research Associations
6. Centres of Excellence
7. Academic Institutions
8. Focus Incubation Centres
9. Manufacturers' Associations
10. Textile Technology Parks

The questionnaires which were administered to manufacturing enterprises consisted of questions that sought responses about products being manufactured, manufacturing capacity, imports, exports, machines used, raw material, employees, expertise, financial status, business performance, opinions and suggestions. Data and information was collected for years 2015 to 2019 (extending to 2020 wherever possible).

Purposive sampling technique, which is a non-probability sampling method, was used for product manufacturing firms so as to ensure appropriate representation of product manufacturers from each segment of technical textiles. Since the number of raw material and machine manufacturers were small, help of experts was sought to identify sample firms from among them and the firms so identified were approached during the survey.

A survey agency was hired by IIT Delhi for collection of data from manufacturing firms (product, raw material and machine manufacturing firms). As for the stakeholders other than the manufacturers, primary data and information has been collected directly by members of IIT Delhi who were specially deployed for this purpose. The primary data collection faced a number of challenges because it was carried out during the Covid-19 pandemic.

Stakeholders' Workshops

Seven workshops with experts were conducted by IIT Delhi. It was ensured that each of the workshops had a distinct and clear focus in terms of segment/category of organisations participating in that particular workshop. All the workshops were conducted in virtual mode due to restrictions on physical gathering due to Covid-19 pandemic. IIT Delhi team engaged with TRAs, COEs, academic institutions, apex industry associations & institutions and product manufacturing firms from all segments of technical textiles. The discussions during the workshops were aimed at identifying emerging areas for product innovation, production and export capacities, gaps in resource availability, extent of access to technology and skills, facilitators and impediments to growth and policy-related suggestions by the participant for the Government.

Secondary Data: Sources and analysis

Data and information available in the published documents of Ministry of Textiles, Government of India, ITTA, FICCI, EXIM Bank of India, Invest India, KPMG and several national and global market research agencies was accessed for estimating product-wise market size and growth rates.

World Integrated Trade Solutions, World Bank (WITS), UN Comtrade, and ITC Trade Map were referred for analysing International Trade of Technical Textiles & India's contribution with respect to important products.

Analysis of technical textiles trade of India for the period 2012-2013 to 2019-2020 was carried out by extracting data from the website of Ministry of Commerce, Government of India.

Business profiling of more than 100 companies from technical textile industry has been done by using data from their annual reports, CMIE Prowess dx© database and Tofler Database.

Other sources for obtaining secondary data and information are websites of Ministry of Textiles, individual companies, various academic institutions (Indian and foreign), ITTA, different TRAs, all the COEs, BIS, Invest India, Focus Incubation Centres and Textile Technology Parks. Information from technical reports and research papers from academic journals and associations have also been accessed. A detailed list of all secondary sources is provided in the Annexures.

2.2.2 Methods used for analysing the data

A mixed-method approach has been used to analyse the data. The qualitative data collected through questionnaires and workshop proceedings was cleaned before being analysed. Cleaning of the data involved cohesive collation and parsing of all the data collected. Qualitative analysis techniques were used to construe, describe and understand the data. Industry relevant analytical methods like Porter's five forces model have been used. The major companies for case analysis were identified using Delphi technique.

The quantitative data was similarly cleaned and assessed. Numerous checks were performed to identify and eliminate errors. The methods encompass descriptive and summary statistics with tabulated data, diagrammatic and graphical representation of information, trend analysis, growth movement through cumulative average growth rates, (CAGR), factor analysis, etc., to generate meaningful insights. The data has been normalized to remove disproportionate effect of any outliers.

2.2.3 Workflow

The workflow process followed for primary data collection is shown in the figure below:

Figure 2.1: Process for primary data collection

Related to Secondary data:

The workflow process followed for secondary data collection is shown in the figure below:

Figure 2.2: Process for secondary data collection

2.2.4 Limitations of the study

Although best efforts were made in collecting, collating, analysing, and presenting the information in this report, there are some limitations of the study which are as follows:

1. IIT Delhi is suggesting 449 HSN Indian codes as technical textile products. The composition of these codes has been arrived at after careful examination of previously identified codes from Baseline report (2016), 207 ITC HS Codes notified by Ministry of Textiles in December 2020 and the codes mentioned in Exim Bank Report (2018). These were discussed and screened by domain experts who categorised these into segments. All the analysis that is related to imports and exports of technical textiles pertains to 449 codes.
2. Best efforts were made to obtain responses from as many firms and stakeholders as possible for the survey that was rolled out during the pandemic period. As the participation in this study was completely voluntary, therefore the results based on analysis of primary data are limited only to those stakeholders and companies who consented to submit their responses.
3. The period for primary and secondary data is collated till FY 2020.

3. Introduction to Technical Textiles in India

3.1 Definition of Technical Textiles

Technical or engineered textiles are defined as products, materials, and fibres that are used for their functional use rather than for aesthetic purposes. Technical textiles have varied applications in several vital industries including aerospace, packaging, hazard protection, shipping, sports, agriculture, defence, healthcare, construction, etc.

3.2 Segments of Technical Textiles

Technical textiles industry is broad-based, and its output is categorised into 12 application segments viz. Agrotech, Buildtech, Clothtech, Geotech, Hometech, Indutech, Meditech, Mobiltech, Oekotech, Packtech, Protech, and Sportech. A brief description of each of these is presented below:

i. **Agriculture, Horticulture, Fisheries, and Forestry Textiles (Agrotech):** The Agrotech segment includes textile products used in agriculture, horticulture (including floriculture), fisheries, animal husbandry, forestry and other allied activities. Agrotech products help in production and protection of crops and other related produce from livestock and marine life.

ii. **Architectural and Constructional Textiles (Buildtech):** Buildtech consists of those textile products which have application in building and construction industry. Buildtech products include architectural membranes, tarpaulins (canvas & HDPE), awnings and canopies, scaffolding nets, wall coverings and acoustic fabric.

iii. **Clothing Textiles (Clothtech):** Clothtech segment comprises textile material and products manufactured to fulfil functional requirements of clothing, garments, and footwear industry. Shoelaces, interlinings, zip fasteners, elastic fabric, garments and umbrella cloth are some of the major products that are included in this segment.

iv. **Geotextiles (Geotech):** These materials are permeable and have been designed for uses such as soil reinforcement, separation, filtration, drainage and erosion control. Products in Geotech segment are used in nonwoven, woven and knitted forms in roads, railway tracks, embankments, waterworks etc. Major products in this segment are Geogrids, Geonets, and Geocomposites.

v. **Household Textiles (Hometech):** Technical components of furniture, household textiles, and floor coverings, etc., are categorised as Hometech. Other major products in Hometech segment include fibrefill, mattress & pillow components, carpet backing cloth, stuffed toys and blinds.

vi. **Industrial textiles (Indutech):** Textile products which are designed for filtration, conveying, purification of products and other industrial uses are classified under Indutech segment. Therefore, Indutech includes filters, conveyor belts, drive belts, bolting cloth, computer printer ribbons and paper-making fabrics.

vii. **Medical and Hygiene Textiles (Meditech):** Meditech segment consists of textile material used for healthcare and hygiene applications. This segment includes products like diapers, sanitary napkins, surgical products, artificial implants, masks, PPE kits and surgical gowns.

viii. **Transportation Textiles (Mobiltech):** Mobiltech segment includes textile products that are used for applications in automotive components of terrestrial vehicles of various kinds, railways, airplanes, boats and ships, satellites and space crafts. The main products of Mobiltech segment are seat belt webbings, airbags, helmets, seat upholstery, airline disposables and nylon tyre cords.

ix. **Environment Protection Textiles (Oekotech):** Textile products that are used for applications related to environmental protection are categorised as Oekotech products. Oekotech products are used in erosion control, air and water purification, waste recycling and treatment.

x. **Packaging Textiles (Packtech):** This segment consists of products manufactured for applications in packaging of industrial products and food products.

xi. **Protection and Safety Textiles (Protech):** Products of Protech segment are used for their functional performance in the areas of protection of personnel and physical assets. The main user groups are those associated with external security duties (defence), fire control services, police, para-military forces as well as residential and industrial security.

xii. **Sport and Recreation Textiles (Sportech):** High-performance textile materials used for sportswear and sports equipment are categorised in this category. Some sportech products are artificial turfs, sports nets, fishing rods, balloon fabrics, parachutes fabrics, hockey sticks, racquets and sail cloths.

3.3 Indian Technical Textiles Industry

The size of Indian technical textiles industry is estimated at US$ 18.89 Billion in FY 2091-20, and it is approximately 8.7% of US$ 217.81 Billion global technical textiles market. The penetration level of technical textiles is relatively lower in India at 5-10% as compared to 30-70% in developed countries. Government of India has launched National Technical Textiles Mission with a financial outlay of Rs. 1,480 Crores with the aim of positioning India as a global leader in Technical Textiles. Its implementation period will be for four years (from FY 2020-21 to 2023-24). The Mission will facilitate market development, market promotion, international technical collaborations, investment promotions and 'Make in India' initiatives. The aim of the mission is to grow the domestic market at the rate of 15-20 percent per annum and take the market size to US$ 40-50 Billion by the year 2024. The mission also aims at increasing the exports of technical textiles from current annual value of approximately Rs. 14,000 Crores to Rs. 20,000 Crores by 2021-22. It also targets to maintain an average annual growth of 10 percent in exports till 2023-24.[1]

3.4 Industry's response to Coronavirus pandemic

The outbreak of Coronavirus (termed as COVID-19) pandemic towards the end of December 2019 posed a huge challenge to the entire world. World Health Organisation (WHO) declared the outbreak a global health emergency on 30th January 2020 and a Global Pandemic on 11 March 2020. Meanwhile, Government of India responded with alacrity and activated an emergency response to face the challenge and contribute towards minimising its impact. There emerged a pressing need for Body Coveralls, a part of Personal Protection Equipment (PPE), which are specialised protective suits meant for providing high level of protection to the health professionals dealing with COVID-19 patients.

Prior to March 2020, Body Coveralls suitable for COVID-19 (classified as class-3 exposure level under ISO 16003 Standard) were not manufactured in India and the country had to depend on imports from China, USA and Europe. The requirement of such Coveralls was less than 50,000 per year and the strict quality requirements for these were prescribed by the Ministry of Health & Family Welfare, Government of India. Due to disruption in imports because of outbreak induced movement restrictions in China, Ministry of Health & Family Welfare (MoH&FW) approached Ministry of Textiles in the last week of January 2020 seeking support to develop domestic sources of supply of PPEs (Body Coveralls and N-95 masks) so that Indian health professionals could use them as protection while combating COVID-19 pandemic.

Ministry of Textiles and Ministry of Health & Family Welfare launched Outreach programmes and invited fabric and garment manufacturers to explore possibilities of developing suitable products and establishing production capacity on war footing. Active collaboration of Government with Indian Technical Textiles industry started from 30th January 2020. Industry associations and several manufacturers of all categories were engaged in this endeavour. MoH&FW finalised technical specifications for Body Coveralls on 2nd March 2020.

The technical requirement was for the Coveralls to pass ISO 16003 Class-3 exposure pressure (Synthetic Blood Penetration Resistance Test). Initially, there was only one laboratory (SITRA, Coimbatore) which had the testing facility for conducting Synthetic Blood Penetration Test. DRDO set up a test facility at its laboratory in Delhi (INMAS) in the first week of April 2020. Due to the concerted efforts of the Ministry since then, there are 11 laboratories which are now engaged in conducting tests on PPE Coveralls as well as on fabrics.

Until March 2020, only two fabric manufacturers and four garment manufacturers had qualified from tests carried out at SITRA. Ministry of Textiles held a series of stakeholders' consultations, and several domestic

[1] Annual Report 2020-21, Ministry of Textiles, Government of India

hosiery and apparel manufactures were persuaded to take up the manufacturing of PPEs. These sustained efforts led to 106 indigenous units establishing manufacturing capacities for Coveralls by April 2020. The actual production of Body Coveralls shot to more than 4.5 lakh units per day by mid-May 2020. Within a period of just two months, a new industry, worth US$ 1 billion or Rs. 7,000 Crores with nearly 1,100 manufacturers certified by 11 approved laboratories has been created with unprecedented promptness.

India has so far produced more than 6 crore PPE Coveralls and exported 2 crore sets to USA, Europe, Middle East and Africa, Australia, and a few other countries. India has also produced more than 15 crore N-95 Masks and has exported 4 crore masks by November 2020. There are more than 200 certified manufacturers of N-95 masks who have a production capacity of 32 lakh pieces per day. India is the second largest producer of Personal Protection Equipment in the world and has enough surplus production to meet export demands too. India has converted the crisis into an opportunity and has emerged as a global leader in manufacture of PPE, giving a boost to the 'Make in India' programme and continuing its march towards creation of '*Atmanirbhar Bharat*'.

4. Exhaustive List of Technical Textile Products

Technical textile industry is in its nascent stage but is evolving at a fast pace. As a result of this rapid growth, the industry is undergoing a large number of changes in a short span of time. One such change is in the product portfolio of what constitutes technical textiles. Constant product innovation results in addition of new products to the existing pool of technical textile products.

In order to ensure that the stakeholders are better informed, an effort has been made to compile an exhaustive list of technical textile products under 12 different segments. This effort has relied on expert opinion and secondary research which has been followed by rationalisation and removal of duplication. Segment-wise list of products is presented below. Information on whether the respective product is manufactured and consumed in India, imported into and exported from India is also presented against each of the products.

4.1 Agrotech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Anti Bird Nets	Y	Y	N	Y
2	Anti Hail Nets	Y	Y	Y	Y
3	Anti-Insect Nets	Y	Y	Y	Y
4	Crop Covers	Y	Y	N	Y
5	Crop Support Nets	Y	Y	N	Y
6	Dole Nets	Y	Y	N	Y
7	Fishnet Twines	Y	Y	N	Y
8	Fruit Protection Covers	Y	Y	N	N
9	Gill Nets	Y	Y	Y	N
10	Ground cover Fabric	Y	Y	N	Y
11	Harvesting Nets	Y	Y	N	Y
12	Jute Soil Savers	Y	Y	N	Y
13	Mulch Mats	Y	Y	N	Y

14	Nylon Monofilament Fishing Nets	Y	Y	Y	Y
15	Nylon Multifilament Fishing Nets	Y	Y	y	Y
16	Pelagic Nets	Y	Y	N	N
17	Purse Seine Nets	Y	Y	N	Y
18	Root Ball Nets	Y	Y	N	Y
19	Seed production Cages	Y	Y	N	N
20	Shade Nets	Y	Y	N	Y
21	Staking Cords	Y	Y	Y	Y
22	Trawls (Trawl Nets)	Y	Y	Y	Y
23	Turf Protection Nets	Y	Y	N	N
24	Vermi Beds	Y	Y	Y	Y

4.2 Buildtech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Acoustic Fabrics	Y	Y	Y	Y
2	Architectural Membranes	Y	Y	Y	Y
3	Auditorium Fabrics	Y	Y	Y	Y
4	Awnings and Canopies Fabrics	Y	Y	Y	Y
5	Canvas Tarpaulins	Y	Y	N	Y
6	Coir Blinds/ Awnings	Y	Y	N	Y
7	Fabric Formwork for Concrete	Y	Y	N	N
8	Flex material for hoardings and advertisements	Y	Y	Y	Y
9	HDPE Tarpaulins	Y	Y	Y	Y
10	Jute Tarpaulins	Y	Y	N	Y
11	LDPE Sheets	Y	Y	N	Y
12	Lifting Slings	Y	Y	Y	Y
13	Polyester Harnesses Belts	Y	Y	Y	N
14	PP Tarpaulins	Y	Y	N	Y
15	PVC Coated Tarpaulins	Y	Y	N	Y
16	PVC Laminated Flex	Y	Y	Y	Y

17	Scaffolding Safety Nets	Y	Y	Y	N
18	Shelter Fabrics	Y	Y	Y	Y
19	Tents	Y	Y	Y	Y

4.3 Clothtech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Cloth Labels, Cloth Badges	Y	Y	Y	Y
2	Coated Fabrics	Y	Y	Y	Y
3	Coated Interlinings	Y	Y	N	N
4	Cotton Sewing Threads	Y	Y	Y	Y
5	Elastic Narrow Fabrics	Y	Y	Y	Y
6	Embroidery Backings	Y	Y	Y	Y
7	Functional Yarns	Y	Y	Y	Y
8	Garment Elastic Tapes	Y	Y	Y	Y
9	Hook and Loop Fasteners	Y	Y	Y	Y
10	Industrial Sewing Threads	Y	Y	Y	Y
11	Institutional Uniforms	Y	Y	N	Y
12	Interlining for Apparels including Over the Back (OTB) for embroidery	Y	Y	Y	Y
13	Interlinings for Coats	Y	Y	N	Y
14	Laces and Tapes	Y	Y	Y	Y
15	Military Fabrics	Y	Y	Y	Y
16	Nylon Taffeta	Y	Y	Y	N
17	Panty Hose, Tights, Stockings, Socks and Other Hosiery	Y	Y	Y	Y
18	Rayon Taffeta	Y	Y	Y	Y
19	Shoe Linings	Y	Y	Y	Y
20	Tactical Vests for Military use	Y	Y	Y	Y
21	Textured Yarn	Y	Y	Y	Y
22	Tulles	Y	Y	Y	Y
23	Velcro	Y	Y	Y	Y
24	Wadding	Y	Y	Y	Y
25	Zip Fasteners	Y	Y	Y	Y

4.4 Geotech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Extruded Polypropylene Geogrid	Y	Y	Y	Y
2	Gabions	Y	Y	Y	Y
3	Geo Composites	Y	Y	Y	Y
4	Geo fabrics	Y	Y	Y	Y
5	Geobags	Y	Y	Y	Y
6	Geocells	Y	Y	Y	Y
7	Geogrids	Y	Y	Y	Y
8	Geomembranes	Y	Y	Y	Y
9	Geotextiles for Road Construction	Y	Y	N	N
10	Geotextiles 100 csm-724 gsm	Y	Y	Y	Y
11	High Strength Polyester	Y	Y	Y	Y
12	Nonwoven, Needle punch felt for Geobags	Y	Y	Y	Y
14	PET Geogrids and HDPE Geocells	Y	Y	Y	Y
15	Polymer and Steel Gabions for Shore Protection	Y	Y	Y	Y
16	PP Woven Fabrics with different GSM & Colour	Y	Y	Y	Y
17	Prefabricated Vertical Drains	Y	Y	Y	Y

4.5 Hometech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Acrylic Floor Covering Yarns	N	Y	Y	N
2	Bed Linen, Table Linen, Toilet Linen and Kitchen Linen	Y	Y	Y	Y
3	Blackout Curtains	Y	Y	N	Y
4	Blinds	Y	Y	N	Y
5	Carpet and Textile	Y	Y	Y	Y

	Floor Coverings (including Textile Backing Cloth)				
6	Cloth Napkins	Y	Y	Y	Y
7	Coir Mats	Y	Y	N	Y
8	Comforters	Y	Y	Y	Y
9	Curtains	Y	Y	Y	Y
10	Cushions, Comforters and Quilts	Y	Y	Y	Y
11	Dry Wipes & Kitchen Wipes	Y	Y	Y	Y
12	Fabric Tapes	Y	Y	N	Y
13	Faux Leather	Y	Y	Y	Y
14	Filter Fabrics (HVAC and Vacuum Cleaner)	Y	Y	Y	Y
15	Flock Coated Fabric	Y	Y	Y	N
16	Hollow Fibre Pillows	Y	Y	Y	Y
17	Jute Carpet Backing cloth	Y	Y	Y	Y
18	Laminated Mattress Protectors	Y	Y	Y	Y
19	Linoleum	Y	Y	Y	N
20	Mattress Pads	Y	Y	N	Y
21	Mosquito Nets	Y	Y	Y	Y
22	Needle Punch Carpets	Y	Y	Y	Y
23	Nonwoven Thermal Bonded Waddings	Y	Y	Y	Y
24	Nonwoven Wipes for home use	Y	Y	Y	Y
25	Painting Canvas	Y	Y	Y	Y
26	Pillow Covers	Y	Y	N	Y
27	PP Air Conditioner Filter Cloth	Y	Y	N	Y
28	Quilts	Y	Y	Y	Y
29	Refreshing Wipes	Y	Y	Y	Y
30	Refreshment Wipes	Y	Y	Y	Y
31	Stuffed Toys	Y	Y	Y	Y
32	Ticking Fabrics	Y	Y	Y	Y
33	Woven Pile Fabrics and Chenille Fabrics	Y	Y	N	Y

4.6 Indutech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Abrasive Cloth	Y	Y	Y	Y
2	Acoustic Insulation Fabric	Y	Y	Y	N
3	Advanced Composites for Oil and Gas	Y	Y	Y	N
4	AGM Glass Battery Separators	Y	Y	Y	N
5	Bolting Cloth	Y	Y	Y	Y
6	Computer Printer Ribbons	Y	Y	Y	Y
7	Conveyor Belting Fabrics	Y	Y	Y	Y
8	Decatising Cloth	Y	N	N	Y
9	Drive Belts	Y	Y	Y	Y
10	High-performance Ropes and Cordages	Y	Y	Y	Y
11	HVAC Filter Cloth	Y	Y	Y	Y
12	Industrial Filter Fabrics	Y	Y	Y	Y
13	Industrial Hoses	Y	Y	Y	Y
14	Industrial Tapes	Y	Y	Y	Y
15	Industrial Webbings and Slings	Y	Y	Y	Y
16	Industrial Wipes	Y	Y	Y	Y
17	Laminated Nonwoven Filters	Y	Y	Y	Y
18	Liquid Filter Fabrics	Y	Y	N	Y
19	Meta Aramid Fibres	N	Y	Y	N
20	Nonwoven Jute Felts	Y	Y	N	Y
21	Nylon Ropes	Y	Y	N	Y
22	OPAN Fibre (Pyromex)	Y	Y	Y	Y
23	Paper Making Fabrics	Y	Y	N	Y
24	Peel Ply Fabrics	Y	Y	Y	Y
25	Polyamide Nylon Monofilament Yarns	Y	Y	Y	Y
26	Polyester Industrial Yarns	Y	Y	Y	Y
27	Printed Circuit Boards	Y	Y	Y	Y
28	Ropes and Cordages	Y	Y	Y	Y
29	Speaker Fabrics	Y	Y	Y	N
30	Tape Fabrics (Nylon Curing, Electric Cable,	Y	Y	Y	Y

	Nuclear Plant Pipes)				
31	Twines	Y	Y	Y	Y
32	Typewriter Ribbon Cloth	Y	Y	N	Y
33	Water and Oil Filters	Y	Y	Y	Y
34	Water Repellent Canvas	Y	Y	Y	Y
35	Waterproof Covers	Y	Y	Y	Y
36	Wicks and Gas Mantle Fabrics	Y	Y	N	N
37	Woven Fabrics of Glass	Y	Y	Y	Y
38	Woven Filter	Y	Y	N	Y
39	Woven Narrow Goat Hair Puttis Tape	Y	N	N	Y
40	Woven Narrow Jute Webbing	Y	Y	N	Y

4.7 Meditech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	3 Ply Surgical Mask & Hygiene Disposables	Y	Y	N	Y
2	AB Cotton (Absorbent Bleached Cotton)	Y	Y	N	Y
3	Abdominal Sponges	Y	Y	N	Y
4	Adhesive Gauze Bandages	Y	Y	Y	Y
5	Adhesive Medicinal Tapes	Y	Y	Y	Y
6	Adult Diapers	Y	Y	Y	N
7	Anti-Microbial Fabrics	Y	Y	Y	Y
8	Arm board Covers	Y	Y	N	Y
9	Artificial Heart Valves	Y	Y	Y	N
10	Artificial Joints	Y	Y	Y	Y
11	Artificial Ligaments	N	Y	Y	N
12	Artificial Vascular Grafts	N	Y	Y	N
13	Baby Diapers	Y	Y	Y	N
14	Baby Pants	Y	Y	Y	Y
15	Bleached open weave and leno weave gauze rolls-for export	Y	N	N	Y
16	Blood pressure Cuffs	Y	Y	N	N
17	Burn Therapy Dressing Soaked In Protective	Y	Y	N	N

	Gel				
18	Caps(used as Mask)	Y	Y	N	N
19	Carbo-Melt Fabrics	Y	Y	N	Y
20	Combined Dressings	Y	Y	N	Y
21	Community Masks	Y	Y	N	Y
22	Compression Stockings and Compression Garments	Y	Y	Y	Y
23	Cotton Spunlace Non – Woven Roll Goods	Y	Y	N	Y
24	Coveralls	Y	Y	Y	Y
25	CTG Belts and Medical Mask Tapes	Y	Y	N	Y
26	Dental Floss	Y	Y	Y	Y
27	Disposable Hospital Bed Sheets	Y	Y	N	Y
28	Draw Sheets	Y	Y	N	Y
29	Dust Mask & Respirators	Y	Y	Y	Y
30	Ear cleaning Buds	Y	Y	Y	Y
31	Extra Corporeal membrane oxygenation (ECMO)	N	Y	Y	N
32	Eye Pads	Y	Y	Y	Y
33	Finished Goods (Cotton Balls, Pleat & Wool Roll Cotton Pad, Round, Square, Oval, Rectangle, 5X6)	Y	Y	Y	Y
34	Gauze Swabs	Y	Y	Y	Y
35	Heart Patches	Y	Y	Y	N
36	Hernia Meshes	Y	Y	Y	Y
37	Hospital Room- Clean Garments/Sterile Products	Y	Y	Y	Y
38	Incontinence Diapers	Y	Y	Y	N
39	Inflatable mattress / pillows	Y	Y	Y	Y
40	Isopropyl Alcohol Swabs	Y	Y	N	N
41	Magic Coin Tissues	Y	Y	N	Y
42	Mayo Table Covers	Y	Y	N	Y
43	Medical Aprons	Y	Y	N	Y
44	Medical Bandages	Y	Y	N	Y
45	Medical Gowns	Y	Y	N	Y
46	Medical PPE- washable cloth- reused	Y	Y	Y	Y
47	Medical wear in 100% cotton and 100%	Y	Y	N	Y

	synthetic fabric for Type 6B garments				
48	Medicated Cotton Wool	Y	Y	N	Y
49	Medicated Dressings	Y	Y	Y	Y
50	Medicated Lints	Y	Y	Y	Y
51	Melt-blown Fabrics	Y	Y	Y	N
52	Mortuary Bags	Y	Y	N	Y
53	N95 Masks-NIOSH approved	Y	Y	Y	Y
54	Non-surgical Face Masks	Y	Y	N	Y
55	O.T. Towels	Y	Y	N	Y
56	PPE Coveralls	Y	Y	Y	Y
57	Reusable Masks	Y	Y	N	Y
58	Reusable PPEs	Y	Y	N	Y
59	Sanitary towels (pads) and tampons	Y	Y	N	Y
60	Sanitizing Wipes	Y	Y	Y	N
61	Scrub Suits	Y	Y	N	Y
62	Single use PPEs	Y	Y	Y	Y
63	Surgical Disposables	Y	Y	Y	Y
64	Surgical Drapes	Y	Y	N	Y
65	Surgical Dressings	Y	Y	N	Y
66	Surgical Gowns	Y	Y	Y	Y
67	Surgical Masks	Y	Y	N	Y
68	Surgical Sutures	Y	Y	Y	Y
69	Surgical Swabs and Pads	Y	Y	Y	Y
70	Surgical Tapes	Y	Y	Y	Y
71	Synthetic Non Absorbable Hernia Mesh	Y	Y	N	Y
72	Synthetic Non Absorbable Sutures	Y	Y	Y	Y
73	Under Pads	Y	Y	Y	Y
74	Medical Wipes	Y	Y	Y	Y

4.8 Mobiltech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Airbags	Y	Y	Y	Y
2	Automotive Carpets	Y	Y	Y	Y
3	Automotive Heat Shields	Y	Y	Y	N

4	Automotive Textiles	Y	Y	Y	Y
5	Brake Diaphragm Fabrics	Y	Y	Y	N
6	Car body Covers	Y	Y	Y	Y
7	Car Upholstery: Seat Cover Fabrics	Y	Y	Y	Y
8	Cargo Nets	Y	Y	Y	Y
9	Chafer Fabrics for Tyres	Y	Y	N	Y
10	Cycle Tyre cord Fabrics	Y	Y	Y	Y
11	Dipped Rayon tyre cord Fabrics	Y	Y	Y	N
12	Grey Rayon tyre cord Fabrics	Y	Y	Y	N
13	Headliners	Y	Y	Y	Y
14	Helmets (Textile material inside the helmets)	Y	Y	Y	Y
15	Inflatable Floats & Boats for Defence	N	Y	Y	N
16	Insulation Felts	Y	Y	N	Y
17	Literature pockets in Air planes	N	Y	Y	N
18	Marine yarns for cruise ships	N	Y	Y	N
19	Mooring Ropes for Shipping	Y	Y	N	Y
20	Nylon Tyre Cord Fabric - Dipped Fabric	Y	Y	Y	N
21	Nylon Tyre Cord Fabric (HSN – 59021090) - Greige Fabric	Y	Y	Y	N
22	Polyester Tyre Cord Fabric	Y	Y	Y	N
23	Railway Fabrics	Y	Y	N	N
24	Sails	N	Y	Y	N
25	Seat Belt Webbings	Y	Y	Y	Y
26	Spacer Mesh	Y	Y	Y	N
27	Sunblind/Sun visors	Y	Y	N	N
28	Tarpaulins	Y	Y	N	Y
29	Transport Ropes	Y	Y	Y	Y
30	Truck Covers	Y	Y	Y	Y

4.9 Oekotech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Drainage Geonets	Y	Y	Y	N
2	Erosion Mats and Nets	Y	Y	Y	N
3	Geocells	Y	Y	Y	Y
4	Geomattresses	Y	Y	Y	Y
5	Geomembranes	Y	Y	Y	Y
6	HDPE/PP Geogrids	Y	Y	Y	Y
7	Knitted and Coated Mesh & Geotextiles	Y	Y	Y	Y
8	Landfill Solutions (Liners and Fabrics)	Y	Y	N	Y
9	Nonwoven Geotextiles	Y	Y	Y	Y
10	GI Wire Netting Facia	N	N	N	N
11	Geo Mattresses	N	N	N	N

4.10 Packtech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Advanced Composites (Anti Carcinogenic Packaging, Anti-corrosive)	Y	N	N	Y
2	Bulk Bags	Y	Y	Y	Y
3	Cordura Fabrics (for bags)	Y	Y	Y	N
4	D cut bags	Y	Y	N	Y
5	Flexible Intermediate Bulk Containers (FIBCs)	Y	Y	Y	Y
6	Gunny Bags	Y	Y	Y	Y
7	Handle Bags	Y	Y	Y	Y
8	HDPE Woven Mesh for Vegetable Packing	Y	Y	N	Y
9	HDPE Woven Sacks and Bags	Y	Y	N	Y
10	Hook and Loop Tapes	Y	Y	Y	Y
11	Hydrocarbon Free Food Grade Bags (various	Y	Y	N	Y

	capacities)				
12	Jute Hessian and Sacks	Y	Y	N	Y
13	Jute Shopping Bags	Y	Y	Y	Y
14	Laminated Nonwoven Fabrics	Y	Y	Y	Y
15	Leno Bags	Y	y	N	Y
16	Military Backpacks	Y	Y	Y	Y
17	Nonwoven Fabric Bags	Y	Y	Y	Y
18	Polyolefin Woven Sacks	Y	Y	Y	Y
19	PP Woven Sacks and Bags	Y	Y	Y	Y
20	Punching Bag Fabric	Y	Y	Y	Y
21	Rucksack Fabric	Y	Y	Y	Y
22	Sacking Bags	Y	Y	Y	Y
23	Soft Luggage (including Vanity/Executive/Brief Cases)	Y	Y	Y	Y
24	Stitching Threads	Y	Y	Y	Y
25	Tea-Bags (Filter paper)	Y	Y	Y	Y
26	Toiletry Bags and Satchels	Y	Y	Y	Y
27	W cut Bags	Y	Y	N	Y
28	Wallets and Purses	Y	Y	Y	Y
29	Wrapping Fabric	Y	Y	N	Y

4.11 Protech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Aerostat Fabrics	Y	Y	N	Y
2	Anti-Static Garments	Y	Y	Y	Y
3	Aramid Fabric	Y	Y	Y	Y
4	Ballistic Fabric	Y	Y	N	Y
5	Bio Gas Balloons	Y	Y	N	Y
6	Bitumen & Wax Coated Fabric	Y	Y	Y	N
7	Bomb Disposal Jackets	Y	Y	Y	N
8	Bullet Proof Protective Jackets	Y	Y	Y	Y
9	Camouflage Nets	Y	Y	Y	Y
10	Chemical Protective Clothing	Y	Y	Y	N
11	Electric Static Discharge Tapes made	Y	Y	Y	N

	for safety shoes and work shoes for electronic assembly industries				
12	EMI Shielding textiles	Y	Y	Y	N
13	Fighter Aircraft Special Clothing	Y	Y	Y	N
14	Fire Retardant Apparel	Y	Y	Y	Y
15	Fire Retardant Fabric for furnishings	Y	Y	N	Y
16	Fire Retardant Zippers	Y	Y	Y	Y
17	Flame Resistant Fabric	Y	Y	Y	Y
18	High Altitude Clothing	Y	Y	Y	N
19	High Visibility Clothing	Y	Y	N	Y
20	Industrial Gloves	Y	Y	Y	Y
21	Infra-red Clothing (Military use)	Y	Y	Y	N
22	Life Jackets and Life Belts	Y	Y	Y	Y
23	Man dropping Parachute Fabric	Y	Y	Y	Y
24	Meta Aramid Fibres	N	Y	Y	N
25	Nuclear Biological and Chemical Protection Suits (NBC)	Y	Y	Y	N
26	Overcoats, Capes and Anoraks	Y	Y	Y	Y
27	Para Aramid Fibres	Y	Y	Y	N
28	Submariner Clothing	Y	Y	Y	N
29	Tarpaulins for use of security forces	Y	Y	Y	Y
30	Thermal Liners for fire and safety	N	Y	Y	N
31	Truck Covers	Y	Y	Y	Y
32	Umbrella Cloth Fabrics	Y	Y	Y	Y
33	UV Resistant Clothing	N	Y	Y	N
34	Waterproof & Breathable Fabrics	Y	Y	Y	Y
35	Wind Cheaters and Rain Coats	Y	Y	Y	Y

4.12 Sportech Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Active wear A (Jackets, Wind-cheaters, Shorts, Outdoor legwear, Track suits, Jackets, Tear-proof designs, Swim suits)	Y	Y	Y	Y
2	Active wear B (Yoga pants, Leggings, Joggers, Capris, Shorts, Long Tops, T-shirts (for multiple usage), Crop-tops, Hoodies, Swim suits)	Y	Y	Y	Y
3	Artificial Turfs	Y	Y	Y	N
4	Basketballs	Y	Y	Y	Y
5	Breathable Fabric for sports jackets	Y	Y	Y	Y
6	Cordages for climbing ropes	Y	Y		Y
7	Cricket Nets	Y	Y	Y	Y
8	Footballs	Y	Y	Y	Y
9	Golf Nets	Y	Y	Y	N
10	High Performance Sports and swimwear (Skinsuits, Football jersey, Surfsuits, Golf T-shirts, Tracksuits, Yoga pants, Swimsuits, Sweatshirts, Trekking apparels)	Y	Y	Y	Y
11	Hot air Balloon Fabrics	Y	Y	Y	Y
12	Moisture management Fabrics	Y	Y	Y	Y
13	Others Sports Nets (other than Soccer, Volleyball, Tennis and cricket)	Y	Y	Y	Y
14	Parachute Fabrics	Y	Y	Y	Y
15	Punching Bags	Y	Y	Y	Y
16	Roller Blinds	Y	Y	Y	Y
17	Rugby Balls	Y	Y	Y	Y
18	Sail Cloths	Y	Y	Y	Y
19	Shoe components	Y	Y	Y	Y
20	Shoetech-waterproof	Y	Y	Y	Y

	shoes which also are visible in dark				
21	Sleeping Bags	Y	Y	Y	Y
22	Snookers/Pool Table Cloths	Y	Y	Y	Y
23	Soccer Nets	Y	Y	N	Y
24	Sport Composites	Y	Y	Y	Y
25	Sport Rings	Y	Y	Y	N
26	Sports footwear components	Y	Y	Y	Y
27	Sportswear (includes gloves, pads, guards)	Y	Y	Y	Y
28	Tennis Nets	Y	Y	N	Y
29	Tent Fabric	Y	Y	Y	Y
30	Toe Puffs	Y	Y	Y	N
31	Trekking Boots	Y	Y	Y	Y
32	Velcro for sports use	Y	Y	Y	N
33	Volley Ball Nets	Y	Y	Y	Y
34	Volley Balls	Y	Y	Y	Y
35	Yarns for sports shoes	Y	Y	Y	Y
36	Yarns for sportswear	Y	Y	Y	Y

4.13 Smart Textiles Products

	Product	Manufactured in India	Consumed in India	Imported into India	Exported from India
1	Colour changing materials (Thermochromic heat sensitive material)	Y	Y	Y	N
2	Constant Temperature Bandages	N	Y	Y	N
3	Cooling Vests	Y	Y	Y	Y
4	Fire Suits	Y	Y	Y	N
5	GPS Shoes	Y	Y	Y	Y
6	Heated Seats	N	Y	Y	N
7	Life Belts (Abdominal Belt)	N	Y	Y	N
8	Life vest for blood pressure monitoring	N	Y	Y	N
9	Life vest for cardiac patients	N	Y	Y	N
10	Music Producing Jackets	N	Y	Y	N

11	Optical fibres for pulse monitoring	N	Y	Y	N
12	Polar protective clothing	Y	Y	Y	N
13	Sensor fitted medical caps	N	N	N	N
14	Ski jackets with GPS	N	Y	Y	N
15	Smart Baby Jumpsuits	Y	Y	Y	N
16	Smart Diving Suits	Y	Y	Y	N
17	Smart Gloves	Y	Y	Y	N
18	Smart military clothing with sensors and GPS	Y	Y	Y	Y
19	Smart Sleeves	Y	Y	Y	N
20	Smart Socks	Y	Y	Y	N
21	Smart Yoga Pants	Y	Y	Y	Y

5. Institutional Consumers of Technical Textiles in India

5.1 Demand side interventions by the Government

The growth of any industry is dependent on the level and extent of demand for its products. Government of India is implementing schemes and measures to increase the consumption and demand for technical textiles in the country. In addition to the discretionary use of technical textile products which happens due to market forces in the normal course, there are also some areas of usage where Government is making it mandatory to use technical textiles. The Government has also identified the possibilities of use of technical textiles as a part of implementation of various national missions, community development programmes, infrastructure development and Government schemes such as National Health Mission, Jal Jeevan Mission and National Horticulture Mission etc.

There are 92 application areas of technical textiles that have been identified for mandatory use across 10 Central Ministries/Departments. There are 68 applications (out of 92 that have been identified) which have already been notified for mandatory usage[1]. This mandate has resulted in Government Ministries/Departments becoming significant institutional consumers of technical textile products in India. The consumption of technical textile products by various Government departments and Public Sector Undertakings (PSUs) in India has been described in the following sections.

5.1.1 Agrotech

Regular on-field supervision by the Government's agricultural development personnel and promotional incentives being offered by the Government to the farmers have already enhanced the consumption of Agrotech products viz. micro-irrigation pipes, shade nets, vermin beds, insect nets, water carrying pipes etc. The standards of most of these items have been notified by the BIS and Ministry of Agriculture has released advisory for mandatory use of certain Agrotech products by various departments of Central and State Governments. Despite all these measures, the institutional procurement has not increased significantly. This delay is because different Ministries at the Centre and in States have not been able to issue necessary enabling instructions and notifications for their mandatory use in schemes under their respective charge.

[1] Technical Textiles: The Future of Textiles, Invest India, 2020

Based on our research through secondary sources, it can be inferred that the Agrotech products that are commonly consumed by Government institutions are fishnets and shade nets. At present, primary consumers of these products are research institutes working in the field of agriculture and allied vocations under the aegis of the central government. Evidence of recent procurement is available for Navsari Gujarat Research Centre of ICAR-CIBA, Indian Grassland and Fodder Research Institute, Jhansi, and Department of Agricultural Research and Education, Dehradun.

Central Government, along with SASMIRA, has taken the initiative to promote usage of agro-textiles in the North-Eastern region through its ambitious scheme "Promoting usage of agro-textiles in Northeastern region" which is aimed at promoting the use of suitable agro-textiles like shade nets, ground covers, bird protection nets, frost protection covers/crop covers, anti-hail nets, pond lining, etc.

5.1.2 Buildtech

Major institutional buyers in Buildtech segment are Public Sector Organisations and Government departments that are involved in construction of roads & highways, railways, public works, rural development, agriculture, water and sanitation, health, mining and telecom. Products that are commonly purchased are scaffolding nets, tarpaulins, and tents.

Another Buildtech product that is purchased by the Government institutions is Flex. Flex banners, posters and hoardings are used by various Government departments (most commonly it is the department responsible for information & publicity) for information dissemination of Government messages among the public.

5.1.3 Clothtech

Typical applications for which technical textiles products of Clothtech segment are purchased by the Government institutions are interlining, shoe fabrics, elastic and inelastic even fabrics, lining fabrics, and work wear garments. Most of the products are consumed as part of workwear as well as uniforms of functionaries and employees of various Government departments and PSUs.

5.1.4 Geotech

The main user departments of Geotextiles products are Ministry of Road Transport & Highways, Indian Railways, National Highways Authority of India, Ministry of Shipping, and Ministry of Water Resources. Items such as Geotubes, Geocells, Geonets and Geogrids are used in slopes and embankments. Woven & nonwoven Geotextiles are used for filtration, drainage, and protection against stone protrusion, and these are among the important products that have been authorised for mandatory usage by the Ministry of Water Resources. Textile products have also offered inventive engineering solutions for several applications in civil and geotechnical engineering and for infrastructure in water resources projects. The Ministry of Railways has conducted many pilot tests for application of Geotextiles on certain routes. Items such as Geogrids and Geocomposites have been recommended by Indian Technical Textiles Association (ITTA) to the Ministry of Railways. Ministry of Road Transport & Highways is one of the largest institutional buyers and the largest consumer of Geotextiles in India. The synthetic and natural Geotextiles are being used for extending the lifespan of the roads. For district level and village level roads, the use of Coir Geotextiles which is cheaper and bio-degradable has been initiated in many places.

Items such as Geotubes, Geomembranes, and Geobags are often used at ports to prevent shoreline erosion by water. An example of this is the construction of a Geotube sea wall which has been done at Uppada village in East Godavari district of Andhra Pradesh for the prevention of erosion by the sea. Irrigation Department, Kerala has proposed the use of Geotextile, Bags and Geo Mega Bags for prevention of erosions. Geotubes have also been used at Kolkata port on an experimental basis. The Border Roads Organisation (BRO) uses jute sacks in Geotextiles application for road construction.

Under Phase 3 of the Pradhan Mantri Gram Sadak Yojana (PMGSY), the Central Government has planned to use coir fabric for the construction of roads. This is expected to provide support to the Geotextile industry which has been badly affected by the halt in construction due to COVID-19 pandemic. The PMGSY guidelines for new technology states that 15 percent length of roads in each batch should be constructed as per the latest construction technology. Of this, five percent should be developed using Indian Road Congress (IRC) accredited technology. The IRC is now authorised to deploy Coir Geotextiles for construction of rural roads, which implies five percent of the road would be developed using coir geotextiles.[2]

5.1.5 Hometech

The special fabric used for upholstery in the coaches of passenger trains is a commonly procured Hometech product by the Government. It is Vinyl coated upholstery fabric that is Rexine made of several layers of Poly Vinyl Chloride (PVC). It has a fire-retardant coating on one surface and backing of synthetic cloth on the other surface. Indian Railways is the largest customer of this upholstery fabric which it uses for seat covers and berth covers. Flooring material i.e. carpet is another product of Hometech segment that has institutional consumers. The floor carpet is procured extensively by various Government departments and public sector organisations for their official premises.

5.1.6 Indutech

The Government and public sector institutions that procure products in Indutech segment are organisations in fertilisers, petrochemicals and coal mining industry and they procure products such as different types of filters,

[2] Invest India (https://www.investindia.gov.in/siru/technical-textiles-future-textiles)

conveyor belts and hose pipes. In addition to that, there are many Government organisations especially in the security functions (Army, Navy, Paramilitary forces) that procure high strength ropes of Nylon and Jute.

5.1.7 Meditech

The Government institutions that procure Meditech products are various hospitals, clinics and health centres of central, state and local governments. The purchases are often made by those departments of respective governments or public sector undertakings which have been entrusted with the responsibility of procurement function. According to the Baseline report of 2016 *(Source: Ministry of Textiles, Government of India)*, the total annual purchases of Meditech products at Government hospitals are estimated to be worth Rs. 1,070 Crores out of which, close to 95% of the expenditure is incurred in procuring surgical dressings and sutures. Due to the outbreak of COVID-19, there has been a huge spurt in demand for N 95 masks and PPE kits from a large variety of institutions during 2020 and 2021.

5.1.8 Mobiltech

Textile products that are used as components in different types of automobiles, aircrafts, trains, spacecrafts, earthmovers, forklifts are categorised under Mobiltech.

Products of Mobiltech purchased by various public sector undertakings as well as Ordnance Factories (which produces vehicles for India's military) are tyres (having tyre cord as the technical textile product) and other Government Departments who purchase it for maintaining their running vehicles. In addition to this, other items like seat belts, drive belts, hose pipes, headliners, vehicle upholstery, moulded parts, etc., are also purchased by Ordnance factories. ISRO, Indian Air Force as well as Hindustan Aeronautics Limited procure various components made of composites for the body and parts of aircraft, space craft and satellites.

5.1.9 Oekotech

Government departments and public sector undertakings procure soil seals, textiles drainage systems (Canal lining), erosion prevention systems, textiles for protection against hazardous substances, textile noise barrier systems and landfill textiles.

The study of documents accessed from published sources indicated that in the recent past, textile-based drainage systems have been mainly procured by Inland Waterways Authority of India and the water resources departments of various states, such as Rajasthan, Kerala, and Madhya Pradesh. Canal lining and bank protection of rivers and canals with the use of Oekotech products is being implemented in some projects. Military Engineer Services has procured Oekotech products for Environmental Park Irrigation System.

5.1.10 Packtech

Jute/HDPE sacks and bags are extensively used in packing fertilizers, chemicals, food grains, cement, pharmaceuticals etc. Government is promoting it as a sustainable fabric. Jute Packaging Material Act, 1987 (JPM Act) is under force across the country and it provides for compulsory use of jute packaging material in the supply and distribution of certain commodities in the interest of production of raw jute and jute packaging material. The Government sector purchases jute bags worth over Rs. 7,500 Crores annually and Government has made it mandatory for 100% of food grains and 20% of sugar to be packed in diversified jute bags.[3]

5.1.11 Protech

Indian armed forces and those responsible for maintaining law and internal order are the major consumers of protective textiles products. Various items of protective apparel and protective gear are required by personnel responsible for internal and external security. The hazardous elements from which protection is needed are extreme weather, thermal, ballistic, nuclear, biological, chemical, flame, heat, and flash. The protective textile products used by the country's defence forces are classified into six broad categories:

1. High Altitude Clothing
2. Ballistic Protective Clothing - Bullet Proof Jackets (BPJs)
3. Ballistic Helmets
4. Fire Retardant Fabrics/Apparels
5. High Visibility Clothing
6. NBC Suits, CPC, Industrial Gloves & others

The annual budget for clothing of the Indian Army is about Rs. 1100 Crores[4]. Nearly 35% (400 Crore) of their requirement of protective clothing is procured through imports while the rest of it is usually produced and delivered by ordnance factories and different research laboratories of DRDO. The import worth of protective gear is over Rs. 200 Crores. Super high-altitude clothing is one of the major items of protective clothing that is imported from European countries.

In addition to Indian Army, there are various other organisations which consume protective clothing. For example - Power Generation plants (e.g., those of National Hydroelectric Power Corporation Limited, NTPC etc.), Fertilizer plants (e.g., Rashtriya Chemicals and Fertilizers Limited), and Petrochemicals plants (e.g., Mangalore Refinery and Petrochemicals Limited). Indian Naval Headquarters has an annual budget of around Rs. 100 Crores for various technical textiles products such as protective and extreme winter clothing, safety footwear, FR protective wear, NBC protection etc[5]. Indian Coast Guard also procures protective clothing for its employees. Indian Air Force procures protective clothing and protective gear for pilots. The pilot's clothing and gear for Tejas light combat aircraft have largely been produced locally by DRDO with an import content of only 10%. Indian Railways has been a key institutional buyer of Fire Retardant (FR) fabric and it purchases

[3] Cabinet Committee on Economic Affairs, Government of India, 2020

[4] Army Eyes Domestic Technical Textile Producers, TechnicalTextile.net, 2015

[5] Report on the First Indian Navy-ITTA Clothing and Footwear Seminar, ITTA, 2016

nearly 40% of the FR production of India which is approximately 13.50 lakh meters and worth Rs. 30 Crores annually.

India has a shortfall in procurement of adequate quantity of bulletproof jackets for its security forces. Significant and continuous efforts are being made by Ministry of Textiles and Ministry of Defence to bridge this gap. During 2016-17, 50,000 bulletproof jackets were procured for Indian Army through revenue route.[6] A contract valued at Rs. 639 Crores for capital procurement of 1,86,138 Bullet Proof Jackets (BPJs) was signed with SMPP Private Limited in April 2018.[7] Delivery of the BPJs commenced from April 2019.

5.1.12 Sportech

The growth of sports and leisure industry has created more options for the use of technical textiles in different sports. Most of the items of sports equipment (with technical textile component) are procured by various bodies associated with Sports Authority of India and Universities. Parachute fabrics are consumed by Aerial Delivery Research and Development Establishment (ADRDE), the DRDO laboratory for research purposes. Avalanche Airbag is procured by the Indian Army. On the other hand, the Ministry of Defence, the National and State Disaster Relief Force, the Directorate of Fisheries and the Department of Defence Production procure different Fibre Reinforced Boats, lifeboats, life jackets, sleeping bags and sports tents.

5.2 Technical textile products procured by Government organisations & PSUs

The details of procurement of technical textiles by Government organisations and PSUs are as follows:

Table 5.1: Technical textile products procured by Government organisations & PSUs

S. No.	Name of the Segment	Name of the agencies procuring technical textiles products	List of products
1.	Agrotech	Navsari Gujarat Research Center of ICAR-CIBA	Fishnets
		Department of Animal Husbandry, Dairying and Fisheries, Government of India	Fishnets
		Directorate of Horticulture & Food Processing, Assam	Agro-textile kits
		Indian Grassland and Fodder Research Institute, Jhansi	Micro-irrigation sets
		Department of Agricultural Research and Education, Dehradun	Shade nets
2.	Buildtech	Rashtriya Chemicals and Fertilizers Limited, Mumbai	Tarpaulins
		Chennai Metro Rail Limited	Tarpaulins
		Central Research Institute for Dryland Agriculture	HDPE Tarpaulins

6 https://www.indiatimes.com/news/india/after-a-wait-of-seven-years-indian-army-finally-gets-first-lot-of-50-000-bulletproof-vests-266033.html

7 https://www.hindustantimes.com/india-news/defence-ministry-inks-rs-639-crore-bullet-proof-jacket-contract/story-1l411RPK5SiJACS4jca60I.html

		Ordnance Clothing Factory Avadi	Tents
		Braithwaite, Burn and Jessop Construction Comp Ltd	Tents
		Central Ground Water Board	Fly Tents
		Jal Sakti- River Development and Ganga Rejuvenation	Fly Tents
		District Health Office ZP Osmanabad	Posters
		Uttarakhand State Aids Control Society	Posters
		Western Railway - Materials Division -Pratapnagar	Acrylic Board with Poster Printing
		Rashtriya Chemicals and Fertilizers Limited	Posters
		North Western Railway	Tarpaulins
3.	Clothtech	Machine Tool Prototype Factory, Maharashtra	Trousers
		Malabar Cements Limited	Uniform
		Metals and Minerals Trading Corporation of India, Karnataka	Uniform Cloth
		Chaudhary Charan Singh University, Meerut	Uniforms
		Jawaharlal Nehru Port Trust, Maharashtra	Suiting and Shirting
		Sashastra Seema Bal, Ministry of Home Affairs, Govt. Of India	Khaki Drill Fabrics
		Delhi University- Bharti College	Sports Jersey
4.	Geotech	Western Railway (Ratlam)	Geogrids, Nonwoven Geotextiles
		Central Water and Power Research Station (Pune)	Geotextiles
		National Hydroelectric Power Corporation Limited (Subansiri Lower Project)	Geomembranes
		Bridge and Roof Company (India) Limited (Palta Work Project Site & Dhamra Port, Odisha)	Polypropylene Woven Geotextiles, Polyester Multifilament Woven Geotextiles
		National Highways Authority of India	Geotextile products
		Jammu And Kashmir Forest Department, NH1A project	Geotextile mats, woven coir mats and coir fibre logs
		Kashmir Irrigation & Flood Control Department	Geotextiles, Fabrics, Geotextiles, Bags and Geo Mega Bags
		Irrigation Department, Kerala	Geotextiles, Fabric, Geotextiles, Bags and Geo Mega Bags
5.	Hometech	National Council of Science Museums	Floor Carpets
		Delhi Metro Rail Corporation Limited	Carpets
		Balmer Lawrie and Company Limited	Rugs
		IHQ of MoD (Army)	Flooring, Mattresses, Carpets
		Eastern Railway (West Bengal)	Vinyl coated upholstery fabric
		Research Design and Standards Organization (Indian Railways)	Vinyl coated upholstery fabric
		Southwestern Railway	Vinyl coated upholstery fabric
		S.M.S. Medical College-Jaipur	Mattresses (with Rexine cover) Rubber coir, foam, Trolley Pad

			Rubber coir, Rexine Cloth (Baniyan Foam)
6.	Indutech	National Centre for Antarctic and Ocean Research, Goa	Filter Fabric
		Ministry of Road Transport & Highways	Filter Fabric, Hose Pipes
		Hindustan Organic Chemicals Limited- Materials Department	Filter Fabric
		Rashtriya Chemicals and Fertilizers Limited	Filter Fabric, Pipe filters, Conveyor Belts
		IHQ of MoD (Army)	Nylon Filters
		Department of Fertilisers, Vijaipur	Air Filters
		Southeastern Coalfields Limited, Bilaspur	Oil Filters
		Directorate of Purchase and Stores, Maharashtra	Braided Teflon/PTFE Hose Pipes
		THDC India Limited, Rishikesh	CP Hose Pipes
		The Fertilisers and Chemicals Travancore Limited, Kerala	Conveyor Belts
		National Aluminium Company Limited, NALCO, Odisha	Conveyor Belts
		Heavy Vehicle Factory, Chennai	Filter absorbent
		Ordnance Parachute Factory, Kanpur	Webbing nylon
		Material Organisation-Kochi - NAVY	Nylon ropes
		IHQ of MoD (Army)	Twine Jute 3 Ply, Jute Felts
7.	Meditech	All India Institute of Medical Science (AIIMS)	Surgical items
		Armed Forces Medical Supplies and Disposal	Surgical items
		Regional Cancer Centre, Kerala	PPE Kits
		Paradip Port Trust, Medical Department	N95 Masks
		VMMC and Safdarjung Hospital	N95 Masks
		Rajasthan Medical Services Corporation Limited, Jaipur	N95 Masks
		Employees State Insurance Corporation (Kerala)	Nonwoven fabrics, Surgical masks
		Sports Authority of India, CRC Bhopal	Surgical items
		LGB Regional Institute of Mental Health, Assam	Surgical items
		Kolkata Port Trust- Medical Department	Surgical items
		Artificial Limbs Manufacturing Corporation of India	Kneecaps
8.	Mobiltech	Bharat Heavy Electricals Limited	
		Nuclear Power Corporation of India Limited	Tyre
		Bharat Petroleum Corporation Limited	Tyres
		Eastern Coalfields Limited	Tyres
		Directorate General of Civil Aviation	Aircrafts
		Hindustan Aeronautics Limited	Aircrafts
		Metals and Minerals Trading Corporation Limited, Karnataka	Tyres
		South Bengal State Transport Corporation, Durgapur	Tyres
9.	Oekotech	Water Resources Department, Madhya Pradesh	Canal Lining, Dam embankment (protect soil erosion)

		Water Resources, Rajasthan	Canal Lining
		Irrigation Department, Kerala	Canal works
		Inland Waterways Authority of India	Rip - Rap type Bank Protection
		Military Engineer Services, Gujrat	Environmental Park Irrigation System
		West Central Railway	Water Recycling
		Punjab Agro Industries Corporation	Wastewater Recycling
		Farakka Barrage Project - River Development and Ganga Rejuvenation	Deep scoured bed of Feeder Canal
10.	Packtech	Karnataka State Seeds Corporation Limited	Packing Materials like Non-Woven cloth bags, HDPE Bags
		Food Corporation of India	Jute Bags/ Teabags
		Rashtriya Chemicals and Fertilizers Limited	HDPE Bags
		Sardar Vallabhbhai Patel National Police Academy	Jute carry Bags
		Madras Fertilizers Limited	HDPE Bags
		Department of Fertilisers- FCI Aravali Gypsum and Minerals India Ltd, Jodhpur	HDPE Bags
		Indian Institute of Pulses Research-Kanpur	Jute Gunny Bags
		Rajasthan State Mines and Minerals Limited	HDPE Woven Laminated Sacks
11.	Protech	Defence Materials and Stores Research and Development Establishment (DMSRDE)	Bullet Proof Jackets and Bullet Proof Helmets
		Ordnance Clothing Factory, Shahjahanpur	Angola drab poly wool fabric for man's shirt, Fabric for winter suits
		Ordnance Clothing Factory, Avadi	Flame resistant (FR) Fabric
		Ordnance Factory, Dehradun	Jacket and Trousers (Combat PC Disruptive)
		Mangalore Refinery and Petrochemicals Limited	Flame Resistant Fabric
		Integrated Head Quarters of MoD (Navy)	Flame Resistant Fabric, Bullet Proof Jackets and Bullet Proof Helmets
		Defence Bioengineering & Electro Medical Laboratory (DEBEL)	Self-Cleaning and Antimicrobial Fabric
		Indian Coast Guard	Protective clothing
		Proof and Experimental Establishment (DRDO)	Protective clothing
		Rashtriya Chemicals and Fertilizers Limited	Flame Resistant Fabric
		Headquarters, Indian Air Force	Flak Jackets
		Central Industrial Security Force	Bullet Resistant Jackets
		Central Ordnance Depot Kanpur	Military Shoes
		NHPC Limited- RO Jammu-NHPC	Winter Jackets
		NHPC Limited- Subansiri Lower Project	Safety Shoes
12.	Sportech	Sports Authority of India, NERC Imphal	Hockey sticks and balls, Footballs
		Neyveli Lignite Corporation Limited	Fibre Glass Boats

		Aerial Delivery Research and Development Establishment (ADRDE)	Parachutes
		Department of Defence Production	Inflatable Boats
		Directorate of Fisheries	Fibre Reinforced Plastic (FRP) Boats
		Ordnance Equipment Factory	Anti-Skid shoes
		Rashtriya Chemicals and Fertilizers Limited	Windsock cloth and reinforced PVC hoses
		IHQ of MoD (Army)	Avalanche Airbags

Source: Central Public Procurement Portal, Government of India (Compiled by IIT Delhi)

It can be observed from the above discussions that institutional buyers play a significant role in creating a market for technical textiles in India. The directions issued by the Government to make use of technical textile products mandatory for certain applications are important contributors towards market development. More opportunities should be created to enhance the awareness and subsequently the demand of technical textiles products in India. This will expand the market and lead to more consumption of technical textiles products in various areas of application.

6. Investments in Technical Textile Industry of India

Textile sector has witnessed a spurt in investment during the last five years. The industry (including dyed and printed) attracted Foreign Direct Investment (FDI) worth US$ 3.68 billion from April 2000 to December 2020.[1] Government of India has come up with several export promotion policies for the textile sector.

India is working on major initiatives to boost its technical textiles industry. Owing to the pandemic, the demand for technical textiles, mainly masks, PPE suits and pandemic related medical products has been on the rise. Ministry of Textiles, Government of India is supporting the industry through various measures.

Technical textiles are gaining attention because the industry is growing at a brisk rate and offering opportunities for innovation and employment generation. The Textile Ministry considers the sector to be a thrust area for the Government because of the significantly high value addition that takes place in the technical textile value chain. It is important to document and study the recent investments made by domestic and foreign investors in the technical textile industry of India to get an idea of how attractive the industry is for the future growth of the country. It is with this objective that extensive secondary research was carried out and information was mined from the reports published in the last few years in mass media as well as web sites and web portals. The documentation of FDI and domestic investment is presented in the following paragraphs.

6.1 Foreign Direct Investment (FDI)

Policy highlight regarding FDI in textiles

Government of India has allowed 100% FDI under the automatic route in textile industry of India.

Highlights of policies related to domestic investment in technical textiles

At the central level, the main scheme to promote investment is Amended Technology Upgradation Fund Scheme (ATUF) which is aimed at incentivising the entrepreneurs to invest in upgradation of technology. It provides a one-time capital subsidy for 'eligible machinery' for a period of seven years (starting January 13, 2016). The scheme has a total budget provision of Rs. 17,822 Crore for textiles for seven years. Expenditure

[1] Textile Industry & Market Growth in India, India Brand Equity Foundation, 2021

of Rs. 21.03 Crores in 2018-19, Rs. 180.24 Crores in 2019-20 and Rs. 397.28 Crores in 2020-21 (Total for three years is Rs. 598.55 Crores) has been incurred under this scheme in the form of subsidy released to enterprises for technical textiles.

The cap on capital investment subsidy has been increased from Rs. 30 Crores to Rs. 50 Crores. The Government has also invested in developing and implementing online monitoring system (which is known as i-ATUFS for online implementation and monitoring of A-TUFS. A total of 9605 UIDs have been issued under ATUFS for enterprises with total estimated investment in project cost of Rs. 39,826.28 Crores as of January 2020.

There are some state governments in India such as Haryana which offer special benefits to those firms who invest in setting up textile units in their respective states.

6.1.1 Current scenario of FDI in textile industry

1. Cumulative FDI inflows in the textile sector stood at over US$ 3.46 billion between April 2000 and September 2020[2].
2. The top 10 investing countries in Indian textile sector account for approximately 70% of the total FDI inflows. The remaining 30% of the FDI is made by 35 other countries and NRIs.
3. Highest amount of FDI is routed through Mauritius which accounts for one-third of cumulative FDI investment so far. Belgium is ranked second with USA and Singapore ranking third and fourth with a share of 7% and 6% respectively[3].

6.1.2 Recent Foreign Direct Investments in technical textiles industry

1. Toray Industries (India) Private Limited, the Indian subsidiary of Toray Industries Inc., a large Japanese enterprise has set up its new production base in Sri City Special Economic Zone (SEZ) located on the Andhra Pradesh-Tamil Nadu border. It is a leading manufacturer of fibres and textiles, performance chemicals and carbon fibre material and has plans to invest about Rs 1,000 Crores in the unit which is spread over an area of 110 acres. The unit will have two plants – polypropylene (PP) spun bond plant that will produce advanced technical textile material (belonging to Meditech segment) used in diaper manufacturing, and the 'engineered plastics resin compounding' plant that will make raw material for electrical components of automobiles as well as electrical and electronic connectors. As per the company sources, both plants will initially generate 130 direct and 520 indirect jobs and the number of jobs generated will go up during subsequent phases.
2. Ahlstrom-Munksjo Fibercomposites India Pvt. Ltd. has attracted an investment of Rs. 114 Crores between 2014 and 2016.

[2] Indian Textiles and Apparel Industry Analysis, India Brand Equity Foundation, 2021

[3] Foreign Direct Investment Scenario in Indian Textile Sector, Wazir Advisors, 2016

3. Arvind Ltd. made an entry into nonwoven fabrics through Arvind OG Nonwovens Pvt. Ltd., which is a joint venture between Arvind Ltd. and OG Corporation of Japan. It has established its manufacturing facilities near Ahmedabad, Gujarat. Arvind Ltd. holds 74% equity stake in the JV with the remaining 24% coming into India as FDI by OG Corporation. The joint venture (JV) manufactures high quality nonwoven fabrics using needle-punch technology for bag house filtration, artificial leather and a variety of other applications. The unit started production in May 2014 with one line of needle-punching technology. It has an initial investment of nearly Rs. 50 Crores by the two promoter firms and Indian financial institutions.
4. Chiripal Industries Ltd. in collaboration with Tormore Investments Ltd. has generated an inflow of Rs. 42 Crores between 2014 and 2016. Further, collaboration between Chiripal Industries Ltd. and Orange Mauritius Investments Ltd. has generated an FDI inflow of Rs. 48 Crores.
5. Government of Gujarat recently approved five big investment proposals by four firms, who will invest close to Rs. 6,000 Crores in diverse sectors. The companies will set up manufacturing facilities in Dholera and Halol. Baby diaper manufacturing brand Avgol's proposal for setting up a Rs. 1,000 Crore new technical textile plant at Halol has also been approved. Another leading company Trafalgar's Rs. 250 Crore investment proposal has also got the nod of the state government. The company has sought to produce state-of-the-art natural fibre-based industrial sacks, a substitute of plastic.
6. Jayashree Textiles Ltd. announced the launch of its fabric collection made with Sorona®, a sustainable, partially bio-based polymer. It is an outcome of collaboration between Jayashree Textiles Ltd. and DuPont Biomaterials which has materialised in June 2021.[*]
7. The Kakatiya Mega Textile Park in Telangana has been set up with the main objective of providing world-class infrastructure facilities for textile industry. South Korean textile and apparel company, Youngone Corporation, will be investing US$119 million over the next five years, starting 2021.
8. Reliance Industries Ltd (RIL) has tied up with Turkish textile manufacturer Kivanc Tekstil to manufacture and market its sustainable and eco-friendly fabric brand R|Elan's GreenGold fabric in Turkey.[*]

6.2 Major investments by Indian firms in recent past

1. Diversified Welspun Group is investing Rs. 4,000 Crores on three large textile projects in Gujarat. The group is investing Rs. 2,000 Crores in setting up an integrated textile manufacturing zone. It is investing Rs. 1,000 Crores on capacity enhancement of its technical textile business, while a similar amount has been earmarked for its advanced textile arm that makes specialised materials for aerospace, defence and automobiles.
2. Welspun India has also established a new facility in Anjar, Gujarat, which has been built with an investment of Rs. 150 Crores. The facility has capabilities of spun lace and needle punch lines that can manufacture multilayer composites for various applications. The initial capacity of the manufacturing unit is 2,400 MT per annum. Products produced at this unit provide nonwoven solutions for high-end industrial

applications such as filtration, acoustics, automotive, fire safety, thermal insulation, vibration control, aero-space, defence, and mass transportation.

3. Reliance Industries Ltd. (RIL) has entered into a partnership with Vardhman Textiles Ltd., one of the largest textile companies in India, to manufacture Innovative R|Elan Fabric in 2020.*
4. Ahmedabad-based Rudrax Industries is the first Indian company that has started manufacturing chemical bonded nonwoven machinery which is used to produce nonwoven interlinings. Rudrax is setting up a bigger production facility and plans to produce Thermobond nonwoven machines from next year.*
5. Strata Geosystems India Pvt. Ltd. has partnered with a 140-year-old textile veteran in the US, Glen Raven Inc. in 2019 to set up a plant to provide the highest quality of Geosynthetics and civil engineering solutions. This new facility is the largest geogrid plant in India and provides high capacity to cater to India's demand while continuing to strengthen international markets.*
6. Garware Technical Fibres Ltd. has in the recent past established an aerostat envelope production facility with Aero-T from Israel providing the technology, know-how, integration, acceptance and continuous support for aerostats development and production. Simultaneously, there has been collaboration with Indian R&D establishments, such as DRDO/ADRDE and the end customers to understand their needs and co-develop customised solutions.*
7. Sidwin Fabric Pvt. Ltd. has increased its capacity in 2019 by investing Rs. 10 Crores.
8. Manas Geo Tech India Pvt. Ltd. is in the process of setting up a new plant for PVC geo membrane extrusion in Bawal, Haryana. The new plant will have a production capacity of about 5,000 tonnes annually and by July 2021 the plant would be ready.*
9. In 2019, Geo Source invested in a drainage composite line to provide a composite product called GS Drain, which solves major drainage problems in re-wall construction, railway tunnels and landfill sites. Geo Source is planning to start a new nonwoven production line that will require installing a small fibre line for its own consumption. The plan is to set this up by 2024.*
10. Kusumgar Corporates has entered into an agreement in 2020 with Thai Acrylic Fibre Co Ltd (TAF) of Aditya Birla Group to manufacture outdoor fabrics in India with Durashine fibre. Durashine is a superior quality solution dyed acrylic fibre from TAF and is suitable for various outdoor applications.*
11. A.T.E. has entered into a partnership with W+D BICMA Hygiene Technologie GmbH, Germany to help the domestic textile industry to cater to the rising demand for medical and hygiene textiles. The tie-up between A.T.E. and W+D BICMA will help the Indian textile industry expand its product offerings and capture a fair market share in the growing medical and hygiene textile market.*
12. Supreme Nonwovens Group, through its majority-owned Thailand subsidiary Supreme Feltol Thailand Co, has announced the acquisition of automotive interior trims and NVH business of Futuris Automotive. Futuris is a subsidiary of Adient Plc, USA. Supreme Feltol Thailand Co is a JV between Supreme Treon and Feltol Thailand Manufacturing Company.*
13. Supreme Group is taking 100% ownership of Supreme-Treves, which was established in 1996 as a joint venture between Supreme Nonwovens and Trèves of France, a Tier 1 system supplier of automotive interior trim and noise, vibration and harshness (NVH) components.*

6.3 Initiatives taken by the Government of India

1. Under Union Budget 2020-21, a National Technical Textiles Mission (NTTM) was proposed for a period from 2020-21 to 2023-24 at an estimated outlay of Rs. 1,480 Crores.
2. Under the Scheme for Integrated Textile Parks (SITP), 5 technical textile parks were sanctioned with the budgeted outlay of Rs. 200 Crores.
3. Under the Technology Mission of Technical Textiles, 11 Focus Incubation Centres (FICs) have been set up to help budding entrepreneurs develop innovative technical textile products. An investment worth Rs. 59.35 Crores has been made for the same.
4. In Union Budget 2020-21, the Government of India has allocated around Rs. 3,515 Crore to the Ministry of Textiles and Rs. 80 Crores for the scheme on Integrated Textile Parks.
5. The Government of India has launched Production Linked Incentive (PLI) scheme to provide incentives for manufacture and exports of specific textile products made of manmade fibre. Under the scheme, the government has approved Rs. 10,683 Crores for manmade fibre and technical textiles manufacturing.
6. The Government of India has also launched Amended Technology Up-gradation Fund Scheme (A-TUFS), estimated to create employment for 35 lakh people and enable investment worth Rs. 95,000 Crores by 2022. In Union Budget 2020-21, the Government has allocated Rs. 761.90 Crores for Amended Technology Upgradation Fund Scheme (A-TUFS).
7. On January 27, 2021, the Textiles Committee, Ministry of Textiles, India signed an MoU with the Nissenken Quality Evaluation Center, Japan to provide required support to each other's textile industries and improve trade between the two countries. The main objective of this MoU was to ensure that Japanese buyers are guaranteed quality Indian textiles through a testing and conformity assessment, research and development (R&D), and consultancy. Both countries have agreed to share and exchange relevant technical information on a regular basis, put in place standards and quality assurance norms.[*]
8. In 2018, a budget of Rs. 25 Lakhs was allocated by the Tamil Nadu Government (India) to promote technical textiles.

[*]Data on amount of investment is not available in the public domain

7. Employment potential of Technical Textiles in India

7.1 Employment scenario in technical textiles

India's textiles and apparel industry that contributes 2.3 percent to the country's GDP, is responsible for 13 percent of industrial production and 12 percent of export earnings. It is the second largest employer in the country and provides employment to about 45 million people. This figure is likely to have touched 55 million by the end of 2020.

The Indian technical textile industry is estimated to employ about 12 lakh people directly and 3 to 4 times indirectly in 2019-20. Even though the employment figures are not accurately available, a fairly safe and conservative estimate of the numbers can be arrived at on the basis of 9.89 lakh direct employees of technical textile industry in year 2012-13 that was stated in the 'Baseline survey of the Technical Textile industry in India (2016)', commissioned by the Ministry of Textiles, Government of India. This survey also states that the technical textile industry witnessed steady growth in employment at a rate of 3% per annum during the previous five years. It had also projected that the growth of man-power employed in technical textile sector would continue to be 3% and was expected to reach 10.80 lakh by 2015-16.

Since then, we have witnessed an uptick in investments as well as a step up in growth of technical textiles on the back of a slew of policy measures introduced by the government and a rapid increase in the variety and number of applications that technical textiles have been put to. The industry has experienced a CAGR of 12 percent in the last five years, a faster growth than in any years prior to that. It is reasonable to assume that with a CAGR of 12 percent, direct employment would have continued to grow at the rate of at least 3 percent per year. If that be so, then the direct employment in 2019-20 is expected to be around 12.16 lakhs.

Table 7.1: Estimated employment in India's technical textile industry

Financial Year	Employment (Persons in lakhs)
2015-16	10.80
2016-17	11.12
2018-19	11.80
2019-20	12.16

Source: IIT Delhi Analysis

As per the Baseline survey (2016), skilled manpower comprises approximately 43% of the total manpower employed in Indian technical textile industry. The primary survey of product manufacturing enterprises carried out by IIT Delhi as part of the present Baseline Survey (2020) has yielded that skilled manpower constitutes 51% of the manpower employed in the industry. It establishes that technical textiles is a specialised field and therefore, as in the past, the skilled workforce will continue to form a significant part of total workforce. The recent survey of sample firms as part of the present study indicates that the overall growth in employment in India has been at a rate of 7%. The deployment of skilled workforce increased at the rate of 5 percent annually, that of semi-skilled workers increased at 12 percent per year and of unskilled workers at 8.5 percent in recent years. The semi-skilled workforce is around 21 percent and unskilled workforce 28 percent of the total workforce. 37 percent of the surveyed firms reported having employees who had undergone formal textile education.

Converter industries such as those in Packtech segment are characterised by requirement of an additional workforce that is involved in converting the technical textile into final products. Even though the exact census of such workforce is not available, anecdotal accounts of industry professionals peg the number of people involved in convertor industries at around 1.75 Lakh. Some technical textile material that such converter industries make are Jute and hessian bags, FIBC bags, Canvas tarpaulins, HDPE tarpaulins, and so on. The converter industry does the fabrication and stitching from the specified technical textile fabric.

7.2 Employment outlook in Technical Textiles

Government of India and the governments of various states have introduced several new and unique policy measures, guidelines and incentives to spur the growth of Technical Textile industry to a level that is significantly higher than in the past. Some of these schemes and initiatives that will add to the growth in employment are as follows:

1. Scheme for Integrated Textile Parks (SITP): Under the Scheme of Integrated Textile Park (SITP), Government provides 40% subsidy with a ceiling of Rs. 40 Crores to set up Textile Parks for infrastructure creation and employment generation. There are 56 textiles parks which have been sanctioned and are being implemented. Once these become fully operational, the above parks are expected to house 5,333 textile units and generate employment for about 3,44,443 persons and attract investment of over Rs. 26,529 Crores. An amount of Rs. 1,398.98 Crores has been released under SITP in these 56 textile parks. So far, 23 textile parks are complete as per scheme guidelines. Also, the Government of India has approved a scheme for setting up Mega Investment Textiles Parks (MITRA) over the next three years to give domestic manufacturers a level-playing field in the international textiles market. Based on the figures available from existing and upcoming parks, an investment of Rs. 800-900 Crores generates an approximate employment for 10,000-12,000 people. There are two textile parks associated with technical textiles that are partly operational (Mundra SEZ Textile & Apparel Park Limited and and Vraj Integrated Textile Park Limited). It is expected that these will provide employment to around 20,000 people once these are fully operational as per plan.

2. Amended Technology Upgradation Fund Scheme for textiles industry (ATUFS): A budget provision of Rs. 17,822 Crores has been approved for seven years from 2015-16 to 2021-22 to meet the committed liabilities of Rs. 12,671 Crores, and Rs. 5,151 Crores for new cases registered under ATUFS. The scheme is likely to attract an investment of Rs. 100,000 Crores and create more than 35 lakh jobs signifying that Rs. 2.86 Lakhs worth of new investment is required per generated job

through this scheme. As per the Annual Report of the Ministry of Textiles (2020-21), for the entire textile industry, 11107 UIDs have been issued with project cost of Rs. 46,860.70 Crores and provisional subsidy value of Rs. 3,378.06 Crores committed till 25.03.2021. Progress of ATUFS as regards only the technical textiles is given as under:

Table 7.2: Progress of ATUFS as regards technical textiles

S. No.	Segment Name	No. of UID Issued	Project Cost (Rs. Crores)	Subsidy Amount (Rs. Crores)	Employment		
					New	Existing	Total
1	Technical Textiles (15% subsidy)	403	2669.83	246.08	6221	20315	26536

(Source: Annual Report 2020-21, Ministry of Textiles, Government of India)

New employment for 26,536 people has been generated just on account of the impact of ATUFS.

3. Samarth (Scheme for capacity building in textile sector): The scheme had an estimated budget of Rs. 1,300 Crores and aimed to train 10 lakh persons over a period of 3 years (2017-20). This scheme has tried to address the shortage of skilled manpower in textile sector, including technical textiles. Figures for technical textiles are not available separately.

4. National Technical Textiles Mission (NTTM): This is the most important, exclusive and ambitious scheme till date and it aims to position the country as a global leader in technical textiles market. Its aim is to take domestic market size of technical textiles industry to US$ 40-50 Billion by the year 2024 with an average growth rate of 15-20% per annum. The multipronged approach that is being envisaged in NTTM is meant to give a major boost to employment generation. The Mission will have four components including research, innovation and development with an outlay of Rs. 1,480 Crores; promotion and market development; export promotion; education, training and skill development. The Mission will promote technical education at higher engineering and technology levels related to technical textiles and its application areas covering engineering, medical, agriculture, aquaculture and dairy segments. Arrangements have been made under the Mission for skill development of 50,000 people in the field of technical textiles.

Considering the recent thrust being given to technical textiles, it will not be unreasonable to assume that a growth rate of 4 percent can be safely assumed for projection of employment generation from 2019-20 onwards and upto the year 2024-25. Based on those projections, the employment in technical textiles is likely to be as shown in the following table:

Table 7.3: Projected employment in India's technical textile industry	
Financial Year	**Employment (Persons in lakhs)**
2019-20	12.16
2020-21	12.64
2021-22	13.14
2022-23	13.67
2023-24	14.22
2024-25	14.78

Source: IIT Delhi Analysis

The employment in India's technical textiles industry is projected at 14.78 lakh persons by 2024-25.

7.3 Educational qualifications and skills required for jobs in technical textiles

A study was carried out regarding the jobs that have been advertised in the media over the past two years. The following table shows the various jobs that have been advertised in the technical textiles industry. These jobs range from junior to senior positions and as can be seen from the table, each role requires different levels of technical knowledge and educational qualification.

Table 7.4: Educational qualification and skills required for various jobs under technical textiles

S. No.	Job Title/Designation	Educational qualification Required	Work experience desired	Skills required and tasks performed
1.	Machine operators and machine helpers	No requirement specified	Prior work experience in operating textile machines or assisting the operators of textile machines in textile manufacturing units is essential	- Must have sound skills of working on and routine maintenance of textile machine(s) - Should have a good understanding of the varying quality of output that can be produced by textile machines being used in India - Must have an aptitude to learn, absorb and utilise the different capabilities of the machines - Should be able to handle basic maintenance of the machinery - As a helper, the person should be able to assess the requirement of consumables and maintain the stock of the same. Basic skills for maintaining machines as well as assisting the operator in record keeping is essential
2.	Floor managers and	Bachelor's degree in any	Relevant and	- Ability to communicate well with

	supervisors	field is desirable but is not essential. Person(s) with relevant experience in textile industry may be considered without a degree.	adequate experience in textile engineering/ technology is essential	the factory labour - Ability to ensure machine and worker efficiency on the manufacturing floor - Ability to build and implement work roster for workers for daily shifts - Ability to ensure that orders are completed on time
3.	General managers, plant managers, and production managers	Bachelor's degree in any discipline is acceptable, however, a degree in a technical discipline is preferred. A diploma in textile technology and textile engineering is desirable for some of the positions	Prior, extensive experience of handling middle/senior management responsibility in textile industry is essential	- Ability to coordinate with all the floor managers/supervisors to ensure smooth functioning at the production facility/factory - Ability to coordinate with various departments such as production, quality control and research and development - Ability to ensure that the production process is efficient - Ability to ensure timely completion of orders - Ability to handle responsibility for the upkeep of infrastructure and machinery - Ability to ensure that products meet the quality standards and are consistent
4.	Vice-Presidents, senior consultants, and expert advisors	Bachelor's Degree in a relevant discipline depending upon the line of products being manufactured by the company. The degrees specified include Textile Technology, Electrical Engineering, Chemical Engineering/Processing, Mechanical Engineering, Quality Assurance, Quality Control etc. In some cases, a Master's degree in the relevant field or MBA is also specified as a requirement for such jobs	Prior and relevant experience in textile industry is essential for each of the roles at this level	- Ability to provide technical advice, inputs to design, production processes and marketing strategies - Ability to coordinate with several manufacturing units and ensuring quality standards - Ability to ensure that products meet all the requirements and specifications - Must provide technical training to other employees - Should be able to fine tune the production process(es) in the manufacturing units under their charge - Ability to enhance the supply chain - Ability to maintain the public relations of the firm - Act as a bridge between workers and the management of the firm - Should be able to develop and expand the business of the firm by adding more customers or adding

				more sales to existing customers
5.	Research and Development (Textile Research Associations and Centres of Excellence)	Bachelor's and Master's degree is required. Doctoral degree is desirable for many positions		- Should have thorough understanding of Material Testing Methods and Standards - Ability to help in product, method development and trouble shooting - Understand customer expectations and develop appropriate products and services - Should have experience of textile processing, ability to carry out defect analysis, root cause analysis and suggest solutions - Should be able to carry out process audit and suggest process improvements, support implementation of Quality Management Systems / certifications, chemical testing, waste water treatment - Experience in technical textile product development and production activities

7.4 Frequent recruiters in technical textiles

Reliable and accurate information about names of such firms which recruit frequently is important to know for all those studying employment in technical textiles industry of India. Therefore, the advertisements placed by firms for recruitment of professionals specialising in technical textiles were scanned and identified from three major internet-based job portals viz. Naukri.com, Monster.com and Timesjobs.com. In addition to this, the websites and media reports associated with colleges and polytechnics that offer diploma courses in textiles were studied carefully and a consolidated list of firms which were reportedly hiring diploma holders from such institutions was prepared. The information about job openings posted by firms of technical textile industry on two other websites viz. Local Walkins and Work India were also studied. The names of the organisations which recruit professionals frequently for their technical textiles operations are as follows:

- Supreme Nonwoven Industries Pvt. Ltd. as well as other firms of 'Supreme Group'
- Century Enka Ltd.
- Techfab India Industries Ltd
- SRF Ltd.
- Bombay Dyeing Ltd.
- Arvind Ltd. as well as other firms of Arvind group
- Welspun India Ltd. as well as other firms of Welspun Group
- Alok Industries Ltd.
- Premier Mills Pvt. Ltd. as well as other firms of Premier Mills Group

7.5 Major concerns related to employment in technical textiles

The industry faces shortage of skilled man-power. The major concerns pertaining to manpower are as follows:

1. Lack of adequate seats at ITIs and Polytechnics related to textile technology, leave alone technical textiles: Technical textiles industry needs skilled workers for many of its common operations such as coating of fabrics, different stages in the production of nonwovens and working on composites, etc. At present, the institutes offering courses in the textile stream do not provide specific training and education that is required for technical textile industry. Enterprises have to invest considerable amount and effort in providing on-the-job training or develop in-house training courses so as to equip the employees with basic essential level in technical textiles.

2. High attrition: Industry faces lack of skilled employees especially because of frequent advancements in technologies. This makes it essential that engineers and technologists working in the industry stay in the industry and upgrade their skills and knowledge. However, it is observed that engineers and technologists who were formally educated for career in textiles, often leave for careers in IT services, data analysis and business management, due to inability of the industry to pay adequate compensation which is needed to retain such talent.

8. Major Firms of Indian Technical Textile Industry

8.1 Arvind Limited

8.1.1 Company snapshot

Information	Description
Year of Incorporation	1931
Key Executive (s) & Designation	Aamir Akhtar (CEO, Lifestyle Fabrics – Denim), Susheel Kaul (CEO, Lifestyle Fabrics – Knits & Wovens), Mr. Ashish Kumar (CEO, Arvind Advanced Materials and Arvind Envisol), Kamal Singal (MD & CEO, Arvind SmartSpaces Ltd.), J. Suresh (MD & CEO, Arvind Fashions), Rishi Roop Kapoor (CEO, Anup Engineering), Dinesh Yadav (CEO, New Businesses), Shailesh Chaturvedi (MD & CEO, Tommy Hilfiger Apparels India), Vipen Malhotra (President & CEO, Arvind Ltd.), Brijesh Bhatti (CEO, Ankur Textiles)
Primary business	Fabric and Apparel, Brands & Retail, Advanced Materials, Telecom, Real Estate, Engineering, Environmental Solutions, & Internet
Geographical Presence	Manufacturing facilities in Gujarat, Maharashtra and Karnataka Offices across India and Abroad Global exports
Number of Employees	Total 42000 across verticals (3000 in Advanced Materials Division)
R&D expenditure during 2020	Rs. 33.27 Crores (Overall for Arvind Limited)

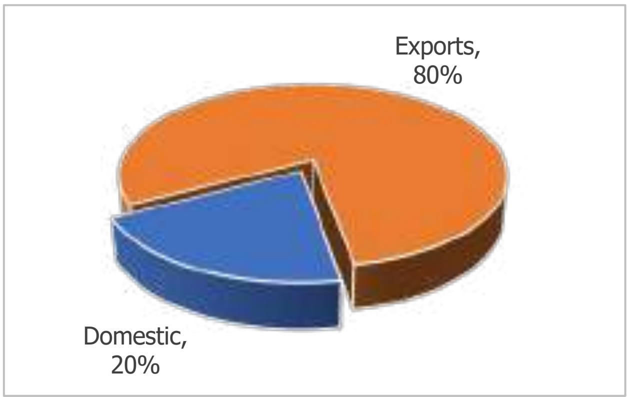
8.1.2 Operating business segments

Information	Description
Advanced Materials Division (AMD)	Arvind Advanced Materials is an endeavour to branch out into other areas of material science which use textiles as a backbone. Focus is on new fibres, new technology, and new products to solve the problems of infrastructure, healthcare, energy, and industrial applications. The product range comprises different kinds of Filter Fabrics, Belting Fabrics, Coated Fabrics, Nonwoven Fabrics, Filter Bags, Protective Fabrics and Garments, FFP2 mask, Coverall for PPE, Glass and composites.
Fabric and Apparel	Arvind supplies fabric for many high-fashion brands across the world. It has started amalgamation of wearable tech with its Fabrics. It has increased the use of Better Cotton Initiative (BCI) and other sustainable yarns. It is making denim, woven, knits and voiles Fabrics and garments.
Brands & Retail	Arvind Lifestyle Brands Limited retails a range of global fashion brands to the country across categories. Some of the brands are ARROW, SEPHORA, IZOD, TRUE BLUE, TOMMY HILFIGER.

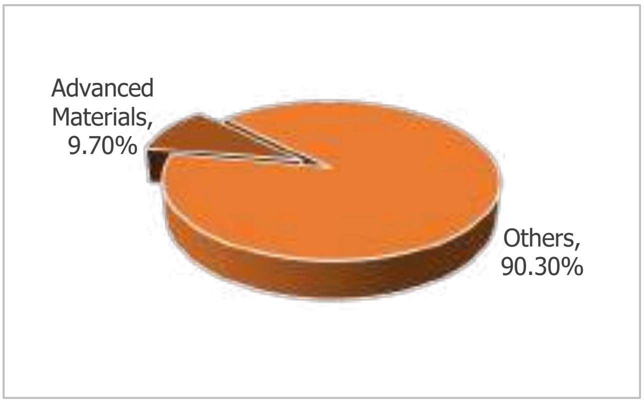
8.1.3 Technical Textiles product portfolio

Segment	Brand/Product
Agrotech	Agro Nets
Buildtech	Coated Fabric for Tarpaulins, Hoardings & Signage, Modern construction roof and structural material for construction using composite material
Clothtech	Sewing threads and nonwoven interlinings
Geotech	Geogrids
Hometech	Window Blinds
Indutech	Filtration Fabrics, Belting Fabrics and Composites
Meditech	Surgical Cotton, Laboratory Coats
Mobitech	Seat Cover Fabrics
Oekotech	Filter Bags
Packtech	Luggage Fabrics
Protech	Fire Retardant Fabrics and garments, and FFP2 Masks, Coveralls for PPE, High Altitude Clothing, Chemical Protective Clothing, High Visible Clothes & Industrial Gloves etc.
Sportech	Badminton Racquet, Tennis Racquet, Hockey stick etc.

8.1.4 Sources of revenue share (2020)



8.1.5 Revenue share by segment (2020)



8.1.6 Business performance of technical textiles in last three years (Rs. Crores)

Business Performance Outcomes	2018	2019	2020
Net Sales	630.00	715.00	679.00
Net Profit	Information not available		
Operating Profit	65.00	91.00	98.00
Return on Capital employed	9.9%	10.2%	8.8%

8.1.7 Key strategic moves and developments related to Technical Textiles

Year	Strategy	Description
2019-21	Product innovations & development	Carbon fibre moulded sports goods like tennis rackets, badminton rackets, hockey sticks
		Continuous lamination driven Fibre Glass Reinforced sheets
		Thin-wall pultrusion Radomes, heavy FRP decks, epoxy resin products
		Belting products based on new blends like cotton nylon, aramids, leno etc.
		High temperature nonwoven filter products based on Meta Aramids
		Viscose felt for biodegradable packing
		Expanded range of human protection products such as electric arc protection, molten metal protection, high visibility protection clothing
	Product innovations & development at Human Protection division	Expanded range of human protection products such as electric arc protection, molten metal protection - Aluminium & Iron (D3/E3 protection), Extreme cold weather clothing (designed for minus 50ºC), Sleeping bags for protection against extreme cold (upto minus 50ºC), NBC (Nuclear biological chemical) suit and high visibility protection clothing

8.1.8 Company overview

Arvind Limited, founded in 1931, is the flagship company of a US$ 1.5 billion-dollar conglomerate. It is among the global leaders in apparel manufacturing and is also transforming water management through its subsidiary Arvind Envisiol which provides end-to-end solutions for water & wastewater treatment, desalination & zero liquid discharge. The company sources state that Arvind Limited is an innovator in advanced materials and a wearable technology manufacturer that is also delivering state-of-the-art engineering solutions. Arvind owns 22 global patents for environmental solutions, and is the largest fire protection fabric producer in the country.

8.1.9 Contact information

Name of company: Arvind Limited

Address: Naroda Road, Near Chamunda Bridge, Ahmedabad-380025, Gujarat, India

Telephone: +91-79-68268000

Email: info@arvind.in

8.2 BMD Private Limited

8.2.1 Company snapshot

Information	Description
Year of Incorporation	1996
Key Executive (s) & Designation	Ravi Jhunjhunwala (Director), Shekhar Agarwal (Chairman), Shantanu Agarwal (Managing Director)
Primary business	Manufacturing of Fabric
Geographical Presence	Manufacturing facilities in Rajasthan and Gujarat Offices across India Exports to ~75 countries
Number of Employees	800
R&D expenditure during 2020	Rs. 5 Crores

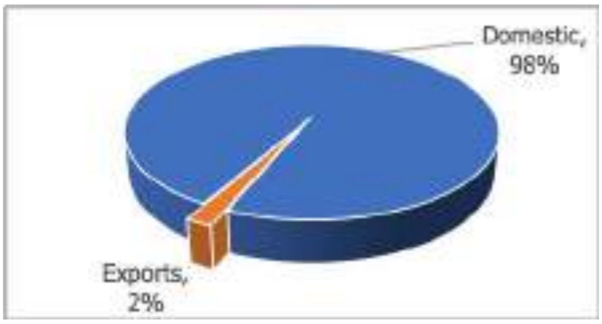
8.2.2 Operating business segments

Information	Description
Automotive Furnishing - Woven Fabrics	Flat Woven – Dobby, Jacquard, Pile Woven – Dobby
Automotive Furnishing - Knitted Fabrics	Warp Knits and Circular Knit types; Flat, Pile and Spacer Fabrics in the Warp Knits category, Flat Jacquard and Pile Jacquard in the circular knits
Office Furnishing Fabric	Woven and Knitted Fabrics for use in office furnishing
Flame-Retardant Textiles	Meta-Aramid, Modacrylic and Cotton based Flame-Retardant textiles for use in industrial workwear

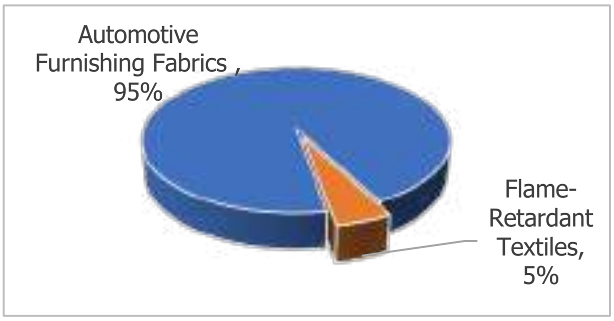
8.2.3 Technical Textiles product portfolio

Segment	Brand/Product
Mobitech	Automotive Furnishing Fabrics
Protech	Flame-Retardant Textiles for Workwear

8.2.4 Sources of revenue share (2020)



8.2.5 Revenue share by segment (2020)



8.2.6 Business performance of technical textiles in last three years (Rs. Crores)

Business Performance Outcomes	2018	2019	2020
Net Sales	279.60	197.91	179.45
Net Profit	10.96	-3.72	3.85
Operating Profit	41.94	32.52	39.87
Return on Capital employed	13.12%	10.58%	13.04%

8.2.7 Key strategic moves and developments related to Technical Textiles

Year	Strategy	Description
1997	New product manufacturing	Started production through process of Weaving Warp Knitting and Tricot Yarn Manufacturing Processing & Lamination
	Automotive Furnishing Fabrics	Launched the company to cater to the automotive furnishing fabric requirements of the domestic market in a JV between the Bhilwara Group and Melba of Australia and DeWitte Lietaer of Belgium
	Promoted as a JV for manufacture of automotive fabric	LNJ Bhilwara Group 50%, Melba Ind Australia 25% and DE Witte Belgium 25%
	New product manufacturing	Started production through process of Weaving Warp Knitting and Tricot Yarn Manufacturing Processing & Lamination
2003	New product manufacturing	Started facility of Circular Knitting
2004	New development	Roller Embossing
2005	Collaboration	Technical collaboration with Kawashima Japan & Michel Thierry
2008		Technical collaboration with Serien Japan
2009		Technical collaboration with Borgstena Group, Portugal Improved the quality and focus on costs and also started Plate Embossing, Laser cutting, Welding dope dyed yarn
2020	Flame-Retardant Fabrics for Workwear	Developed and launched a complete line of Flame Retardant textiles for workwear

8.2.8 Company overview

BMD Private Limited was founded in 1997 and is among the large manufacturers of automotive furnishing fabrics in India. BMD's products are used as fabric for seating and door trims for automobiles. Special fabrics manufactured by BMD are also used in aircrafts, ships and auditoriums. It is a TS 16949 certified company; BMD is a supplier to most of the renowned names in automotive industry. It is a part of the LNJ Bhilwara Group, a billion-dollar conglomerate with significant presence in Textiles, Graphite Electrodes and Power generation.

8.2.9 Contact information

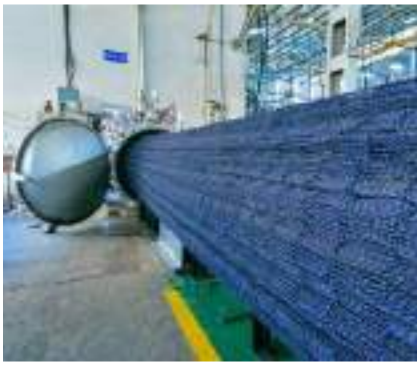
Name of company: BMD Private Limited

Address: Bhilwara Towers, A-12, Sector 1, Noida- 201301 (NCR Delhi), India

Telephone: +91-120-4390300

Email: bmd@lnjb.com

8.3 Garware Technical Fibres Limited


8.3.1 Company snapshot

Information	Description
Year of Incorporation	1976
Key Executive (s) & Designation	Vayu R Garware (Chairman & Managing Director)
Primary business	Technical Textiles
Geographical Presence	Manufacturing facilities in Gujarat and Maharashtra Offices across India and in USA, UK, Canada, Australia, Chile and Norway Exports to ~75 countries
Number of Employees	1198 (Including apprentices and probationers)
R&D expenditure during 2020	Revenue Expenditure - Rs. 11.56 Crores and Capital Expenditure - Rs. 1.06 Crores

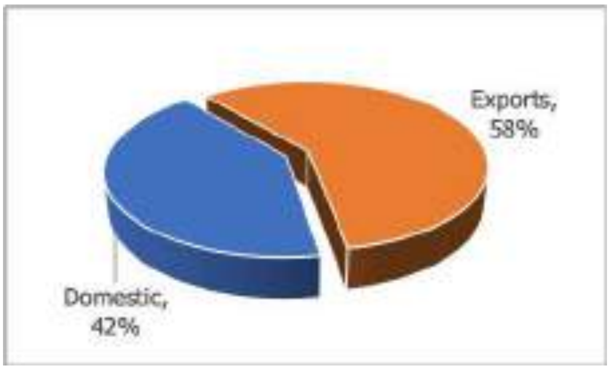
8.3.2 Operating business segments

Information	Description
Fisheries	Fully assembled Trawls, Purse Seine Nets, Gill Nets, Dole Nets, Pelagic Nets, Ropes & Twines
Aquaculture	Cage Nets, Predator protection Nets, Anti Bird Nets, Mooring System, Sea Lice Solutions
Shipping & IPD	8 Strand Shipping Ropes, 3 Strand Industrial Ropes, Specialty Ropes, 12 Strand Ropes, Safety Nets, Cargo Nets, Braided Ropes, Rope Articles, UHMPE Ropes
Sports	Tennis Nets, Volley Ball Nets, Basket Ball Nets, Ski Nets, Cricket Nets, Badminton Nets, Golf Practice Nets, Soccer Nets, Batting Cages, Handball Nets
Agriculture	Shade Nets, Insect Nets, seed production cages, Anti Hail, Nets, Anti Bird Nets, Crop Support Nets, Staking Cords
Safety	Safety Nets, Harnesses, Lifting slings, Ropes, Gloves Safety PPE &Fall Protection, Anti bird Nets
Coated Fabrics	Truck PVC Tarpaulins, Pandal Tarpaulins, Awnings, Auto hoods, Bouncies, Bio Gas Balloons, Bio-Flock, Tank Covers, Inflatables, Transport Ropes, Pandal ropes
Defence	Aerostat Balloon, Radome, Ropes, Camouflage Nets, Air Inflatable Tents, Deployable Tents, Mosquito Nets, Recovery Ropes, UHMPE Ropes, Cordages, etc.

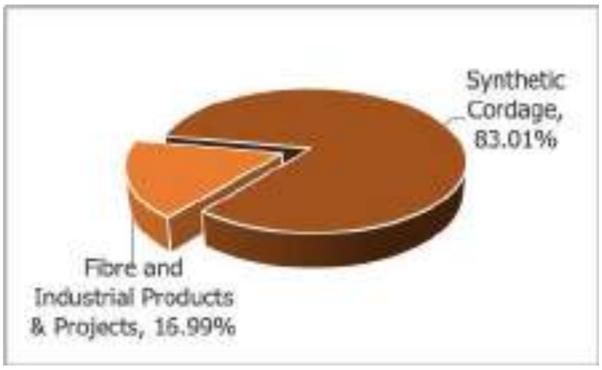
8.3.3 Technical Textiles product portfolio

Segment	Brand/Product
Agrotech	Shade Nets, Insect Nets, Seed production Cages, Anti Hail Nets, Anti Bird Nets, Crop Support Nets, Staking Cords, Fully assembled Trawls, Purse Seine Nets, Gill Nets, Dole Nets, Pelagic Nets, Ropes & Twines
Buildtech	Safety Nets, Harnesses, Lifting Slings
Geotech	Geo Fabrics, Mulch Mats, Boulder Protection Nets, Landfill liners / Fabrics, Polymer and Steel Gabions for Shore Protection etc.
Hometech	Industrial Ropes, Mooring Ropes for Shipping, High Tenacity Poly Propylene
Indutech	Multifilament Yarn, Twine, Stitching Thread, Transport Ropes
Oekotech	Landfill Solutions
Packtech	Stitching Threads
Protech	Tarpaulins, Truck Covers, Bio Gas Balloons, Camouflage Nets
Sportech	Cricket Nets, Soccer Nets, Volley Ball Net, Tennis Nets, Golf Nets etc. - all types of Sports Nets and accessories

8.3.4 Sources of revenue share (2020)



8.3.5 Revenue share by segment (2020)



8.3.6 Business performance of technical textiles in last three years (Rs. Crores)

Business performance outcomes	2018	2019	2020
Net Sales	885.50	1017.82	944.72
Net Profit	105.12	125.61	178.01
Operating Profit	135.16	161.02	147.07
Return on Capital employed	23.80%	25.35%	25.75%

8.3.7 Key strategic moves and developments related to Technical Textiles

Year	Strategy	Description
2020-21	Application focused Solution Strategy	The company has developed a special strategy wherein the pain points of the end users are assessed during interaction and the company develops differentiated effective product(s) as part of the solution

8.3.8 Company overview

Garware Technical Fibres Limited (Formerly Garware-Wall Ropes Limited) is one of India’s leading players in the technical textile sector. Established in 1976, the company today is a multi- divisional, multi-geographical technical textiles company and is known for providing world class innovative solutions in high performance aquaculture Cage Nets, Fishing Nets, Sports Nets, Safety Nets, Agricultural Nets, Coated Fabrics, Polymer ropes and Geosynthetics. A thrust on international business over the years has seen Garware Technical Fibres’ global footprint growing steadily. Garware Technical Fibres has global presence by way of subsidiaries in USA & Chile and Overseas Representative offices in key cities close to its customers in over 75 countries. The Company's products are manufactured in state-of-art facilities at Wai and Pune (both in Maharashtra, India).

8.3.9 Contact information

Name of the Company: Garware Technical Fibres Limited (Formerly Garware-Wall Ropes Limited)

Address: Plot No 11, Block D1,M.I.D.C, Chinchwad, Pune – 411019, Maharashtra, India

Telephone: +91-20-27990301, 27990306

Email: sales@garwarefibres.com/ srao@garwarefibres.com

8.4 Kusumgar Corporates Private Limited



8.4.1 Company snapshot

Information	Description
Year of Incorporation	1970
Key Executive (s) & Designation	Yogesh Kantilal Kusumgar (Director), Siddharth Yogesh Kusumgar (Director), Kiran Nagindas Shah (Director), Ankur Kothari (CEO)
Primary business	KCPL manufactures technical textiles, including Parachute Fabric, Aeronautical and Ballistic Fabric, Military and PPE Kits, Outdoor Fabrics, Industrial Fabrics, Workwear, Rucksack, Luggage and Automotive Fabric
Geographical Presence	Manufacturing facilities in Gujarat Offices across Gujarat and Maharashtra Exports to USA and EU
Number of Employees	Approximately 250 employees
R&D expenditure during 2020	Rs. 10.4 Crores

8.4.2 Operating Business Segments

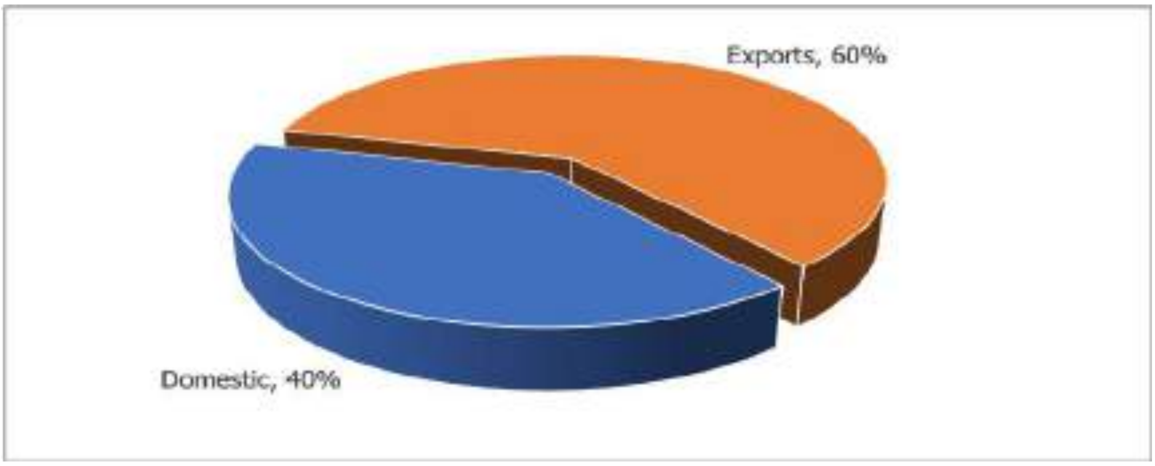
Information	Description
Wearables	Military Fabrics, Outdoor Fabrics, Workwear Fabrics, Automotive Fabrics, Medical Fabrics, Custom Fabrics
Non- wearables	Aeronautical Fabrics, Industrial Fabrics

8.4.3 Technical Textiles product portfolio

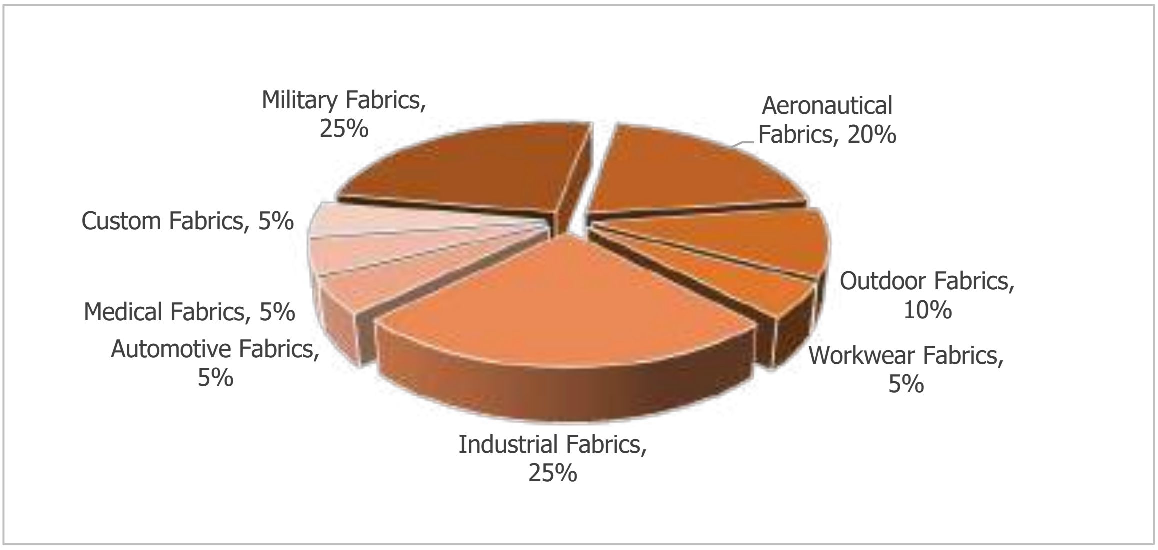
Segment	Brand/Product
Clothtech	Military Fabrics Workwear Uniforms High Altitude Clothing NBC Clothing Tactical Vests
Hometech	Outdoor Fabrics with TAF's Durashine (acrylic based)

Indutech	Textile Tapes Peel ply Fabrics Belting Fabrics Hydraulic and Silicone Hoses Liner Fabrics Automotive Hoses
Meditech	Medicated Dressings Surgical Tapes Blood Pressure Cuffs Fabrics for Stretchers Inflatable Mattresses / Pillows
Protech	Ballistic Fabrics Workwear
Sportech	Active wear Backpack High Altitude Clothing

8.4.4 Sources of revenue share (2020)



8.4.5 Revenue share by segment (2020)



8.4.6 Business performance of technical textiles in last three years (Rs. Crores)

Business performance outcomes	2018	2019	2020
Net Sales	132.92	128.81	181.19
Net Profit	10.46	6.6	13.06
Operating Profit	19.28	12.63	21.81
Return on Capital employed	12.3%	6.67%	14.6

8.4.7 Key strategic moves and developments related to Technical Textiles

Year	Strategy	Description
2019-20	More focus on export opportunities	Industrial segment, medical textile, performance fabrics.
2020-21	Booming sector, need of textiles beyond apparel and functional advantage of textiles in technologies.	PPE kit, Advance high performance fabric, speciality products for military use

8.4.8 Company overview

Kusumgar Corporates Private Limited is one of the leaders in the highly niche technical and specialised textiles sphere. According to the company sources, it is its ability to offer customized solutions coupled with world-class quality and highly competitive prices that has propelled the company to a leadership position in a short span of time. It offers a comprehensive range of textiles for a wide spectrum of applications. Its range includes: Cordura Fabrics, Custom Fabrics, Geo-synthetics, Recreational Fabrics, Parachute Fabrics, Protective Fabrics, Ballistic Fabrics, Filter Fabrics, Parasail Fabrics, Impression Fabrics and Medical Textile Fabrics.

8.4.9 Contact information

Name of company: Kusumgar Corporates Private Limited

Address: 101, Manjushree, V.M. Road, J.V.P.D., Vile Parle (West), Mumbai – 400056, Maharashtra, India

Telephone: +91-22-61125100

Email: info@kusumgar.com

8.5 SRF Limited



8.5.1 Company snapshot

Information	Description
Year of Incorporation	1970
Key Executive (s) & Designation	Arun Bharat Ram (Chairman), Ashish Bharat Ram (Managing Director)
Primary business	Technical Textiles, Chemicals Conglomerate
Geographical Presence	Manufacturing facilities in India, Thailand, South Africa and Hungary Offices across India Exports to ~70 countries
Number of Employees	7000
R&D expenditure during 2020	Rs. 99.68 Crores

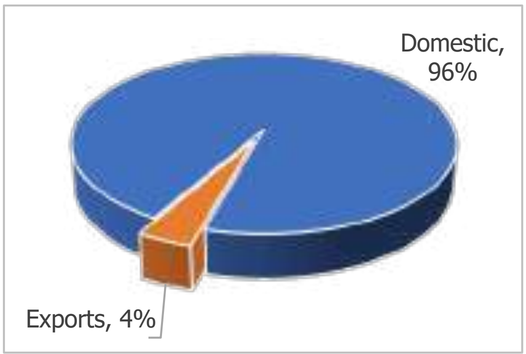
8.5.2 Operating Business segments

Information	Description
Fluorochemicals Business	Refrigerants, Industrial Chemicals, Pharma Grade
Specialty Chemicals Business	Agrochemical Industry, Pharmaceutical Industry
Technical Textiles Business	Tyre Cord Fabrics, Belting Fabrics, Polyester Industrial Yarn

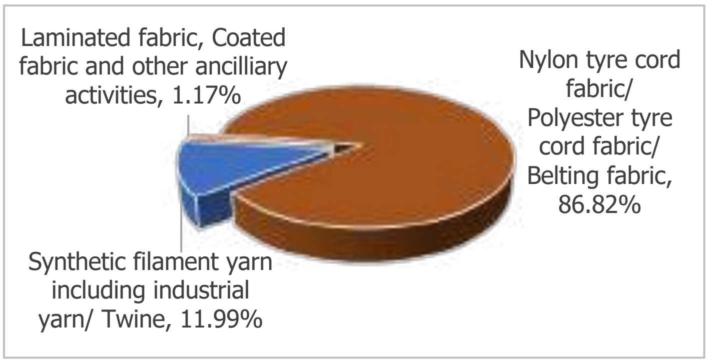
8.5.3 Technical Textiles product portfolio

Information	Description
Indutech	Polyester Industrial Yarn, Belting Fabric
Mobitech	Nylon Tyre Cord Fabric, Polyester Tyre Cord Fabric

8.5.4 Sources of revenue share (2020)



8.5.5 Revenue share by segment (2020)



8.5.6 Business performance of technical textiles in last three years (Rs. Crores)

Business performance outcomes	2018	2019	2020
Net Sales	1532.6	1735.7	1357.6
Operating Profit	247.5	261.3	151.5
Return on Capital employed	6.27%	7.65%	10.6%

8.5.7 Key strategic moves and developments related to Technical Textiles

Year	Strategy	Description
2017-18	R&D	The R&D centre of Technical Textiles Business has developed many variants of Polyester Industrial Yarns for as reinforcements in Geotextiles, Fibre reinforced composites etc., and Aramid based reinforcement Fabric for hoses, each tailor-made for the respective application.
2018-19	Innovation	Novel products involving Nanotechnology are also developed by this Technical Textiles Business (TTB) R&D centre in close association with leading Academic and Research Institutes in India and abroad for various research projects. TTB-R&D also works in close collaboration with major customers for joint developments in the field of tyre cords, belting Fabrics and other Mechanical Rubber Good reinforcements.

8.5.8 Company overview

SRF Limited offers a wide range of high-performance reinforcements covering both nylon and polyester yarns and Fabrics for diverse non-consumer and lifestyle applications. The company is among the large manufacturers of technical textiles in India. It also enjoys a global leadership for most of the products under this business. Apart from India, it has set up manufacturing plants for technical textiles in Thailand and South Africa. SRF's product basket for technical textiles contains Nylon tyre cord Fabrics, Polyester tyre cord Fabrics, Belting Fabrics, Coated Fabrics, Laminated Fabrics, Fishnet Twines and Industrial Yarns.

8.5.9 Contact information

Name of company: SRF Limited

Address: Block-C, Sector-45, Gurugram, Haryana, India

Telephone: +91-124-4354400

Email info@srf.com

8.6 Strata Geosystems (India) Private Limited



8.6.1 Company snapshot

Information	Description
Year of Incorporation	2004
Key Executive (s) & Designation	Narendra Dalmia (CEO)
Primary business	Manufacturing of Geogrids and Geocells
Geographical Presence	Manufacturing facilities in India, USA, UK, Brazil Offices across India Global exports
Number of Employees	450
R&D expenditure during 2020	Rs. 0.20 Crores

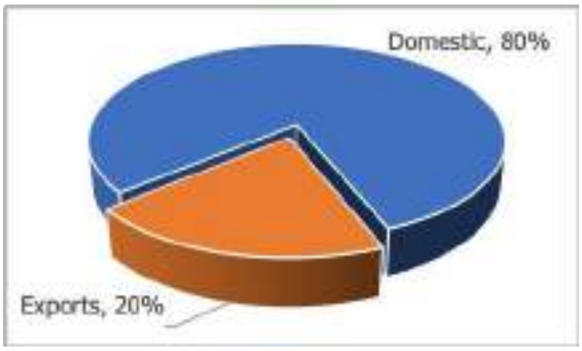
8.6.2 Operating business segments

Information	Description
Manufacturing	Manufacture StrataGrid™ (Geogrid) and StrataWeb®(Geocell)
Construction	Construction of RS Walls in India.
Design	One of the important verticals for the company is design consultancy. It has designed over 1,000 projects globally, following all global design standards and software. Strata has a highly qualified team of engineers which specialises in Geotechnical Engineering.

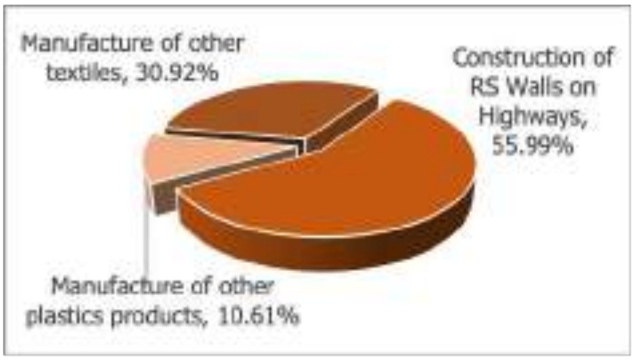
8.6.3 Technical Textiles product portfolio

Segment	Brand/Product
Geotech	Product - StrataGrid™, StrataWeb®

8.6.4 Sources of revenue share (2020)



8.6.5 Revenue share by segment (2020)



8.6.6 Business performance in last three years (Rs. Crores)

Business performance outcomes	2018	2019	2020
Net Sales	156.70	277.30	307.00
Net Profit	11.10	19.70	23.30
Operating Profit	22.60	38.60	58.60
Return on Capital employed	15%	14%	14%

8.6.7 Key strategic moves and developments by company/group related to Technical Textiles

Year	Strategy	Description
2016	Focus on development of Indian codes for geosynthetics	Launched by IRC, RDSO and BIS between 2019-21
2019	Start new geogrid manufacturing facility with state-of-the-art technology and triple capacity	This helped exports and acceptance across 25 countries
2020	Patent solutions	Filed 2 patented solutions for RS walls to increase market share and optimise solution costs
2021	Expand product portfolio rapidly	Leverage existing sales channels
	Draft standards and guidelines	Contributed towards formulation of BIS standards for geosynthetics, contributed towards formulation of IRC guidelines for use of geosynthetics in roads, taking on pilot projects to showcase and promote technology.
	Establish India's largest geogrid and geocell facility	Setup the largest geogrid and geocell facility in India and top 3 in the world

8.6.8 Company overview

Strata Geosystems (India) Private Limited is a non-government company, incorporated on 15 Sep, 2004. It is a leading provider of sustainable, eco-friendly and cost-effective soil reinforcement technology and geotechnical solutions in India. According to the company sources, it is their constant endeavour to build trust and surpass customer expectations with high quality geosynthetic products for infrastructure sector.

8.6.9 Contact information

Name of the Company: Strata Geosystems (India) Private Limited

Address: Sabnam House, Plot No. A – 15/16, Central Cross Road B, Behind MIDC, Andheri (E), Mumbai–400093, India

Telephone: +91-22-40635100

Email: info@strataindia.com

8.7 Supreme Nonwoven Industries Private Limited

8.7.1 Company snapshot

Information	Description
Year of Incorporation	1986-87
Key Executive (s) & Designation	Mohan Kavrie (CEO), Amit Kavrie (MD)
Primary business	Nonwoven Fabrics, Automotive Interior Trim Components
Geographical Presence	Manufacturing facilities in India and Thailand Offices across India Exports to Southeast Asia
Number of Employees	2000
R&D expenditure during 2020	Data not available

8.7.2 Operating business segments

Information	Description
Non-woven for all kind of vehicles, industry and other uses	The company is a supplier of interior trims and NVH components as well as filters for many applications

8.7.3 Technical Textiles product portfolio

Segment	Brand/Product
Mobitech	Supplier of interior trims such as Moulded Carpets, Headliners, Trunk Compartment Trims and Package Trays, and NVH components
Meditech	Disposable Surgical Cloth, Disposable Facial Gowns, Disposable Patient Gowns, Disposable Surgeon Aprons, Disposable Bedspreads and Disposable Surgeon Caps
Geotech	Supertex, Geosynhetic solution for erosion control, filtration, reinforced earthwalls, paving, solid waste separation etc.
Clothtech	Interlining
Indutech	Industrial Filters for dry as well as wet filtration

8.7.4 Sources of revenue share (2020) and **8.7.5 Revenue share by segment (2020)**:
Data not available

8.7.6 Business performance in last three years* (Rs. Crores)

Business performance outcomes	2018	2019	2020
Net Sales	259.17	270.51	220.37
Net Profit	10.3	8.34	5.34
Operating Profit	35.28	35.62	28.21
Return on Capital employed	6.74%	4.23%	2.29%

** CMIE Prowess Database*

8.7.7 Key strategic moves and developments related to Technical Textiles

Year	Strategy	Description
2016	Market dominance in Mobiltech	Supreme Treon has 12 manufacturing plants strategically located across automotive manufacturing hubs in India and supplies to more than 100 different passenger and commercial vehicle models. First company in India to develop and introduce practically all the products of nonwoven in the market. Command 50% share in the Automotive OEM's market.
2016	Expansion through M&A	100% ownership of Supreme-Treves, which was established in 1996 as a joint venture between Supreme Nonwovens and Trèves of France, a Tier 1 system supplier of automotive interior trim and noise, vibration and harshness (NVH) components.
2020	Exapansion through M&A	Acquired the joint venture between Supreme Treon Pvt. Ltd. and Feltol Thailand Manufacturing Company Limited

8.7.8 Company overview

Supreme Nonwoven Industries Private Limited is the largest and most diversified Nonwovens company in India. It provides products and services across the value chain of nonwovens. As per the company sources, it is the largest supplier of interior trims and NVH components with strong design, development, tooling, engineering and manufacturing capabilities. It is a supplier for over 15 large manufacturing companies of automobiles in India. The company produces more than 7000 products.

8.7.9 Contact information

Name of the Company: Supreme Nonwoven Industries Private Limited

Address: Supreme House-110, 16th Road, Chembur, Mumbai – 400071, Maharashtra, India

Telephone: +91-22-25208822

Email: info@supremegroup.co.in

8.8 Tata Advanced Systems Limited

TATA
TATA ADVANCED SYSTEMS

8.8.1 Company snapshot

Information	Description
Year of Incorporation	1989
Key Executive (s) & Designation	Masood Hussainy (Head, Aerostructures and Aero-Engines), Nishant Khurana (Head, COE - Composites and Metallics), Abhishek Sharma (AVP, Finance)
Primary business	Manufacturing of Aerospace grade Composite Parts, Light Bullet Proof Jackets, Vehicle Armouring Solutions
Geographical Presence	Manufacturing facilities in Karnataka and Telangana Offices across India Exports to USA, EU, SAARC, ASEAN and African countries
Number of Employees	1080+
R&D expenditure during 2020	Rs. 1.2 Crores

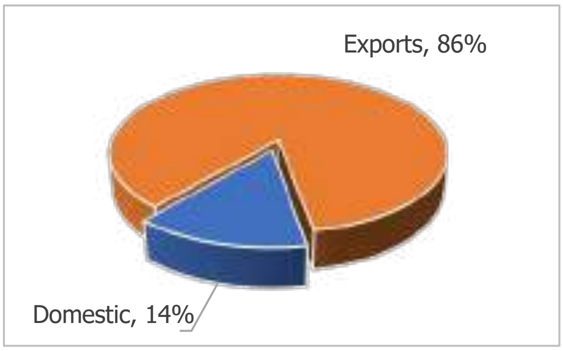
8.8.2 Operating business segments

Information	Description
International Aerospace	Fabrication of Composite Parts for different Aircraft platforms, Metal-Composite Assemblies
Space	Fabrication of composite parts and assemblies for satellite and launch vehicles
Defence (Personal & Vehicle Armouring Solutions)	Light Weight Bullet Resistant Jackets, Light Weight Bullet Resistant Combat Helmets, Protection parts for Armoured Vehicles

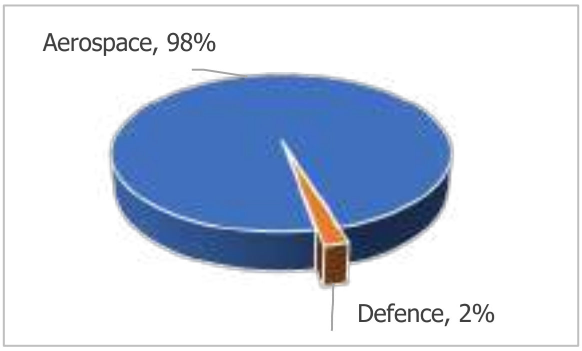
8.8.3 Technical Textiles product portfolio

Segment	Brand/Product
Mobitech	1. Bullet Proof SUVs (Steel + Composite Armour) 2. Bullet Proof Vehicle for Armed Forces 3. Light Weight Advanced Composite Armour 4. Side Mine Blast Protection 5. Composite Aircraft Parts for major OEMs/Super Tier 1s like Boeing, Spirit, GKN, FACC, CTRM, NAL, VSSC etc.
Protech	1. Flexible Ballistic Shield Cover for personnel and vehicle protection 2. VIP Concealable BR Vest 3. Buoyant BR Jacket Outer Carrier 4. Assault BR Jacket Outer Carrier 5. Bomb Blanket Cover (delivered 300 nos.) 6. Anti-ballistic Aramid Carpets for vehicle floor protection 7. Delivered more than 250 nos. to Tata Motors Defence Land systems (light armoured vehicles)

8.8.4 Sources of revenue share (2020)



8.8.5 Revenue share by segment (2020)



8.8.6 Business performance in last three years (Rs. Crores)

Business performance outcomes	2018	2019	2020
Net Sales	397.41	400.87	363
Net Profit	57.21	58.49	36.4
Operating Profit	86.24	98.9	68.88
Return on Capital employed	22.30%	21.9%	15.9%

8.8.7 Key strategic moves and developments related to Technical Textiles

Year	Strategy	Description
2006 - till date	In-house development of Light Weight and cost-effective Bullet Resistant Jackets Outer Carrier to cater to domestic market	Assault BR Jacket Outer Carrier
		Delivered more than 2,50,000 nos. BPJs to Indian Army, State Police forces, private customer
2012 - till date		Buoyant BR Jacket Outer Carrier
		Delivered 9000 nos. to Indian Navy, Coast Guard
		Manufacturing completed for 4500 nos. BRJ to Indian Navy, under inspection by DGQA(N)
2015-16		VIP Concealable BR Vest
		Delivered 3000 nos. to Government & private customers
2015- till date	In-house development of Protection equipment for threats against Bomb (100 gms TNT) and hand grenades (HE-36)	Delivered 300 Bomb Blanket Covers
		Anti-ballistic Aramid Carpets for vehicle floor protection. Delivered more than 250 nos. to Tata Motors Defense Land systems (light-armored vehicles)
		It is the first company in India to develop a light weight Bullet Proof Jacket in collaboration with the Indian Army
		It has developed small arm protection parts for Arjun Main Battle Tank with CVRDE, DRDO, Ministry of Defence
		The company annually delivers 32000+ Aircraft & Space composite components at peak rates to top OEMS & Super Tier 1 firms like National Aerospace Laboratories (NAL), Vikram Sarabhai Space Centre (VSSC), Boeing, Spirit, FACC AG, GE Aviation, Composites Technology Research Malaysia (CTRM) & Collins Aerospace
2019-20	Joint development of protection equipment at par with international standard for promoting in domestic & international market	Flexible Ballistic Shield Cover for personnel and vehicle protection
		Delivered 1000 nos.

8.8.8 Company overview

The Bengaluru based manufacturing facility of Tata Advanced Systems Limited (TASL) which now is the Advanced Material Division but earlier was a separate company Tata Advanced materials Limited (TAML) commenced its commercial operations in 1993. It has been a pioneer of Composite manufacturing & Solutions in India, catering to the demands of Aerospace, Space & Defence (Personal & Vehicle Armouring Solutions) for top OEMs and Super Tier-1 firms all across the world since 1989. It focused solely on design, development and manufacturing of Personal Armour & Defence products from 1993-2006. In 2007 it added Aerospace as a new market for its business. It has more than 900 employees which include young & skilled engineers working at the TASL Bengaluru facility.

8.8.9 Contact information

Name of company: Tata Advanced Systems Limited

Address: No.10, Jigani Industrial Area, Anekal Taluk, Jigani, Bengaluru- 560105, Karnataka, India

Telephone: +91-80-66955500, +91-11-66222666

Email: schavali@tasl.aero

8.9 Techfab (India) Industries Limited

8.9.1 Company snapshot

Information	Description
Year of Incorporation	2003
Key Executive (s) & Designation	Anant Kanoi (CEO)
Primary business	Geosynthetics Product Manufacturer
Geographical Presence	Manufacturing facilities in Dadar and Nagar Haveli and Daman Offices across India and abroad Exports to ~35 countries
Number of Employees	474
R&D expenditure during 2020	Data not available

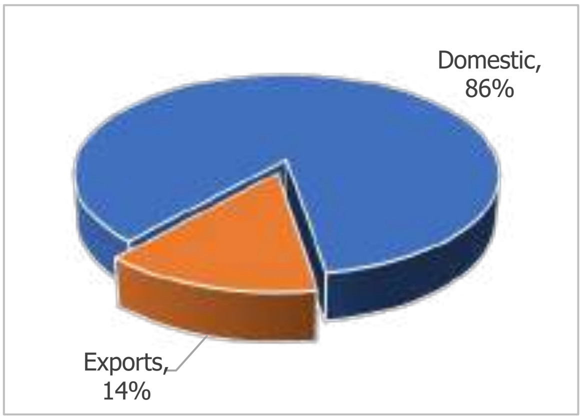
8.9.2 Operating business segments

Segment	Description
TechGrid	Knitted and Polymeric Coated Polyester Geogrids
TechGlass	Bitumen Coated Fiberglass Grids
TechGeo	Nonwoven Geotextiles
TFI 1000	Series Woven PP Multifilament Geotextiles
TechDrain - Drainage composite	Geo Composites
TECHFAB Metal Gabions/Matress/Netting	Metal Gabions
TGC	Reinforced Nonwoven Composites
TechGlass AIC	AIC Asphalt Reinforcement Composites
TechPave	Nonwoven Paving Fabrics
TechGrid PP Biaxial	PP Extruded Biaxial Geogrid
TechStrip Polymeric Strip	Polymeric Strips
TechFab	Polypropylene Staple Fibres
TechCell	Geocells

8.9.3 Technical Textiles product portfolio

Segment	Brand/Product
Geotech	Techgrid, Techgrid PP, TechStrap Polyemetric Strip, TechGlass, TechGlass AIC, TechGeo Needle Punched Nonwoven Textile, TechPave, TechDrain, TechTube Geotextile Tubes, TGC, TFI 3000, TechCell, TechFab Metal Gabions

8.9.4 Sources of revenue share (2020)



8.9.5 Revenue share by segment (2020)

Geotech Products and Solutions: 100%

8.9.6 Business performance in last three years (Rs. Crores)

Business Performance Outcomes	2018	2019	2020
Net Sales	186.1	193.71	233.6
Net Profit	10.31	14.23	20.99
Operating Profit	20.73	23.3	33.98
Return on Capital employed	10.83%	11.99%	10.51%

8.9.7 Key strategic moves and developments related to Technical Textiles

Year	Strategy	Description
2015-20	New and innovative product development	The company has developed DMS, Advanced Data Management System to support design document database for complex projects having multiple structures. It has acquired Emergia Aerospace during 2013. It has complete product range for various applications which is GreenPro Ecolabelled recognised by Global Ecolabelling Network (GEN).

8.9.8 Company overview

TechFab India Industries Limited was founded in 2003, with the objective of providing world class geosynthetic products and services to enable owners, consultants and contractors to design and implement reliable, economic and easy to construct solutions for a wide range of geotechnical, transportation, hydraulic and environmental related problems.

8.9.9 Contact information

Name of company: Techfab (India) Industries Limited

Address: 712, Embassy Centre Nariman Point Mumbai, 400021, Maharashtra, India

Telephone: +91-22-22876224

Email: info@techfabindia.com

8.10 Welspun India Limited



8.10.1 Company snapshot

Information	Description
Year of Incorporation	1985
Key Executive (s) & Designation	B.K. Goenka (Chairman), Dipali Goenka (CEO), Rajesh R Mandawewala (MD)
Primary business	Home Textiles, Advanced Textiles, Flooring Solutions, Pipes, Steel and Infrastructure
Geographical Presence	Manufacturing facilities in India, USA and South Africa Offices across India and abroad Exports to ~50 countries
Number of Employees	20,000
R&D expenditure during 2020	Rs. 29.22 Crores

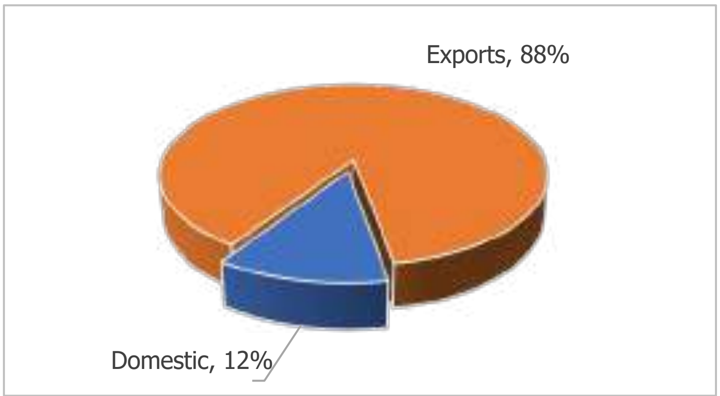
8.10.2 Operating business segments

Segment	Description
Bedding Solutions	Bed sheets, Comforters
Bath Solutions	Towels, Bathrobes
Flooring Solutions	Carpet tiles, Wall to wall carpets, LVT
Advanced Textile	Spunlace, Wet wipes, Needle punch

8.10.3 Technical Textiles product portfolio

Segment	Brand/Product
Hometech	Wadding for home textiles, Comforters, Mattress Pads
Indutech	Industrial filter Fabrics, Liquid filter Fabrics, HVAC, Automotive filter Fabrics, Fabric for Composites
Meditech	Spunlace Nonwoven Fabrics for different applications -Cleaning, Medicated Cloth, Cosmetics, Baby Wipes, Facial Wipes, Bathing Wipes, Facemasks
Mobitech	Nonwoven Needle punch Fabrics for Automotive applications
Protech	Nonwoven Fabrics for Personal protection and safety textiles like Thermal Liners for fire and safety, Medical Gowns, Masks)

8.10.4 Sources of revenue share (2020)



8.10.5 Revenue share by segment (2020)

Data not available

8.10.6 Business performance in last three years for overall textiles (Rs. Crores)

Business Performance Outcomes	2018	2019	2020
Net Sales	4995.87	5395.26	5323.57
Net Profit	304.11	141.77	474.89
Operating Profit	949.21	877.89	1052.37
Return on Capital employed	10.1%	11.1%	12.3%

Note- Net sales from technical textile products for 2020 was Rs. 233.84 Crores.

8.10.7 Key strategic moves and developments related to Technical Textiles

Year	Strategy	Description
2021	Meditech	Spunlace fabric for Hygiene application like wet wipes, face mask, Bed bath wipes and disinfectant wipes Nonwoven fabric development in direction with SUP (Single use plastic) Nonwoven fabric in direction to ESG concept Addition of Spunlace Capacity in Telangana

8.10.8 Company overview

Welspun Group is one of India's fastest growing global conglomerates with businesses in Line Pipes, Home Textiles, Infrastructure, Warehousing, Steel, Oil & Gas, Advanced textiles and Flooring solutions. The company submits that at Welspun, they yearn to be the most comprehensive strategic partner and solution provider, keeping their consumers at the core.

8.10.9 Contact information

Name of company: Welspun India Limited

Address: 6th Floor, Kamala Mills Compound, Senapati Bapat Marg, Lower Parel, Mumbai 400 013, Maharashtra, India

Telephone: +91-22-66136000, 24908000

Email: contact@welspun.com

9. Domestic & Global Markets of Technical Textiles

9.1 Background

The textile industry has been undergoing continuous and rapid transformation resulting in ever newer areas of innovations to meet ever changing requirements of individual and institutional consumers. With the increasing quest to find uses for textiles other than aesthetic, a new category known as Technical Textiles has emerged. These are defined as textiles that are designed for non-aesthetic applications. Different kinds of technical textiles are created for meeting various functional requirements due to characteristic physical properties which make them appropriate for intended applications.

Technical textiles are known by different terms such as Functional Textiles, Industrial Textiles, Performance Textiles, Engineering Textiles, Invisible Textiles and Hi-tech Textiles. Technical Textiles are non-aesthetic but highly versatile textiles, manufactured using natural as well as man-made fibres. These synthetic polymers have huge potential and abundant functionality that outperforms natural fibres.

The global Technical Textiles market is expected to grow at a CAGR of 5.06% between 2020 and 2025. Rising awareness about benefits of technical textiles is likely to enhance their demand across end-use industries including medical, construction, sports, packaging, agriculture etc. India can be a significant force in the rapidly evolving global technical textiles market and hence there is a critical need for conducting a detailed analysis of domestic as well as international market. Such an analysis will help in identifying the strengths and weaknesses, bridge the gaps and influence the overall demand of the Indian technical textiles industry.

Technical textiles are classified into 12 segments as per their application; these segments are presented as follows:

1. Agrotech: Textiles used in agriculture, horticulture, fishing and forestry. Examples- Shade nets, crop covers, fishing nets etc.
2. Buildtech: Textiles used in construction. Examples- Scaffolding nets, awnings, wall coverings etc.
3. Clothtech: Technical textiles for clothing applications such as fabric treated under pressure and high temperature. Examples- Coated laces, interlinings, zip fasteners, labels etc.
4. Geotech: Permeable fabric woven or non-woven used for confinement/ separation, reinforcement, filtration and drainage. Examples- Geotextiles, Geomembranes, Geostrips, Geo-grids etc.

5. Hometech: Textiles used in a domestic environment and interiors. Examples- Fibre fill, blinds fabrics, mosquito nets, furniture fabrics etc.
6. Indutech: Textiles used for chemical and electrical applications and textiles related to mechanical engineering. Examples- Conveyor belts, bolting cloth, coated abrasives, composites etc.
7. Meditech: Combination of textile technology and medical sciences has resulted into a new field called medical textiles. Examples- Diapers, wipes, surgical sutures, hernia mesh, artificial ligaments etc.
8. Mobiltech: Textiles used in the manufacture of automobiles, railways and aircraft. Examples- Tyre cord, seat belt webbing, airbag, insulation felts, seat covers etc.
9. Oekotech: Textiles used in environmental protection applications. Examples- Geomembranes, geo-synthetic clay liners etc.
10. Packtech: Textiles used in packaging, silos, containers, bags, canvas covers, marquee tents. Examples- Leno bags, soft luggage, jute hessian and sacks, shopping bags etc.
11. Protech: Textiles that are used in protection against heat, flame and radiation for fire fighter clothing, against molten metals for welders, for bullet proof jackets etc. Examples- Bullet proof jackets, fire retardant apparel, chemical protective clothing etc.
12. Sportech: Shoes, sports equipment, flying and sailing sports, cycling, winter and summer sports, indoor sports wear. Examples- Sport composites, artificial turfs, parachute fabrics, sleeping bags etc.

A detailed market analysis of technical textile industry and various segments has been done in this chapter.

The market for technical textiles in India is growing at a rapid pace, even as it currently contributes a relatively modest portion i.e. 17 percent of total textile market in India. The market size of textile industry in India is Rs. 7,11,409 Crores while that of technical textiles is Rs. 1,22,943 Crores (US$ 18,879.45 Million) during 2019-20. The share of technical textiles in the total textile industry is expected to reach 28% by 2024-25.

The growth observed in the Indian economy and country's relatively untapped domestic market has fuelled demand for technical textiles. The availability of young and cheap manpower and readily available strong textile value chain has improved prospects for ramping up the production capacities for technical textile industry in India. These characteristics of the ecosystem have created attractive opportunity for technical textiles in India. As per the information received from the field research as well as consulting the industry practitioners and experts, the forecast arrived at by IIT Delhi suggests that the market for technical textiles in India will grow in value from Rs.122,943Crores (US$ 18,879.45 Million) in 2019-20 to Rs. 182,742.15 Crores (US$ 28,062.37 Million) in 2024-25.

The segment-wise data is presented in Table 9.1 as follows:

Table 9.1: Market size of technical textile segments in India - Rs. Crores (US$ Billion)

No.	Technical textile Segment	Year 2019-20 (Estimate)	Year 2024-25 (Forecast)	Segment as % of Total (2019-20)	Segment as % of Total (2024-25) (Forecast)	CAGR % (2019-20 to 2024-25) (Forecast)
1	Agrotech	1,890 (0.29)	3,246 (0.50)	1.54	1.78	11.42
2	Buildtech	5,008 (0.77)	8,239 (1.27)	4.07	4.51	10.47
3	Clothtech	8,205 (1.26)	11,411 (1.75)	6.67	6.24	6.82
4	Geotech	2,050 (0.31)	4,483 (0.69)	1.67	2.45	16.94
5	Hometech	12,352 (1.90)	17,145 (2.63)	10.05	9.38	6.78
6	Indutech	12,821 (1.97)	23,660 (3.63)	10.43	12.95	13.04
7	Meditech	7,861 (1.21)	12,550 (1.93)	6.39	6.87	9.81
8	Mobiltech	11,164 (1.71)	18,274 (2.81)	9.08	10.00	10.35
9	Oekotech	488 (0.08)	972 (0.15)	0.40	0.53	14.76
10	Packtech	50,592 (7.77)	67,332 (2.81)	41.15	36.85	5.88
11	Protech	3,148 (0.48)	5,119 (0.79)	2.56	2.80	10.21
12	Sportech	7,364 (1.13)	10,312 (1.58)	5.99	5.64	6.96
	Total	**1,22,943 (18.89)**	**1,82,742 (28.06)**	**100**	**100**	**8.25**

The segments likely to grow at the fastest rates (at rates faster than a CAGR of 10%) are Oekotech, Protech, Geotech, Meditech, Indutech, Agrotech and Buildtech. Packtech, which has been a mainstay of the domestic technical textiles market is expected to experience a moderated rate of growth and a similar growth trend is expected for Mobiltech. The extent and nature of success of India's National Technical Textile Mission is likely to change these forecasts depending on the response of the market to interventions made under the mission.

The size of technical textiles market in India is a small proportion (8.7%) of the market size of technical textiles in the world in 2019-20. It is expected that by 2024-25, the value of consumption (calculated at constant foreign exchange rates) of technical textiles in India is likely to be 10.06 percent of global consumption of technical textiles in 2024-25. The global market for technical textiles is expected to grow from US$ 217.80 billion to US$ 278.84 billion at a CAGR of 5.06% during the period 2020-25.

The segment-wise data of world market is presented in table 9.2 as follows:

Table 9.2: Market size of technical textile segments in the world (US$ Million)						
No.	**Technical textile Segment**	**Year 2019-20 (Estimate)**	**Year 2024-25 (Forecast)**	**Segment as % of Total (2019-20)**	**Segment as % of Total (2024-25) (Forecast)**	**CAGR % (2019-20 to 2024-25) (Forecast)**
1	Agrotech	9,847	11,749	4.52	4.21	3.60
2	Buildtech	13,923	19,472	6.39	6.98	6.94
3	Clothtech	11,656	13,980	5.35	5.01	3.70
4	Geotech	7,445	9,753	3.42	3.50	5.55
5	Hometech	19,654	24,687	9.02	8.85	4.67
6	Indutech	29,157	37,204	13.39	13.34	5.00
7	Meditech	25,214	34,736	11.58	12.46	6.62
8	Mobiltech	36,345	44,779	16.69	16.06	4.26
9	Oekotech	1,363	2,635	0.62	0.94	14.08
10	Packtech	27,597	33,744	12.67	12.10	4.10
11	Protech	11,187	14,862	5.14	5.33	5.85
12	Sportech	24,416	31,237	11.21	11.20	5.05
	Total	**217,805**	**278,837**	**100**	**100**	**5.06**

It is evident from the forecast presented in the table above that Geotech, Protech, Sportech and Oekotech are the four segments which are likely to grow at a relatively higher rate (CAGR > 5%) in terms of value of technical textiles consumption during the period 2020-25. Mobiltech, Indutech, Meditech, Packtech and Sportech will constitute a major share of the market value of technical textiles.

The market analysis of technical textiles that follows in this section has been presented at the level of products in each of the 12 technical textile segments. The products in Oekotech segment are common with that of other segments such as Geotech. Therefore, analysis of Oekotech segment could not be shown separately at a product level. The products from different segments that have been identified (after consultation with industry experts) for analysis have been chosen because of the perceived moderate to high possibility of success for Indian industry. Some of these products currently have a small domestic market but a large global market and therefore present opportunities for India’s technical textiles manufacturers. According to the objectives specified for the present study, analysis of such products is necessary as it serves as a global trend guide, both, to policy makers and to Indian entrepreneurs.

The sources of information for determining the current market size and developing the forecast ranged from primary survey of a sample of Indian technical textiles product manufacturers, raw material suppliers, machinery manufacturers, industry experts for their assessment and opinions, study of various national and international reports, including referring market research reports by leading industrial market research agencies of the world. Some of these market research agencies whose reports were referred extensively for extracting global market value data are listed as follows:

1. Grand View Research Inc.
2. Mordor Intelligence Inc.
3. Research and Markets Inc.
4. Markets and Markets Research Private Ltd.
5. Market Watch (www.marketwatch.com)
6. Transparency Market Research Pvt. Ltd.
7. Reports and Data (Marketysers Global Consulting LLP)
8. Fortune Business Insights Pvt. Ltd.
9. Data Bridge Market Research (DBMR) Pvt. Ltd.
10. Allied Market Research

In addition to the relevant product, segment and industry based research reports published by the agencies mentioned above, the reports and documents prepared by Ministry of Textiles, Government of India (Annual Reports for financial years 2018-19, 2019-20 and 2020-21), ICRA Management Consulting Services Limited (Baseline survey of the Technical Textile industry in India, 2016), KPMG-FICCI (Technical textiles: Growth engine of Indian textiles sector (2019), Technical Textiles: Emerging Opportunities and Investments (2021), Invest India, Exim Bank of India (Enhancing Exports Of Technical Textile (2018)), Wazir Advisors-FICCI (Technical Textiles: Towards a Smart Future (2016), World bank (World Demand Prospects for Jute (1987), US Department of Commerce (2016 Top Markets Report: Technical Textiles, A Market Assessment Tool for U.S. Exporters), BCC Research (Geosynthetics: Materials, Applications and Markets (2015), CII (Strategic Roadmap for Geotextiles in India (2020). In addition to the above, the valuable assessments made by industry associations such as Indian Technical Textiles Association (ITTA), Confederation of Indian Industry (CII) and Federation of Indian Chambers of Commerce & Industry (FICCI) have also been incorporated in the analysis.

The market analysis has been illustrated with the help of appropriate graphs and tables which are placed alongside the information pertaining to each of the respective products and the application segments. The segment-wise market analysis is described in the sections that follow.

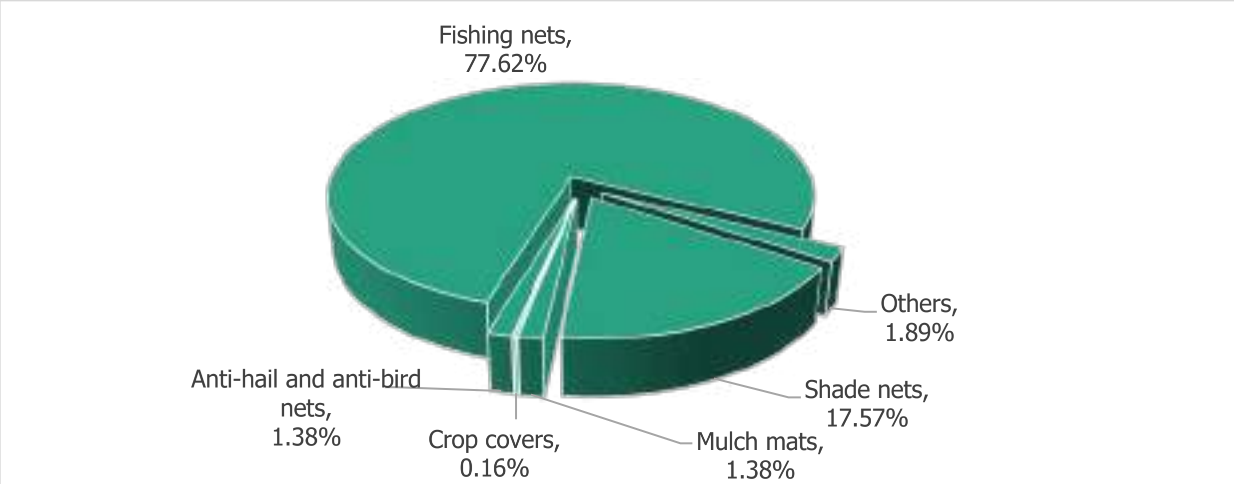
9.2 Agrotech

Agrotech or Agro Textile is used to classify woven, nonwoven and knitted fabrics applied for agriculture & horticulture uses. They prevent soil from drying out, increase crop yield, improve product quality and protect farmers from exposure to harmful pesticides and chemicals.

Major technical textiles products under Agrotech segment are as follows:

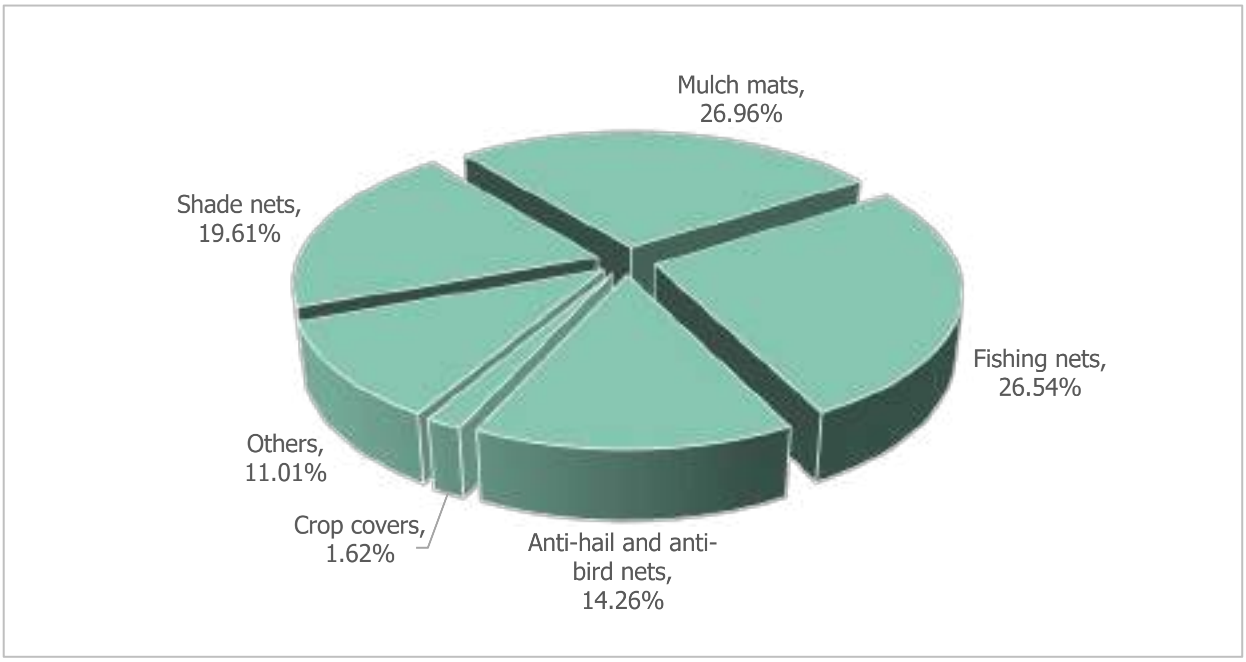
1. Anti-hail and Anti-bird Nets
2. Crop Covers
3. Fishing Nets
4. Mulch Mats
5. Shade Nets

Figure 9.1: Percentage contribution of Agrotech products in the domestic market (2019-20)



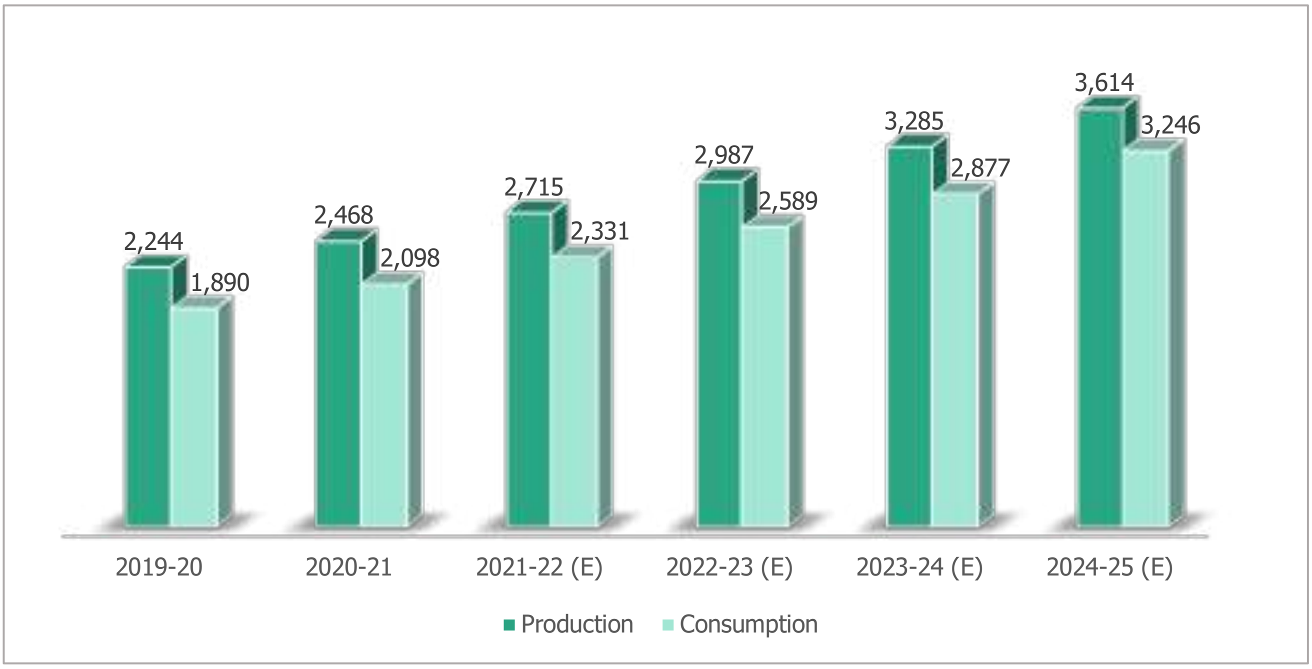
Fishing nets constituted the largest share (77.62%) of the Indian Agrotech market in 2019-20, followed by shade nets (17.57%), mulch mats (1.38%), anti-hail & anti-bird nets (1.38%). Crop covers also hold a small share (0.16%) of the Indian market.

Figure 9.2: Percentage contribution of Agrotech products in the international market (2019-20)



Mulch mats (26.96%) and fishing nets (26.54%) constitute the largest share in the international market.

Figure 9.3: Production vs. Consumption of Agrotech segment in the domestic market (Rs. Crores)



It is evident from figure 9.3 that the production of Agrotech products (Rs. 2,244 Crores in 2019-20) in India exceeds their consumption (Rs. 1,890 Crores in 2019-20). This presents India with the possibility of exporting its surplus.

Table 9.3: Agrotech - World and India market size 2019-20

Product Name	World (US$ Million)	India (Rs. Crores)	India's share
Anti-hail and Anti-bird Nets	1,404	26	0.23%
Crop Covers	160	3	0.28%
Fishing Nets	2,613	1,467	8.60%
Mulch Mats	2,655	26	0.15%
Shade Nets	1,931	332	2.64%
Others	1,084	36	0.51%
Total	9,847	1,890	2.95%

9.2.1 Anti-Hail and Anti-Bird Nets

Anti-hail and anti-bird nets are mesh products which are woven from HDPE yarn or are a combination of HDPE monofilament and tape in knitted form, stabilised against UV rays. These are designed in a way that allows light and air but stops birds and hail from reaching plants and crops. These are used to protect fruit trees and fruit crops like apples, strawberries, and litchi, etc. Analysts predict that the demand for agriculture nets will remain high in countries such as India and China because of large areas under agriculture.

There is very little trade of anti-hail and anti-bird nets to and from India. Some of the major manufacturers are Netlon India Limited, Garware Technical Fibres Ltd., Kwality Nets Manufacturing Company Ltd. and B&V Agro Irrigation Co. Ltd. Main global manufacturers are KARATZIS S.A., Jinguan Net Co. Ltd., Internet France (Thailand) Co. Ltd. etc.

In 2019-20, the Indian market for anti-hail and anti-bird nets was worth Rs. 26 Crores as compared to the global market which was worth US$ 1,404 Million. The Indian market is expected to grow at a CAGR of 14% and is likely to be valued at Rs. 50.06 Crores by 2024-25. The global market is expected to grow at a CAGR of 2% and is expected to be worth US$ 1,550.13 Million by 2024-25.

9.2.2 Crop Covers

Crop covers provide protection to the crops from insects and create a micro-climate for crops by maintaining a warmer and humid micro-environment. The polyethylene monofilament meshes are made up of clear plastic (polythene) or spun-bonded polyester and can be woven, nonwoven or knitted.

Asia Pacific region led by China, India and Japan has witnessed a significant growth owing to large scale of agricultural operations at the national level. Rising demand for high crop yield and changing climatic conditions have motivated the farmers to use these covers for crop protection. In the future too, this may drive the nonwoven crop cover market trends in the region.

Key manufacturers of crop covers in India are Sidwin Fabrics Pvt. Ltd., Alpha Foam Pvt. Ltd., K T International, Surya Tex Tech, Admire Fibretex India Pvt. Ltd, Jill Mill Nonwoven Pvt. Ltd. and CTM Technical Textiles Ltd. Some of the prominent global players dealing with nonwoven covers are Mitsui Chemicals, Berry Global and Kimberly Clark Corp.

The crop covers market in India is at a nascent stage. India had a market size of around Rs. 3 Crores in 2019-20. However, it is likely to grow at a CAGR of 4% for the next five years to be worth Rs. 3.65 Crores in 2024-25. The global crop covers market was worth US$ 160 Million in 2019-20 and is expected to grow at a CAGR of 3% for the next five years and have a value of US$ 185.48 Million.

9.2.3 Fishing Nets

Fishing nets are an important product of technical textiles which are used for marine and inland fishing by fishermen, fishing trawlers and boats. They are usually made of polyamide (PA), polyester (PES), polyethylene (PE), and polypropylene (PP) fibres. Fishing nets are made from fibers woven in a grid-like structure, formed by knotting a relatively thin nylon thread. Nylon fishnet accounts account for over 65-70% of the total fishnet consumption world over. HDPE constitutes about 25-30% of the total fishnets and PP/Polyester constitutes the rest of 5-10% of the total demand globally.

Asia Pacific region is the largest consumption centre for fishing nets, accounting for 44% of global consumption. It is a fragmented market due to the presence of many local manufacturers. Increasing regulations on fishing and anti-dumping duties act as roadblocks in the fishing net fibre market.

About 65% of the country's total production of Fishnets is produced in Tamilnadu. Of the total 550 fishing nets manufacturing units in the country, Tamil Nadu has around 300-350 units and many of these are in Nagercoil. Garware Technical Fibres Ltd. is the largest manufacturer and exporter of fishing nets from India. Other Indian manufacturers are Arthi Enterprises, Aswan Fish Net and Cham Synthetics Pvt Ltd.

Some of the major international players of fishing nets are BASF SE, AdvanSix Inc., TORAY Industries Inc., Royal DSM N.V., Indorama Ventures (Brazil), Amco Polymers and Formosa Chemicals.

India's share in the global fishing nets market stood at 8.6% with a market size of Rs. 1,467 Crores. It is estimated to grow at a CAGR of 11% to reach Rs. 2,471.98 Crores till 2024-25. The market size for the world as a whole was at US$ 2,613 Million and is expected to grow at a CAGR of 3.58% to be valued at US$ 3,115.44 Million in 2024-25.

9.2.4 Mulch Mats

Mulch mats are hairy mulching discs that suppress weed growth, lower water loss from the soil surface and slow down slugs and snails. Mulch mats are used to keep fruits off the soil. This decreases fruit rot and keeps the fruit and vegetables clean. This is particularly beneficial for several horticultural crops including strawberries. Mulch mats are made up of LLDPE, HDPE, LDPE, polypropylene and wool.

Domestic manufacturers of mulch mats are small-scale industries, mostly located in Gujarat. Major Indian manufacturers are Neo Corp International Ltd., Alpha Foam Pvt. Ltd., Fiberweb India, Shivam Polymers, Climax Synthetics Pvt. Ltd., Creative Polymers Pvt. Ltd. and Essen Multipack Ltd. The global market is dominated by players such as BASF SE (Germany), The DOW Chemical Company (U.S.A.), Berry Plastics Group, Inc. (U.S.A.), AEP Industries Inc. (U.S.A.) and RKW Group (Germany).

The global market for Mulch Mats stood at US$ 2,655 Million in 2019-20. It is expected to grow at a CAGR of 4% and likely to be US$ 3,230.21 Million in 2024-25. The Indian market for Mulch Mats was Rs. 26 Crores in 2019-20. It is forecasted that it will grow at a CAGR of 6.6% and expand to Rs. 35.79 Crores by 2024-25.

9.2.5 Shade Nets

Shade nets are synthetic fibre nets which are made up of polypropylene or HDPE in knitted or woven form. They provide protection to plants from insects and extreme weather conditions, reduce water evaporation, and provide shade to greenhouses. Shade nets are commonly used in organic food industries these days. They are also used for covering of swimming pools and parking lots.

China is a major exporter in terms of volume and European nations are major users of shade nets in terms of consumption. Some of the key manufacturers and exporters of shade nets in India are Neo Corp. India Limited, Netlon India Limited, Garware Technical Fibres Limited, Rishi Techtex Limited and UNIMIN India. Major global manufacturers are ACE Geosynthetics Enterprise Co. Ltd., Acme Bag Company and Baliki Holdings.

The global market for shade nets was US$ 1,931 Million whereas the size of Indian market for shade nets was worth Rs. 332 Crores in 2019-20. The global market is expected to grow at a CAGR of 6% whereas the Indian market is expected to grow at a CAGR of 14.33% for the next five years. The market size is expected to be Rs. 648.54 Crores for India and US$ 2,584.11 Million for the world in the year 2024-25.

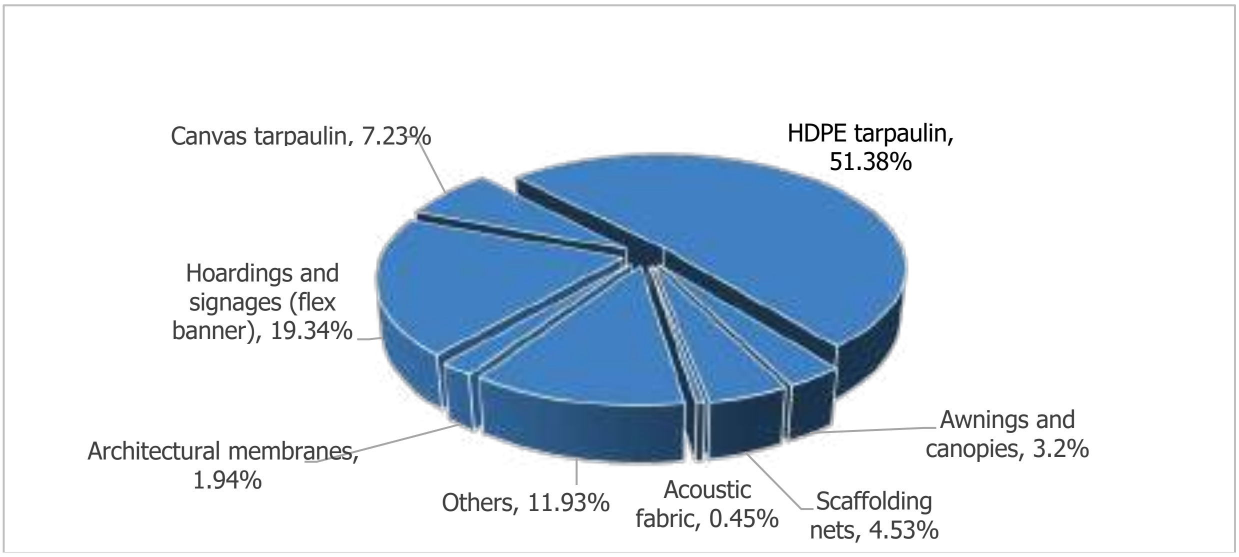
9.3 Buildtech

The textile components and fabrics used in the building and construction industry are called building technical textiles or Buildtech.

Technical textile products under Buildtech segment are as follows:

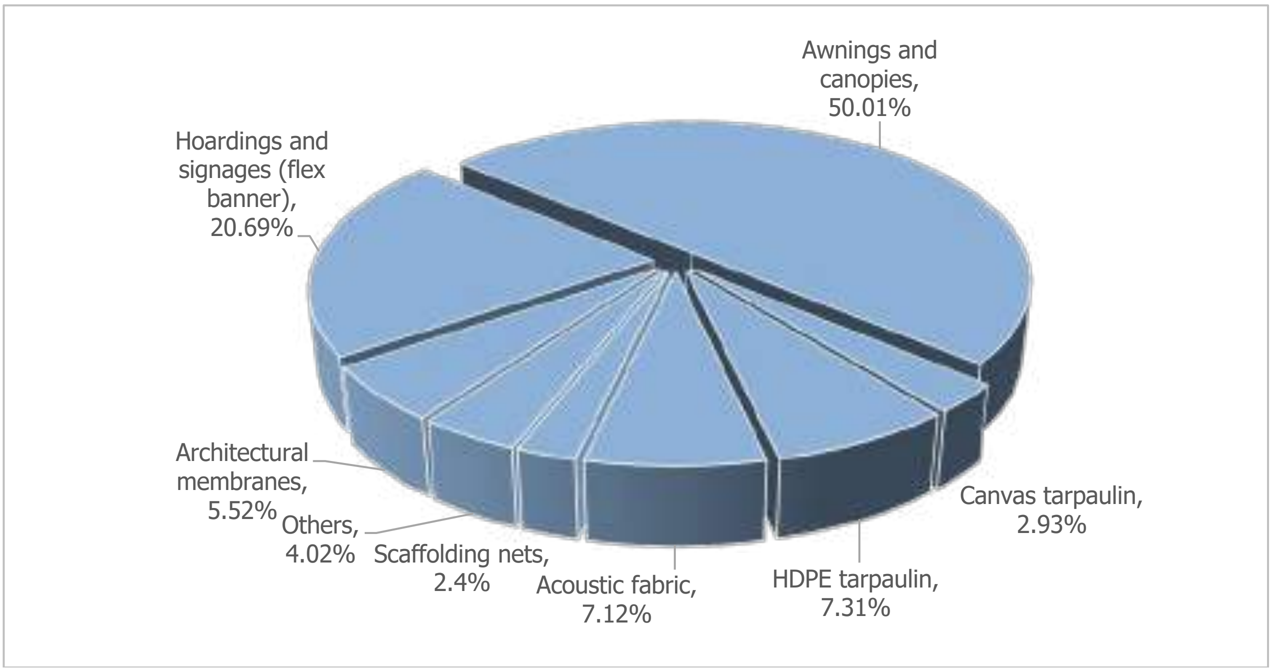
1. Acoustic Fabric
2. Architectural Membranes
3. Awnings and Canopy
4. Canvas Tarpaulin
5. HDPE Tarpaulin
6. Hoardings/Signages
7. Scaffolding Nets

Figure 9.4: Percentage contribution of Buildtech products in the domestic market (2019-20)



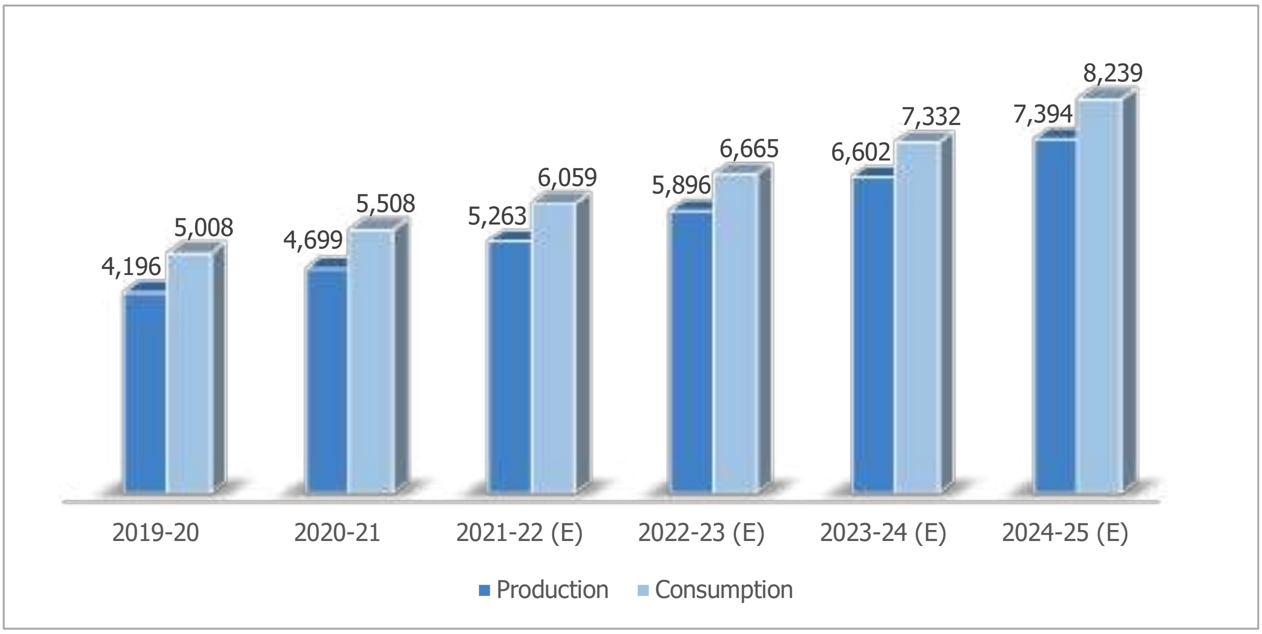
HDPE tarpaulin constituted the largest (51.38%) share (by value) of the market of Indian Buildtech industry in 2019-20, followed by Hoardings & signages (19.34%).

Figure 9.5: Percentage contribution of Buildtech products in the international market (2019-20)



In the international market, Awnings and canopies constituted the largest share – half of the market of global Buildtech industry in 2019-20, followed by Hoardings & signages (20.69%).

Figure 9.6: Production vs. Consumption of Buildtech segment in the domestic market (Rs. Crores)



Consumption of Buildtech products exceeds their production. India is a net importer and the gap between production (Rs. 4,196 Crores in 2019-20) and consumption (Rs. 5,008 Crores in 2019-20) is expected to remain almost the same in value terms for the next five years.

Table 9.4: Buildtech - World and India Market Size 2019-20			
Product Name	**World (US$ Million)**	**India (Rs. Crores)**	**India's share**
Acoustic Fabric	991	23	0.35%
Architectural Membranes	769	97	1.94%
Awnings and Canopies	6,963	160	0.35%
Canvas Tarpaulin	408	362	13.62%
HDPE Tarpaulin	1,018	2,573	38.81%
Hoardings and Signages	2,880	968	5.16%
Scaffolding Nets	334	227	10.43%
Others	560	598	16.39%
Total	13,923	5,008	5.52%

9.3.1 Acoustic Fabric

Acoustic fabrics are polyester based needle punched nonwoven fabrics used for covering walls and ceilings in multiplexes, auditoriums, music studios, stadiums etc. These fabrics help in absorbing the sound resulting in reduction of noise. Fabric acoustic panels are installed on the wall or ceilings to absorb sound. When choosing the fabric wrapping for the acoustic panels, many factors must be put into consideration, such as transparency, functionality, aesthetics and so on. Moreover, transparency is the most important considerable factor. In the recent years, nonwoven acoustic fabrics have become more popular in place of traditional glass wool insulators. While some manufacturers can produce fabric themselves, others usually purchase from professional fabric manufacturers. The multiplex industry is the major driver for the industry.

Major producers at global level include Armstrong, Saint-Gobain, GandS Acoustics, RPG, Abstracta, Texaa, Acoustics First®, Ekous, CMS Danskin, Sonata Acoustic, Acoustical Surfaces, Carpet Concept, Sontext, Soundsorba. SLALOM, Beiyang, Forgreener Acoustics, Mantex Acoustic Material etc. Global top five manufacturers hold a share over 25 percent.

USA and Europe are the major production bases of fabric acoustic panels. USA has kept its leading place in the global production in recent years. Europe is the largest market, with a share over 25 percent, followed by China and North America, both combined have a share of over 40 percent

The consumption of Acoustic fabric in India was around Rs. 22.50 Crores in 2019-20. It is expected to grow moderately at a CAGR of 6% to log in a sale of Rs. 30.11 Crores in the year 2024-25. In 2020, the global market size for Acoustic fabric was US$ 991 Million and it is expected to reach US$ 1,117.62 Million by the end of 2025, with a CAGR of 2.4% during the forecast period.

9.3.2 Architectural Membranes

Architectural membranes are lightweight spatial structures made of tensioned membranes which aid in the construction of buildings. They are used to construct roofs and façades, free-standing buildings, building envelopes, skylights, indoor ceilings and/or accent enclosures. These lightweight structures are ideal for use in a wide range of buildings such as sports and entertainment centres, commercial buildings, living and private spaces.

The Asia-Pacific region, especially India and China, have been the most influential in giving a boost to the global architectural membrane industry. Other geographies which have a large market for these membranes are North America, Canada, Germany and UK.

Lucky International, B & V Membranes, Meridian Architectural Systems Pvt. Ltd. are leading players in India. The prominent manufacturers at the international level are Serge Ferrari, Meyler and Heytex.

India's market size for architectural membranes was Rs. 97.20 Crores in the year 2019-20. It is 2.2% of the size of the world market which was US$ 769 Million. The growth of Indian market is forecasted at a rapid pace of 15% and that of global market at a CAGR of about 7.7% for the next five years. The market for architectural membranes in India is forecasted at a value of Rs. 195.51 Crores and for the world at US$ 1,117.62 Million for the year 2024-25.

9.3.3 Awnings and Canopies

Fabric awning and canopies are the most common types of shading structures. They are durable, water & stain resistant. Awnings and canopies are extensively used in various shops, restaurants, hotels, and other commercial and industrial sites. While the awning is attached to the building, a canopy is a freestanding structure. An awning or overhang is a secondary covering attached to the exterior wall of a building as protection from overbearing sunlight or any harsh weather. Awnings may be retractable, automatic, fixed guide, free standing or drop arm. A canopy is an overhead roof or a structure over which a fabric or metal covering is attached, able to provide shade or shelter from weather conditions such as sun, hail, snow and rain.

North America is a major awnings and canopies market, especially in the residential sector. Asia-Pacific region has immense industry potential owing to growth in the construction industry, particularly in China, India, and Australia.

Mecanco Industries and Awnings India Pvt. Ltd. are the leading producers of awnings and canopies in India. Some of the other major manufacturers are Royal Tensile Structure Pvt. Ltd., Systems India Pvt. Ltd., Pooja Systems, Unitech Awning and Shelter Enterprises and SRF Ltd. are the key players in the awning fabric market in India. Players like Alps Industries and Khosla Profils also manufacture awning fabrics.

Leading global players include Eide Industries Inc., Advanced Design Awnings & Signs, Shade Structures Inc., and Sunair Awnings.

India's share in the global awnings and canopies market stood at 0.39 % with a market size of Rs. 160.20 Crores during 2019-20 but it is likely to grow at a high CAGR of 15% and projected to be worth more than Rs. 322.22 Crores by 2024-25. The world market size in 2019-20 was estimated at US$ 6,963 Million and it is growing at a CAGR of 8% for the next five years and will reach a level of US$ 10,249.87 Million.

9.3.4 Canvas Tarpaulin

A tarpaulin or tarp is a large sheet of strong, flexible, water resistant or waterproof material. Traditionally tarpaulins were made out of cotton, however currently nylon and polyester fibre fabrics are being increasingly used in manufacturing tarpaulins. Cotton canvas tarpaulins are made out of 100% cotton single duck fabric.

They are mainly used in transportation and industrial applications where absorption capabilities are essential. 100% water-proof cotton canvas tarpaulin are used for safety from rain water, dust, direct sunlight and have multiple uses in trucks, tents and outdoor shelter.

Main manufacturers of canvas tarpaulins in India are Gokak Textiles, SRF Ltd., Shri Arjun Tarpaulin Industry (Salem), Calcutta Canvas Company (Chennai), Daisy Trading Company (Mumbai), Shree Tarpaulins, Mafatlal Gujarat Industries Ltd. and Bharat Textiles Proofing Industries Ltd. The industry is highly fragmented with many players in the unorganised sector.

India’s share in the global canvas tarpaulin market stood at 13.62% with a market size of Rs. 361.80 Crores during 2019-20. The world market size stood at US$ 408 Million growing at a CAGR of 6.5% to reach expected market size of US$ 561.97 Million. The likely market for canvas tarpaulin in India for the year 2024-25 is Rs. 475.10 Crores.

9.3.5 HDPE Tarpaulin

Cotton tarpaulins are being replaced by tarpaulins made of HDPE woven and laminated fabric, polyethylene sheets, nylon and polyester fibre fabrics due to better economics than cotton canvas. PE tarpaulins with HDPE woven fabric and LDPE lamination on both the sides are 100% waterproof. PE tarpaulins have the capability to adopt wide range of colours unlike the canvas tarpaulin. HDPE tarpaulins are a major part of the raffia industry.

Tarpaulin is widely used for rain water protection in sheds, transportation – trucks, other automobiles, storage godowns, boats, snowmobiles, construction sites, lumber, grain storage, temporary storages, tents, ground-sheets etc.

Key manufacturers of HDPE Tarpaulins in India are Gujarat Craft, Gujarat Raffia , Binni Limited , Mafatlal Industries Ltd and NKB Extrusions Pvt. Ltd. Some of the major players operating in the global plastic tarpaulin market are Heytex Bramsche GmbH, Sattler AG, Gia Loi JSC, KSA Polymer, Vietnam Hoa Ha Co. Ltd., Fulin Plastic Industry Co. Ltd., MahaShakti Polycoat, JK Plastopack Pvt. Ltd., Tarpaulins Direct (UK) Limited, Cunningham Covers, K-TARP VINA Co. Ltd., Zhejiang MSD New Material Co. Ltd. and A & B Canvas Australia, Heytex, Shur-Co, Midwest Canvas, Gyoha, Dothan Tarpaulin Products and Sattler Group.

According to the Future Market Insights, Domestic market will grow at 12% from Rs. 2,573.10 Crores in 2020 to reach Rs.4,534.68 Crores in 2025. The global market for all types of tarpaulin was valued at US$ 2,141.2 Million in 2020 and the value share of HDPE Tarpaulin was US$ 1,018 Million. It is expected to grow at a CAGR of 4.3% till 2025 to reach US$ 1,260.79 Million by the year 2024-25.

9.3.6 Hoardings and Signages

Hoardings and signages are made of flexible-face sign fabric, which is more commonly called flex. Flex is made of a PVC coated polyester warp knitted fabric. This fabric is highly durable and lightweight and used for outdoor advertising, wall coverings or decorative displays, and illuminated sign canvas printings. There are four types of flex banners – front-lit, back-lit, block-out and black/grey black.

Recently, debates about flex banners being an environmental and health hazard have emerged. Flex is not biodegradable, and when burnt, emits toxic fumes which have serious effect on public health. This may slow down its growth in the future.

The Indian advertising industry is projected to be the second fastest growing advertising market in Asia, after China. The Asia Pacific region is the largest and fastest growing flex banner market.

Pioneer Flex is the largest flex banner company in India accounting for more than 50% of Indian production. Other major manufacturers are Addica Industries LLP, Cleena Industries, and Qrex Flex.

India's share in the global hoardings and signages market stood at 5.2 % with a market size of Rs. 968.40 Crores during 2019-20. It is growing at a CAGR of 12.15% and expected to touch Rs. 1,718.11 Crores in 2024-25. The world market size stood at US$ 2,880 Million growing at a CAGR of 7.6%. The expected market size for the world in the year 2024-25 is US$ 4,160.11 Million.

9.3.7 Scaffolding Nets

Scaffolding netting is a lightweight fabric used to cover a building under construction in order to improve the safety of construction site. It acts as a bi-fold barrier on a building under construction. The net prevents debris from falling out of building and also hides away unsightly work areas giving a tidier look. However, the application of scaffolding nets is not limited to just buildings, but people are increasingly using them for fencing, car shade covering and as floor matting during functions due to easy and cheap availability of the nets.

Scaffolding nets are knitted from High Density Polyethylene (HDPE) UV stabilized monofilament yarn. The UV stabilizers added to HDPE develop resistance to UV rays thus, increasing the product life.

As per market insights, scaffolding nets contribute about 20% of the total cost of using scaffolding with scaffolding net. The production of scaffolding nets stood at Rs. 97 Crores in India in 2012-13 which contributed to the domestic demand.

Scaffolding nets in India is mainly manufactured by the large netting companies like Garware Technical Fibres, Rishi Techtex Ltd., Safe nets, Kwality Nets Manufacturing Co. Pvt., Ltd. and Netlon Ltd.

The market size in 2019-20 was Rs. 226.80 Crores and the expected market size for India in the year 2024-25 is Rs. 365.27 Crores based on the expected CAGR of 10% as driven by high-rise construction industry. The global consumption was about US$ 334 Million in 2019-20 and it is expected to grow at a CAGR of 5% to become US$ 425.92 Million by 2024-25.

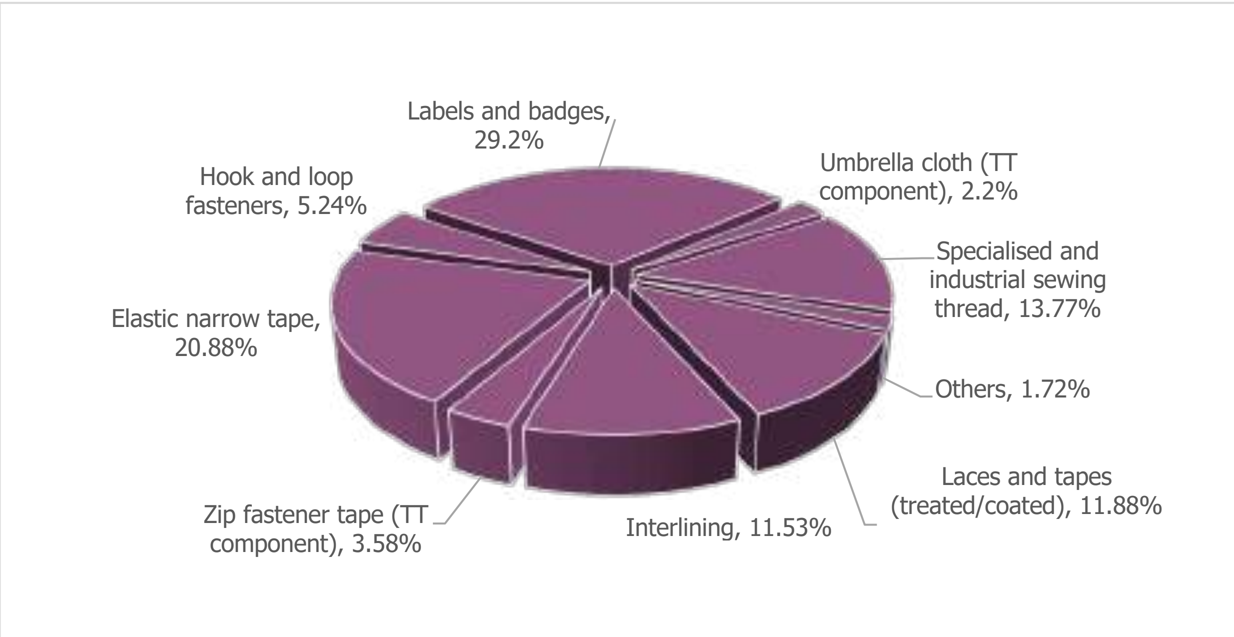
9.4 Clothtech

Clothtech are the type of technical textile materials used for specific applications in making garments. Clothtech is also used for making special purpose cloth and footwear.

Technical textile products under Clothtech segment are as follows:

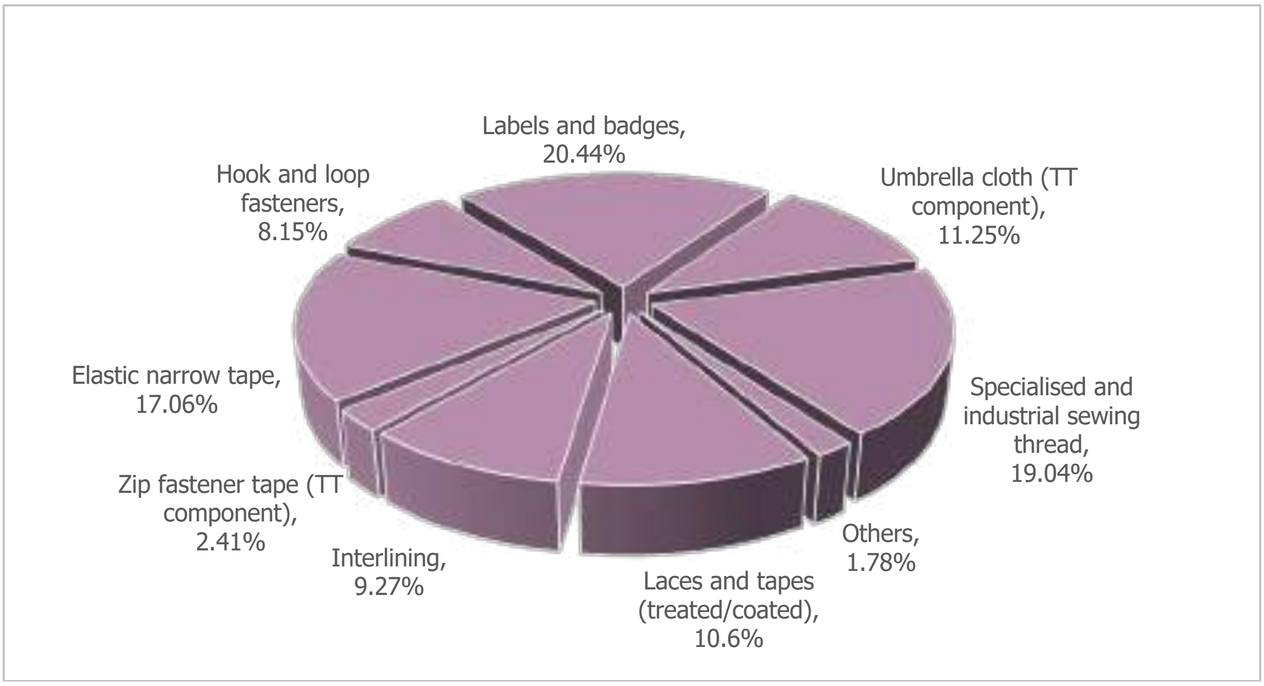
1. Elastic narrow tape
2. Hook and loop fastener
3. Interlining
4. Labels and Badges
5. Shoelaces
6. Specialised and Industrial Sewing Thread
7. Umbrella cloth (TT Component)
8. Zip fastener tape (TT Component)
9. Laces and Tapes

Figure 9.7: Percentage contribution of Clothtech products in the domestic market (2019-20)



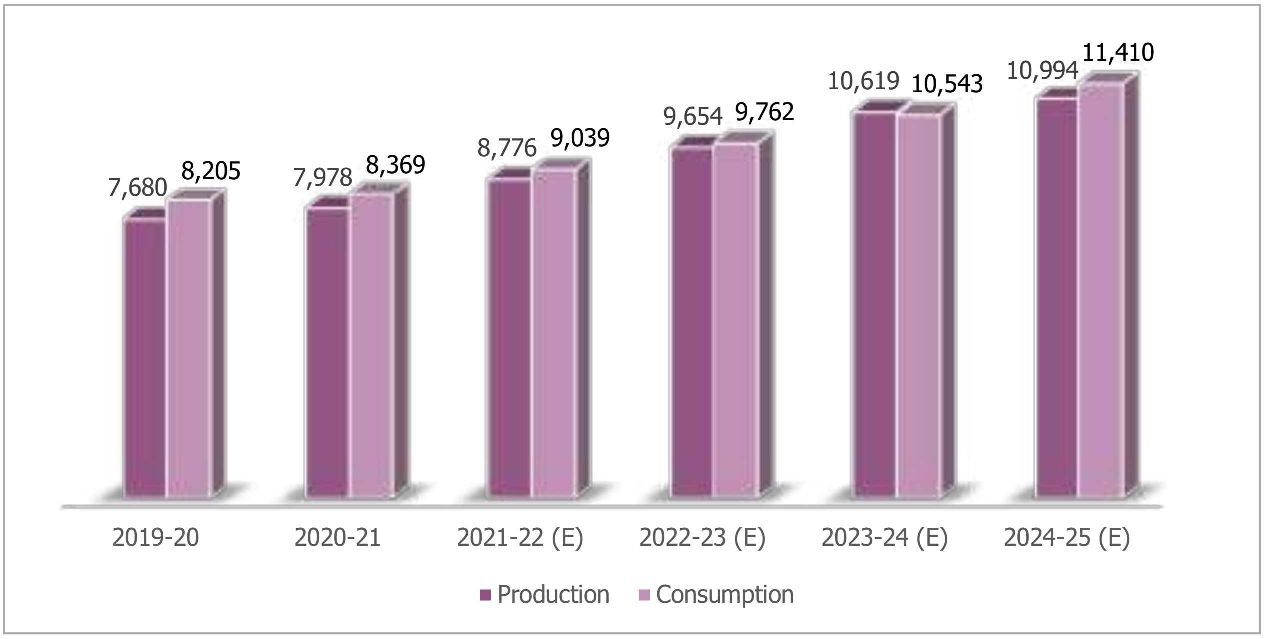
Label and badges constituted the largest (29.2%) share of the Indian Clothtech market in 2019-20, followed by the share of elastic narrow tape (20.88%).

Figure 9.8: Percentage contribution of Clothtech products in the international market (2019-20)



At the global level, labels and badges, specialised industrial sewing thread and elastic narrow tape are the biggest products by market share at 20.44%, 19.04% and 17.06% respectively.

Figure 9.9: Production vs. Consumption of Clothtech segment in the domestic market (Rs. Crores)



The consumption (value estimated at Rs. 8,205 Crores in 2019-20) of Clothtech products exceeds the production (estimated value Rs. 7,680 Crores). India is currently an importer and is going to remain one even though the gap between production and consumption is going to reduce in value terms.

Table 9.5: Clothtech - World and India Market Size 2019-20			
Product Name	**World (US$ Million)**	**India (Rs. Crores)**	**India's share**
Elastic narrow tape	1,989	1,714	13.23%
Hook and loop fastener	950	430	6.95%
Interlining	1,081	946	13.44%
Labels and badges	2,383	2,396	15.44%
Laces and tapes	1,235	975	12.12%
Specialised and industrial sewing thread	2,219	1,130	7.82%
Umbrella cloth (TT Component)	1,311	181	2.12%
Zip fastener tape (TT Component)	281	293	16.03%
Others	207	141	10.48%
Total	11,656	8,205	10.81%

9.4.1 Elastic Narrow Tape

Elastic rubber tapes are elastic inserts used in textile and apparels such as underwear, swimwear, swimsuits, knitwear, socks, bathing caps, lingerie, and sportswear. They are highly heat resistant, have excellent launderability, zero shrinkage in wet as well as dry conditions, have excellent wash resistance, and are resistant to saline water, chlorine, and suntan lotions. Elastic offers better shape and fitting to the garments making it the essential consumable item in many products. Stretching under force, staying firm for longer duration, and regaining the original shape upon withdrawal of force is the greatest characteristic of elastic tape leading to its multiple applications. They are either made from an elastometric yarn or yarn made from cotton, polyester and nylon. More than 3000 varieties are manufactured which can later be classified as woven and knitted based on the manufacturing process used.

The popularity of knitted fabric has led to an increase in the demand for elastic tape. 80-85% of elastic rubber fabrics are consumed by the undergarments industry. The need for exact size is eliminated by the elastic narrow fabrics, providing flexibility of sizes to the manufacturers and convenience of comfort, and fit to the customers.

Some of the leading manufacturers in India for elastic narrow fabrics are J.V. Tapes, Viken Tape Pvt. Ltd., Sky Industries, B R Elastic, Siddhartha Filaments, Premco Global, Tulip Elastic, Agarwal Elastic, MP Tapes, Clifton Tapes, Kumar Elastics, Kohinoor Elastics, and Balaji Tapes. Spica Elastic Pvt. Ltd. is the largest manufacturer of narrow elastic fabrics in India with a capacity of 18 Million metres of narrow fabrics per month. Some of the global players are Habasit, PT. Fillattice Indah Industry, Altra, Cardinal Health, Zenith Garment Accessories Co. Ltd., and China Besco Industrial Co. Ltd.

India's share in the global elastic rubber tapes market stood at 13.23 % with a market size of Rs. 1,714 Crores during 2019-20 and it is likely to grow to Rs. 2,306.25 Crores by 2024-25 as it is expected to grow at CAGR of 6.2% during this period. The global market size in 2019-20 is estimated at US$ 1,989 Million which is likely to grow at a CAGR of 4% and reach US$ 2,419.92 Million by 2024-25.

9.4.2 Hook and loop fasteners

Hook and loop fasteners are two lineal fabric strips attached to the opposing surfaces to be fastened. It consists of two components; hook and small loops on the opposite sides which when pressed together, the hoops catch loops and the two fabrics bind temporarily, which can be separated by pulling the surfaces. Hook and loops are substitutes for conventional attachment methods. It provides comfort when applied in apparels such as shirts, jackets and is a boon for the paediatric and elderly population. Based on application, the hook & loop products market can be divided into footwear & apparel, transportation, industrial manufacturing, medical, automotive, and others. The increasing customer spending on premium footwear for children and sports is accelerating demand for hook and loop fasteners in the footwear industry. Other than apparels, they are also used in bundling products for floriculture, agriculture, viticulture industry for plant and bundle ties, arranging miles of network wire, orthopaedic and orthotic devices, as they offer efficient and adjustable joint and limb support and in-home, and workplace maintenance and these support the demand for hook and loop in the recent years. Asia Pacific, especially India and China are the fastest growing markets.

Sky Industries Pvt. Ltd. is the leading Indian manufacturer of hook and loop. Other leading Indian players are Siddhartha Filaments Pvt. Ltd., Magic Fasteners Pvt. Ltd. Leading global manufacturers are Velcro BVBA (most famous one), 3M, YKK Corporation, Dunlop Industries Inc., Paiho North America, Lovetex Industrial Corp., HALCO, Krahnen & Gobbers GmbH, APLIX, and Gottlieb Binder GmbH & Co. KG. Among these, Velcro BVBA., 3M, APLIX Inc., Kuraray Group, and YKK Corporation accounted for a significant portion in the global market.

India’s market size of Rs. 430 Crores for the hook and loop fasteners market stood at 6.95% of global market during 2019-20. It is likely to grow at a CAGR of 4.5% to Rs. 536.34 Crores by 2024-25 when the world market size is likely to grow at CAGR of 5% from US$ 950 Million in 2019-20 to US$ 1,212.47 Million in 2024-25.

9.4.3 Interlining

Interlining is delicate, thick, and adaptable material used between the inner and outer layers of the garment to improve shape retention, strength or bulk. Its texture depends on the material that is used to make it i.e. the filaments of cotton, nylon, polyester, fleece or with their mixes. The product can be classified as woven, non-woven and knitted. They are used in waistbands, flies, pockets, and belt loops of men's trousers, in the cuffs, collars, plackets of shirts and in the lapels, fronts, collars, and pockets of tailored jackets and blazers. Invisible from the outside, interlining ensures an accurate fit and optimum wearer comfort and, thus it forms an important part of the garment. Interlinings simplify sewing and retain the shape and appearance of materials. It also keeps the apparel easy to wear and lasting.

The Asia Pacific region dominates the interlinings market in terms of revenue. The key factor driving the growth of the market in the region is the presence of major manufacturers of interlining in countries such as China, India, and Bangladesh and the market is expected to grow in the near future due to increase in demand for ready-to-wear clothes. Some of the major global players in the interlinings & linings market are Chargeur, Freudenberg, Wendler, Kufner, QST, Veratex, PCC, Edmund Bell, Block Bindings, H&V, NH Textil, Helsa, Evans Textile, Permess, Whaleys, MacCulloch & Wallis, Godolo, Alam, R.M.I., Shaning, Concorde, Jianghuai, Haihui, YiYi, Yoniner, Huawei, Kingsafe, UBL, Seattle, FIX, Zhonghe, Surya, Ruby, Talreja, Blue Star, Welco Agencies, Turakhia Textiles (IN). Key Indian players are Freudenberg India, Ruby Mills, Bombay Dyeing, Talreja Textiles and Ashima Syntax.

India's interlining market was worth Rs. 946 Crores in the year 2019-20 and is likely to grow at a CAGR of 5.5% and touch a value of Rs. 1,235.41 Crores by the year 2024-25. The world market size stood at US$ 1,081 Million and is expected grow at a CAGR of 3.99% and reach US$ 1,314.57 Million by 2024-25.

9.4.4 Labels and Badges

A label has information on the product's origin, manufacturer, use, shelf-life, and disposal. Labels are of two types printed and woven. Printed labels often use satin, polyester, nylon and cotton twill. They are available in variety of sizes and colours. On the other hand, woven labels are also available in variety of fabric choices like satina and taffeta. Badges are attached to clothing, bags, footwear, vehicles, electrical equipment and are generally made up of metal, plastic, leather, textile or rubber. Badges can be of different types such as button badges, cloth badges, enamel lapel badges and name badges.

China and Europe are the largest consumers of labels and badges. India is a growing market for labels and badges due to increase in the use of track & trace technologies. Label industry is concentrated in several key cities like Bengaluru, New Delhi, Tirupur, Mumbai, Ahmedabad, Kolkata, and other cities of North and North-east in India. Leading Indian manufacturers in India are KK NonWovens, Premco Global, Lynx, Arex Industries, Uniroyal India, Unique Tags. Labels and badges constitute the largest share of the Indian Clothtech industry.

India had a market size of Rs. 2,396 Crores during 2019-20 and it is likely to witness a CAGR of grow at 6.5% to about Rs. 3,276.80 Crores by 2024-25. The estimate of world market size in 2019-20 is US$ 2,383 Million and it is likely to grow for next five years at a CAGR of 4% to reach a figure of US$ 2,899.28 Million in 2024-25.

9.4.5 Laces and Tapes (Treated/Coated)

Treated/Coated Laces and tapes, often referred as laces and tapes are small trimmed narrow fabrics used in clothing sector. The usage of this technical textile is in shoe laces, tapes and laces used in apparels in particular ladies dresses. According to some experts, shoe laces constitute about 95% of the demand for laces and tapes. These laces are primarily made of polyester, cotton and nylon. Due to its durability and better anti-slip properties, polyester laces outdo the others. India is the second largest manufacturer of footwear in the world and this acts as a major driver of the lace industry in India.

Some of the domestic manufactures are Neelam Shoe Lace Industry , India Shoe Lace. Mr. Lacy, Starks, Aventure, OrthoStep, Nike, BIRCH are some of the main global world manufacturers.

The value of India's domestic market for Treated/ Coated Laces and Tapes is estimated at Rs. 975 Crores in 2019-20 and it is expected to touch Rs. 1,526.90 Crores by 2024-25 at a CAGR of 9.5%. The size of world market for this product was US$ 1,235 Million in the year 2019-20 and is likely to grow at a CAGR of 3% for next five years and touch US$ 1,431.70 Million in 2024-25.

9.4.6 Specialised and Industrial Sewing thread

Sewing threads are cabled yarn made out of natural or synthetic fibre. In terms of preference till now, cotton fibre as a natural fibre is more in use than synthetic fibre due to its easy sew-ability as compared to silk or linen. Synthetic fibres such as nylon and polyester are used for their high tensile strength, high abrasion resistance and lesser shrinkage. These threads find their usage in garments, shoes, leather products, quilts and mattresses. Further, there are sewing threads for specialised and industrial uses in footwear, bags, saddler, leno bags and jumbo bags industries. Only the sewing threads used for specialised and industrial purposes like the ones for bags, footwear, saddler, large polypropylene based carry bags and jumbo(FIBC) bags along with specialised threads for core industrial applications are protective applications (Nomex and Kevlar threads) are considered as Technical Textile products due to their specialised functional use.

Despite having some key manufactures of sewing threads in India such as Vardhaman Mills, Madura Coats, Reliance industries and Precot Meridian, India is a net importer of sewing threads The major importer for specialised threads is DuPont which imports both Kevlar and Nomex threads in India.

India’s market size for Specialised and Industrial Sewing Threads was estimated at Rs. 1,130 Crores in 2019-20 and it is expected to touch Rs. 1,769.39 Crores in 2024-25 as a result of growing at a CAGR of 9.5%. The size of world market for this product was US$ 2,219 Million in the year 2019-20 and is likely to grow at a CAGR of 4% for next five years and touch US$ 2,699.75 Million in 2024-25.

9.4.7 Umbrella cloth (TT Component)

Umbrella is a portable canopy-like structure designed to protect a person from sunlight and rain. Umbrella as a whole is made up of canopy material, such as microfibre fabrics, nylon taffeta, cotton, acetate, laces, leather, linen and others, along with materials such as aluminium, steel, wood, and plastic for other parts. Umbrella cloth/fabric is the technical textile component of umbrella. Umbrella fabric is made up of polyester yarn or nylon filament yarn in varying combinations such as 150T, 160T and 190T where T represents the thread density. It can also be made up of pongee, satin, and plastic. There are various kinds of umbrellas; commercial umbrellas, classic umbrellas, bubble umbrellas, wind-resistant umbrellas, automatic umbrellas, golf umbrellas, artistic umbrellas, paper umbrellas and child umbrellas. Unpredictability of weather conditions and rising concerns about skin cancer from the UV radiation of the sun are driving the growth of the umbrella market around the globe.

Major players in international market are GustBuster, CrownCoast, Cloud Nine, Rain Ducky, Repel Umbrella, Blunt Umbrellas, Alexander McQueen, London Undercover, RainStoppers, KolumboNonbreakable, Lewis N. Clark. In India, umbrella fabrics are manufactured mainly by SME and MSME industries with a very limited number of large-scale players. Leading manufacturers of umbrella fabric in India are SL Banthia Industries, Coated Sales Company, Citizen Umbrella Manufacturers, etc. Umbrella fabrics are mainly imported from China.

India’s share in the technical textiles component of umbrella market is 2.12 % of the global market size in 2019-20. India had a market size of Rs. 181 Crores in 2019-20 which is expected to grow to Rs. 241.78 Crores by 2024-25 at a CAGR of 6%. The value of the global market in 2019-20 is estimated at US$ 1,311 Million and it is likely to grow at a CAGR of 1.84% and reach US$ 1,436.13 Million by 2024-25.

9.4.8 Zip fastener tape (TT Component)

Zip fasteners, also known as clasp lockers, are commonly used devices for binding the edges of an opening of fabric or other flexible material, as on a garment or a bag. They are made from three major components namely tape, slider, and elements. Zip fasteners/Zippers come in all different sizes, shapes, and colours. Zip fasteners can be categorised by type and by applications. They can also be classified based on applications, garment, luggage & bags, sporting goods and camping gear. The surge in clothing expenditure is estimated to foster positive development in the global zipper market. Due to the increased penetration of western outfits, fashion conscious consumers, quality branded apparel, and expansion of the automotive industry the zip fasteners market is likely to receive a boost.

The Japanese giant YKK and Chinese challenger SBS account for well over half the global zipper market. Major domestic manufacturers are Vishant Traders Pvt. Ltd., Chetan Enterprises, Priya International, YKZ Zip Fasteners Pvt. Ltd., Toni Industries Pvt. Ltd. and Microplast. The international market is dominated by YKK, RIRI, YBS Zipper, Kao Shing Zipper, IDEAL Fastener, Coats Industrial, SALMI, Max Zipper, Sanli Zipper, HHH Zipper, KCC Zipper, Sancris, SBS, 3F, YCC, Weixing Group, YQQ, XinHong Zipper, CMZ Zipper, Zhejiang LIDA Zipper, Xinyu Zipper, HSD Zipper, TAT-Zipper, JKJ Zipper, DIS, THC Zipper, ABC Zipper, Hengxiang Zipper, Hualing-Zipper and QCC.

India’s market size for zip fasteners was at Rs. 293 Crores in 2019-20 and it is expected to touch Rs. 392.15 Crores by 2024-25 at a CAGR of 6%. The size of world market for this product was US$ 281 Million in the year 2019-20 and is likely to grow at a CAGR of 5.01% for next five years and touch US$ 358.81 Million.

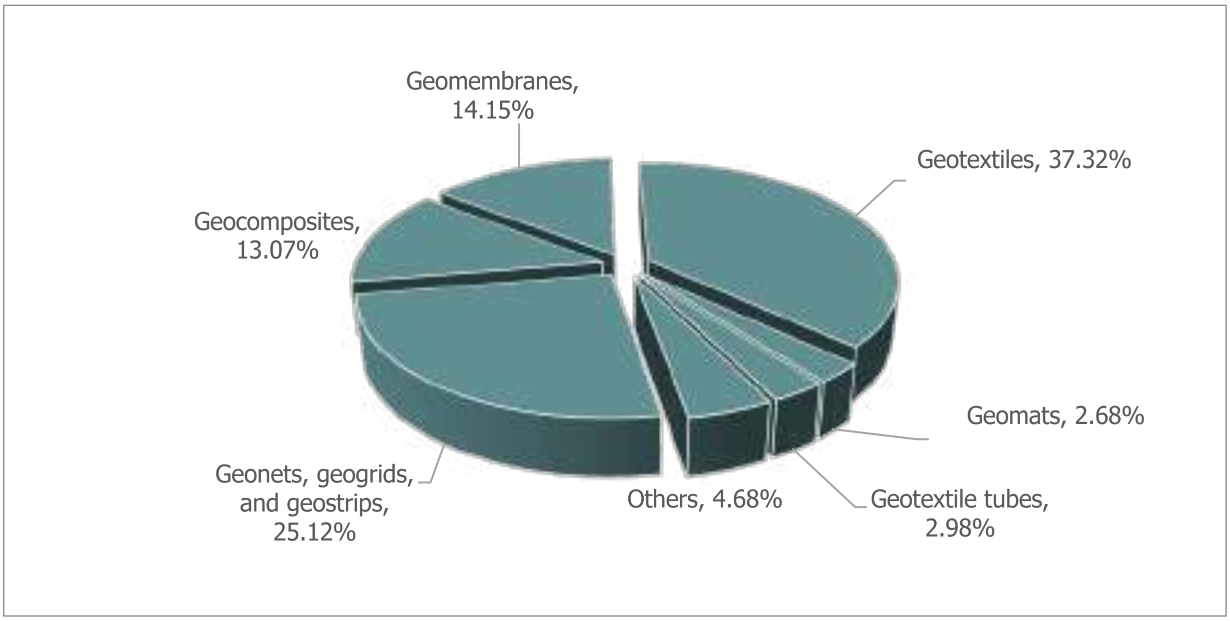
9.5 Geotech

Geotextiles are a kind of geo-synthetic material that owe their success to their resistance to biodegradation. They are mostly made by using synthetic fibres that can be made into a flexible, porous, nonwoven needle felt fabric. They are porous to water flow to a varying degree.

Technical textile products under Geotech segment are as follows:

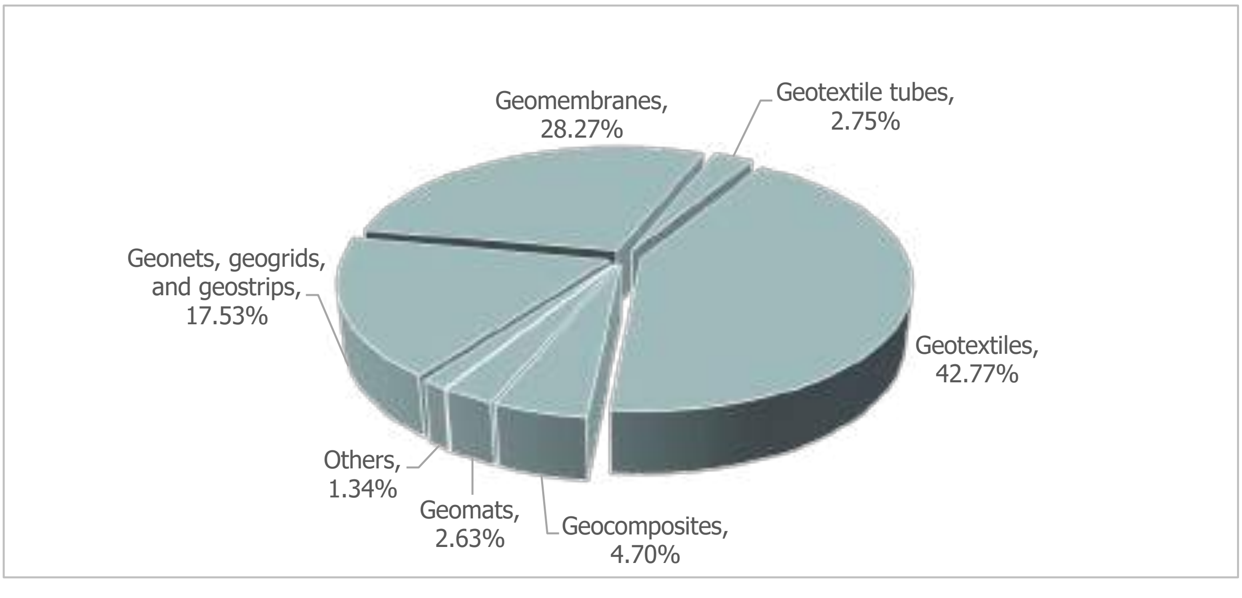
1. Geotextiles
2. Geomembranes
3. Geonets, Geogrids and Geostrips
4. Geocomposites
5. Geotextile tubes
6. Geomats

Figure 9.10: Percentage contribution of Geotech products in the domestic market (2019-20)



Geotextiles form the biggest portion of the domestic market at a share of 37.32% and Geonets, Geogrids and Geostrips at 25.12% have the second largest share.

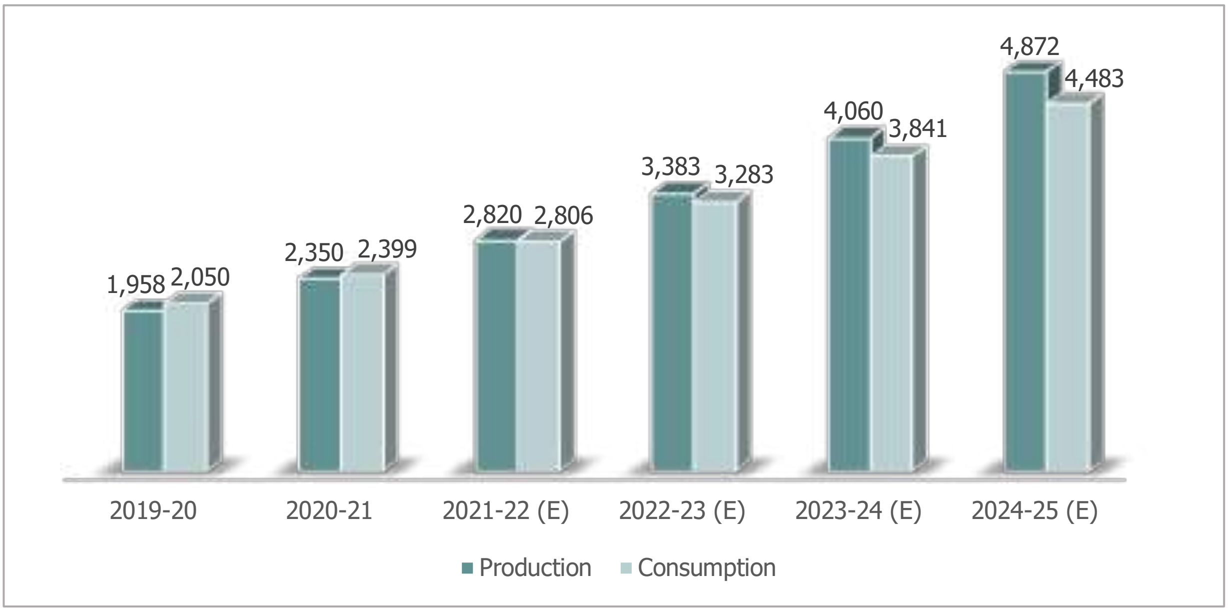
Figure 9.11: Percentage contribution of Geotech products in the international market (2019-20)



Globally, Geotextiles have the biggest market share at approximately 43% and Geomembranes at nearly 28% have the next largest share.

Table 9.6: Geotech - World and India Market Size 2019-20			
Product Name	**World (US$ Million)**	**India (Rs. Crores)**	**India's share**
Geotextiles	3,184	765	3.69%
Geomembranes	2,105	290	2.12%
Geonets, Geogrids and Geostrips	1,305	515	6.06%
Geocomposites	350	268	11.76%
Geotextile tubes	205	61	4.57%
Geomats	196	55	4.31%
Others	100	96	14.74%
Total	7,445	2,050	4.23%

Figure 9.12: Production vs. Consumption of Geotech segment in the domestic market (Rs. Crores)



The consumption (value estimated at Rs. 2,050 Crores in 2019-20) of Geotech products exceeds the production (estimated value Rs. 1,958 Crores). India is currently an importer and is likely to become a net exporter due to expected higher rate of increase in production despite increase in consumption over the coming five years (till 2024-25).

9.5.1 Geotextiles

Geotextiles are permeable material fabricated like a blanket from synthetic yarns or fibres. There are three main types of geotextiles: woven, nonwoven and knitted type. Most of the woven and nonwoven geotextiles are manufactured from yarns and fibres such as polypropylene, polyester, polyethylene and polyamide. A few geotextiles are produced from natural fibres such as jute due to its biodegradable nature. Such geotextiles are mostly used in erosion control applications.

The major applications of Geotextiles are in roads and highways for reinforcement, separation, drainage/filtration, containment and erosion control; railroad track construction and maintenance for separating the sub-grade from the ballast layer or the sub-grade from the sub-ballast layer, reinforcement, filtration, and drainage; flood control and coastline protection through reinforcement of flood control structures such as levees and dams built over soft soils, containment of storm water runoff and restoration of threatened coastlines; waste management through separation, filtration, and erosion control. Residential and non-residential construction utilise geotextiles for reinforcement of retaining walls.

Major global manufacturers of geotextiles are TenCate Geosynthetics Americas, Propex Inc., CONTECH and DuPont and the main manufacturers of geotextiles in India are Techfab India Ltd., Strata Geosynthetics Ltd., SKAPS Ltd., Maccaferi Environmental Solutions, Terram India Ltd.

It is estimated that the market size of geotextiles in India in 2019-20 was Rs. 765 Crores and it is likely to grow at a CAGR of 20% to Rs. 1,903.56 Crores by 2024-25. The global market for geotextiles is US$ 3,184 Million in 2019-20 and it will grow at a CAGR of 6.1% to reach a figure of US$ 4,261.20 Million in 2024-25. USA consumes almost a third of geotextiles of the world.

9.5.2 Geomembranes

Geomembranes are generally non-permeable sheets which are available in large custom panels or rolled goods that can be field seamed to form a barrier system. These are produced from various types of polymers (e.g. LLDPE, HDPE, PVC, CSPE, EPDM and PPE) as well as layered fibreglass and bitumen-impregnated geotextile. The most common use of geomembranes is the containment of hazardous and urban waste and their leachates. Geomembranes are often used in combination with geotextile or mesh underliners. The underliner reinforces and protects the more flexible geomembrane, while providing an escape route for gases and leachates generated in some wastes. The usage of Geomembranes in the developed nations is very high but its use in India is relatively low and that too primarily for water management in the form of liners for canals and reservoirs. In addition to what is strictly defined as Geomembranes, there is a wide range of extruded plastic sheet-based liners of different thicknesses which are also used as liners of water bodies. These are also regarded by some as part of Geomembranes. However, for the present report, such plastics are kept out of the purview of Geotech.

There are only a few Indian manufacturers for Geomembranes and the prominent ones among them are Strata Geosystems (India) Pvt Ltd., Maharshee Geomembrane (India) Pvt. Ltd., Megaplast India Private Limited (MIPL), Maruti Rub Plast Pvt. Ltd., Essen Multipack Ltd. and DP wires Ltd. The major global players are TenCate Geosynthetics, Solmax Geosynthetics LLC, GundleSLE Environmental (GSE), Maccaferri Corporate, Thrace Group, Tenax S.p.A., Tensar International Corporation, GSE Environmental, Fibertex Nonwovens A/S, HUESKER Synthetic GmbH, Fibromat (M) Sdn. Bhd., Agru America Inc., Steklonit, Strata Systems Inc., Pietrucha Group, Global Synthetics and SKAPS Industries. There are two major Geoliner manufacturers too at the global level viz. Owens Corning Inc. and Texel Geosynthetics Inc.

The domestic market for geomembrane in India is as yet limited and is estimated at Rs. 290 Crores for the year 2019-20. However, it is expected to experience a high CAGR of 20% in the next five years and reach a market size of Rs. 721.61 Crores in 2024-25. While the USA, being the largest market for Geomembranes consumed 217 million square yards of Geomembranes worth nearly US$ 1.1 billion in 2020, the world market for Geomembranes in the same year is estimated to have been worth US$ 2,105 million. The world market is likely to grow at a CAGR of 4.5% and log sales worth US$ 2,619.77 Million by 2024-25.

9.5.3 Geonets, Geogrids and Geostrips

Geonets and geogrids are the terms for geosynthetic materials of rigid type that are fabricated in the form of a regular mesh with relatively large voids in the material. Geostrips are fabricated in the form of strips. Geonets and geogrids are produced by different methods (e.g. extrusion, bonding, and interlacing) from polymeric materials. Geonets and geogrids are typically used to provide reinforcement of soil structure beneath civil construction or roads by distributing the load over a broader area. Geonets/geogrids are of two types: biaxial and uniaxial. Biaxial geonets and geogrids are used in roadways, where they are used to stabilise or to reinforce the base materials. Uniaxial geogrids are mainly used to reinforce the soil mass in a steepened slope or segmental retaining wall and to a small extent as a wrapping to confine the aggregate in the wire forms of welded wire faced steepened slopes. Geonets are being used in railway construction on account of their ability to act as filters, separators, and facilitators in channelising water through lateral drainage. In addition, they are used for the reinforcement of rail tracks for stress reduction, thus ensuring long-term efficient performance. Roads and highways, railroads, airports use geogrids to reinforce runways and embankments, geogrids are used primarily in landfill soil reinforcement applications such as reinforcing landfill covers and base liners and geogrids are used to reinforce mining roads and mine walls and ceilings.

The situation in India for geostrips is different from what it is in other countries. Reinforced soil walls are built in large quantities and they consume geostrip and geogrid more than geotextile tubes. Geostrips are mainly used along the road for manufacturing retaining walls due to less availability of space in India. Geostrips have maximum share in reinforced soil wall segment.

Geonets and geogrids are typically fabricated from HDPE, polypropylene, polyester or fiberglass yarn. Geogrids are primarily made of polypropylene, polyethylene, or polyester. Uniaxial grids are made from HDPE and biaxial grids from PP. Geonets are generally made from high-density polyethylene and are used for drainage applications. To provide the geogrid with dimensional stability during handling and installation, the yarns may be coated with PVC, bitumen, or latex. In some cases, two layers of geogrid are offset and welded together to create a sheet with random sized openings that reportedly result in improved soil interaction.

Major players for this product group in India are Strata Geosystems (India) Pvt. Ltd, Techfab India Ltd, Reinforced Earth and Maccaferri Environmental Solutions, Maruti Rub Plast Pvt. Ltd and Geosys India Ltd. Prominent global players are Tensar Corp., Strata Systems, Synteen Technical Fabrics, Tenex, Colbond, Koninklijke TenCate BV, Naue GmbH & Co., Huesker Synthetic GmbH and Ace Taiwan.

The global market for geogrids was US$ 1,305 Million whereas the Indian market stood at Rs. 515 Crores in 2019-20. The global market is expected to grow at a CAGR of 5.5% and likely to touch a value of US$ 1,704.92 Million whereas the Indian market is expected to grow at a CAGR of 15% for the next five years. It is projected that the Indian market will be worth Rs. 1,035.85 Crores by the year 2024-25.

9.5.4 Geocomposites

Geocomposites are those materials which are made of two components viz. geofabric and geonet. These consist of a combination of geotextiles, geonets, geogrids, and/or geomembranes. It is the desired characteristics of the end-product which determines the mix of geocomposite materials and manufacturing methods. Geosynthetic clay liners or GCLs, which are fabricated with a bentonite clay layer either sandwiched between two layers of geotextile or else bonded to a geomembrane or single layer of geotextile are also considered as Geocomposites. The hydrated GCLs are mostly used in landfill liner applications in combination with a conventional geomembrane. The market for geosynthetic clay liners, especially in solid waste applications, is growing faster than other product segments.

The most common type of geocomposite is drainage geocomposites. Drainage geocomposites consist of a three-dimensional core layer through which fluid or gas flows, with geotextiles attached to one or both sides to filter out soils and other particulates that could impede the fluid flow through the drainage core and thus provide stability to the soil by providing friction for shear stability on slopes. There are three types of drainage geocomposites, based on the core materials, Geonet core composites, Geomat core and Cuspated core. The geotextile layer(s) of a drainage geocomposite may be made of woven or nonwoven (usually PP or PE) geotextile. PP monofilament geomats or HDPE geonets are the commonly used drainage cores.

Drainage is the most common application for a geocomposites in different fields such as road building, solid and hazardous waste landfills, mining, and private construction. Drainage composites are also used to remove gases, as in the case of landfill gases.

Major market players which produce Geocomposites in India are TechFab India Ltd., Maccaferri Environmental Solutions and Terram Geosynthetics Pvt Ltd. At the global level, the main producer organisations are ABG Ltd., Terram Geosynthetics Private Limited, Thrace Group, Tenax Group, Crafco, Inc., SKAPS Industries, Koninklijke Ten Cate BV, Tensar International Corporation, GSE Environmental, Officine Maccaferri Spa, HUESKER International, Leggett & Platt Inc., Qingdao Haisan New Energy Co. Ltd., Edifloor S.P.A., American Wick Drain, Alyaf industrial company limited, NAUE GmbH & Co. KG, Contech Engineered Solutions LLC, MDB Texinov, Hanes Geo Components.

The market size for geocomposites in India for 2019-20 is Rs. 268 Crores and is likely to grow at a CAGR of 15% and is estimated to be Rs. 539.04 Crores in 2024-25. The world market for geocomposites is estimated at a value of US$ 350 Million and the forecast is for it to grow at a CAGR of 6.5% and reach US$ 479.78 Million by 2024-25.

9.5.5 Geotextile tubes

Geotextile tubes are among the most commonly used and most economical choice for dewatering a large site, water reservoir or waste water treatment plant. Dewatering tubes remove and control sludge or sediment from a water flow and are a very good alternative to mechanical methods used for dewatering. Geotextile tubes are environmentally friendly because the decanted water can be recycled as also the water that is placed into storm drainages or water tables The large-size Geotextile tubes with high strength and durability can act as effective sludge tubes for heavy containment requirements. Geotextile tube systems are often used for coastal and marine construction for erosion control on the shores, land reclamation, island creation, wetlands creation, construction platforms, revetments, dykes, and offshore structures. The cost efficiency, speed and very low environmental impact, sludge dewatering geotextile tubes are increasingly being used in marine dredging, water and wastewater treatment, construction dewatering, remediation of agriculture and protection of shoreline. Geotextile tubes offer the ideal coastal protection and erosion mitigation solution as they are environmentally friendly and flexible in nature.

Geotextile tubes are made of robust woven geotextile material (using specially engineered woven and composite fabrics) and involve the fabrication of close-ended tubular containers attached with filling ports at regularly spaced intervals. The technology involves the fabrication of large containers made of specially engineered textiles, which are filled with dredged sediments or sand on-site. Similar to dewatering bags, geotextile dewatering tubes are made from permeable fabrics that allow water to pass and filter through the bag.

Major players which produce Geotextile tubes in India are Garware Technical Fibres Ltd., TechFab India Ltd., Maccaferri Environmental Solutions and Flexituff Ventures International Limited (India). The leading manufacturers at the global level are Koninklijke TenCate BV, Maccaferri Corporate and Flint Technical Geosolutions.

It is estimated by industry experts that the market size of geotextile tubes in India in 2019-20 is Rs. 61 Crores and it is likely to grow at a CAGR of 10% and grow to Rs. 98.24 Crores by 2024-25. The global market for geotextiles is US$ 205 Million in 2019-20 and it will grow at a CAGR of 8% to reach a figure of US$ 301.77 Million in 2024-25.

9.5.6 Geomats

Synthetic geomats are usually made of synthetic material filaments (typically polyamide and polypropylene but not always) tangled together to form a high deformable layer of 10-20 mm thickness, featuring very high porosity (greater than 90% on average). However, in India , geomats are very commonly made from natural fibres like Coir (in south India) and Jute (in eastern parts of India). Geomats are used mainly for controlling soil erosion especially on slopes to offer resistance to rain induced erosion. Geomats may also be used as a protection against erosion for canal and river banks. Their use is limited to protect that part of bank that is dry and susceptible to erosion only by raindrops. Like geonets, geomats may also be used as elements for drainage in combination with geotextiles and geomembranes.

Major market players which produce synthetic geomats in India are TechFab India Ltd. and Maccaferri Environmental Solutions, at the global level, the main producer organisations are Tenax Group and Tensar International Corporation.

The world market for Geomats was US$ 196 Million whereas the Indian market stood at Rs. 55 Crores in 2019-20. The global market is expected to grow at a CAGR of 7% and likely to touch a value of US$ 275.17 Million whereas the Indian market is expected to grow at a CAGR of 10% for the next five years. It is projected that the Indian market for geomats will be worth Rs. 88.58 Crores by the year 2024-25.

9.5.7 Geocells

A geocell is a thin-walled cell that, when filled with soil, sand or gravel, enhances the load bearing capability of soft subgrade much better than compacted soil alone. Geocells are usually interconnected to form a honeycomb shape which provides reinforcement through cellular confinement and prevent sub-optimal soil from getting eroded. With the use of geocells, free draining and poorly compacting soil can also be used for construction. Geocells have been constructed from a variety of materials, including fibreglass and aluminum. However, high density polyethylene (HDPE) is becoming immensely popular as a suitable material for geocells. The use of Geocells has not caught on in a big way in India yet and it is very challenging to obtain reliable estimates of its consumption as of now.

9.5.8 Geofoams

Geofoam is rigid cellular foam polymeric material such as expanded polystyrene (EPS) which is used in geotech applications. It acts as a supplementary reinforcement fill material to a poorly compacting soil. Most geofoams and geocomposites are made from expanded polystyrene (EPS). Geofoam is relatively very light and its extreme lightness makes it an attractive fill material. Geofoam is used in embankments, slope stabilisation, retaining structures, utility protection, pavement insulation, and shallow foundations. As geofoam is very light, no large earthmoving equipment is required for moving it. Once the material is delivered to the site, blocks are easily trimmed to size and placed by hand. It also can be constructed in adverse weather conditions. Geofoams are gradually becoming popular in usage.

9.5.9 Geocombs

In contrast to geofoam, whose structure consists of closed polymer cells, geocomb consists of numerous open-ended tubes that are glued, fused or otherwise bonded together. Rigid polymers such as polypropylene and PVC are the most common types of geocomb material. The cross-section of bonded tubes resembles a honeycomb, which explains the name "geocomb" that is given to it. The open ends of the geocomb blocks are usually covered with a geotextile to prevent soil particles from entering the open ends of the tubes. Geocombs were first used in France in the 1980s, but are not yet widely used outside Europe. Geocomb applications include use as a lightweight fill, confinement of coarse-grained soils, and construction of underground storm water storage chambers.

9.5.10 Geopipes

Geocells and geofoams/geocombs are generally used for soil reinforcement, while geopipes are used for drainage of liquids and gases. Geopipes are perforated or solid-wall polymeric pipes used for drainage of liquids or gas (including leachate or gas collection in landfill applications). In some cases, the perforated pipe is wrapped with a geotextile filter. The advantage of geopipes stems from the fact that they allow higher fluid infiltration rates permitting the use of smaller diameters of pipes and they are stress resistant and do not get easily deformed. Polyvinyl chloride is the most commonly used material in the fabrication of geopipes.

Reliable estimates of the use of geopipes are difficult to obtain.

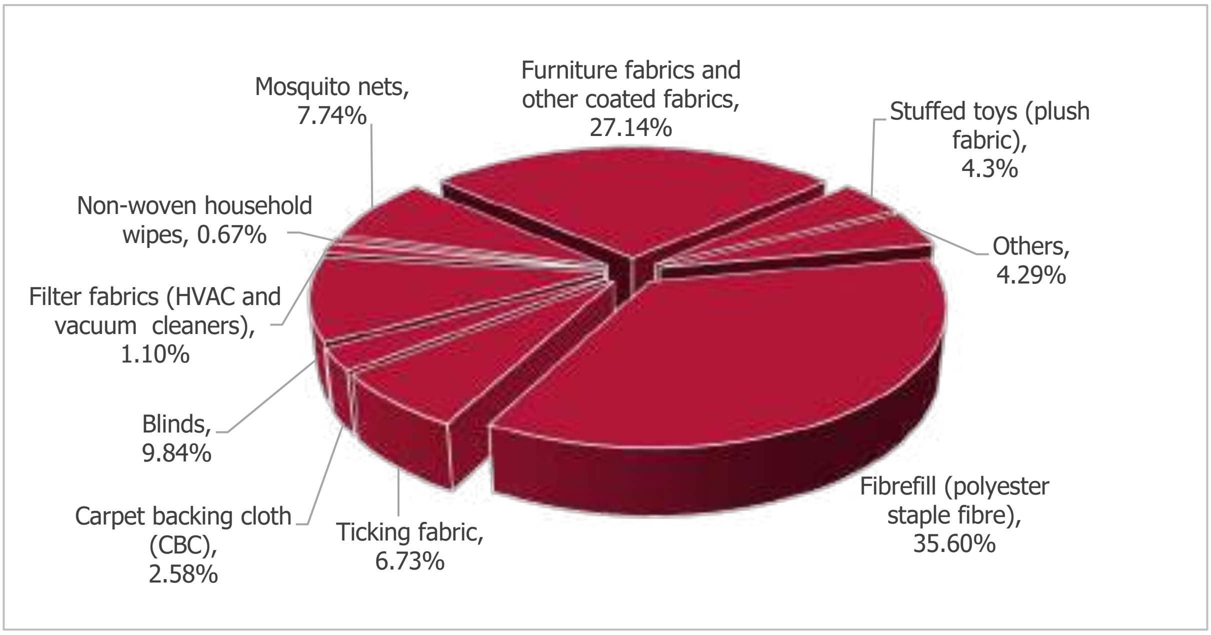
9.6 Hometech

Hometech are textiles used in home furnishings. It constitutes a range of functional and decorative products thus providing solutions to modern living. Some of the major applications of Hometech in the domestic environment are interior decoration and furniture, carpeting, protection against the sun, cushion materials, fireproofing, pillows, floor and wall coverings and textile reinforced structures/fittings.

Technical textile products under Hometech segment are as follows:

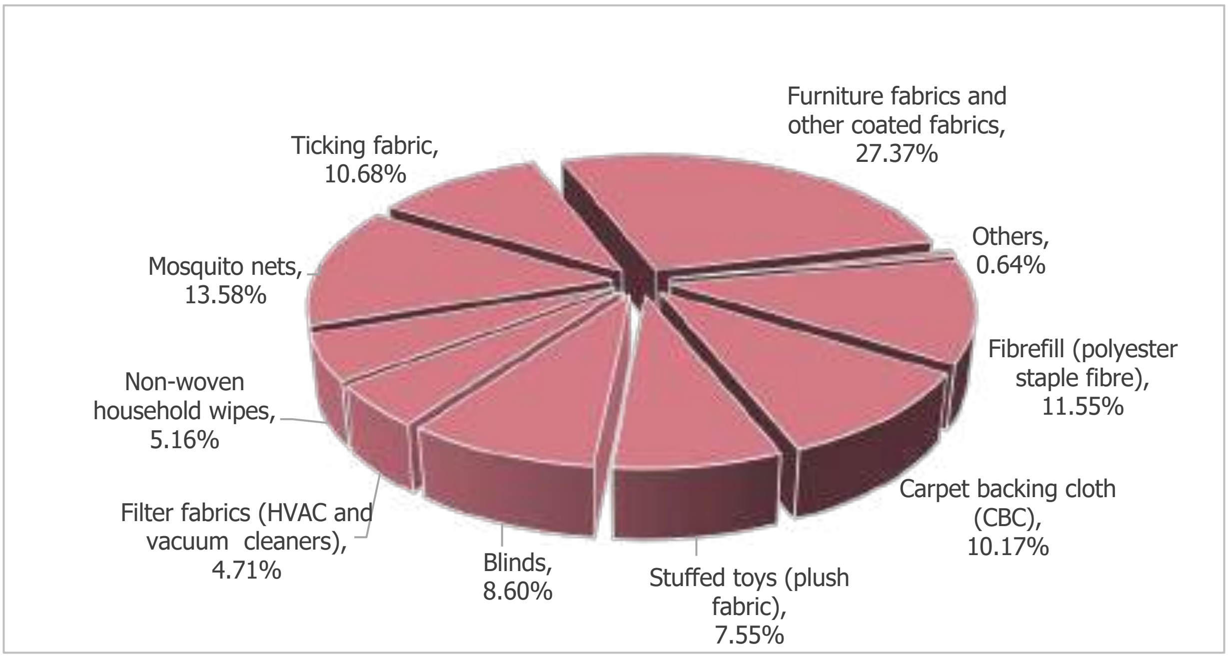
1. Blinds (TT Component)
2. Carpet Backing Cloth (CBC)
3. Fibre Fill (Polyester Staple Fibre)
4. Filter Fabric (HVAC and Vacuum Cleaner)
5. Furniture and Other Coated Fabrics
6. Mosquito Nets
7. Non-woven Household Wipes
8. Stuffed Toys (Plush Fabric)
9. Ticking Fabric

Figure 9.13: Percentage contribution of Hometech products in the domestic market (2019-20)



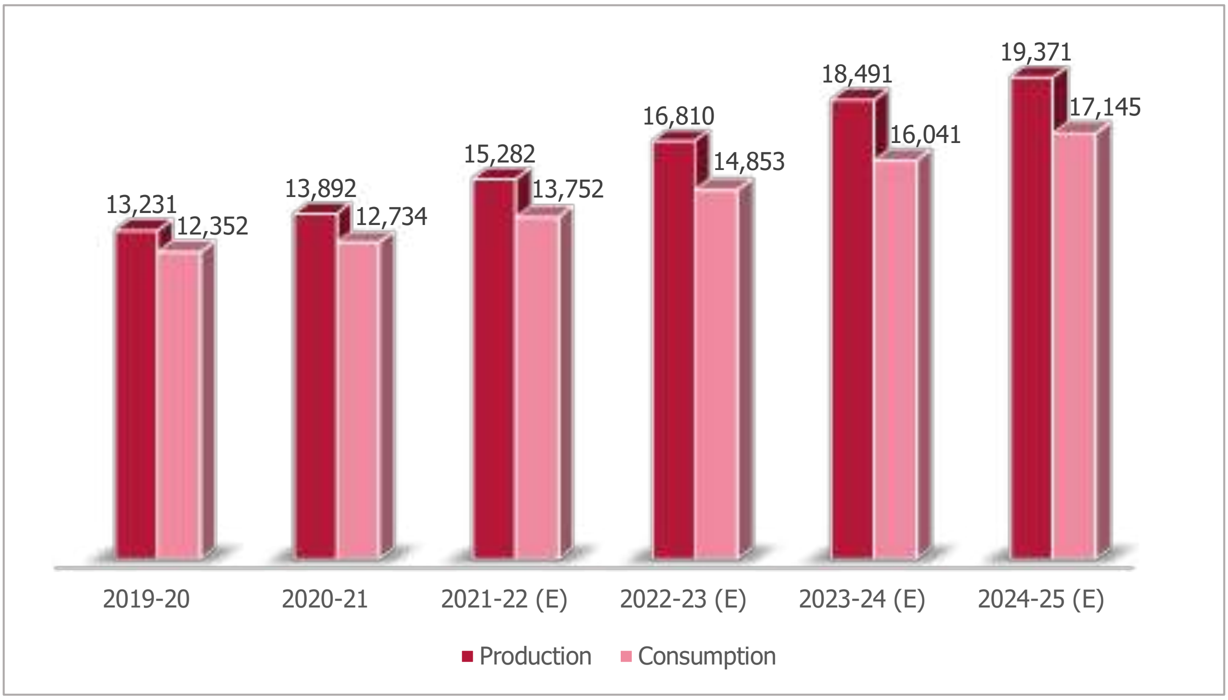
Fibrefill (Polyster staple fibre) comprise the biggest portion of the domestic market at a share of more than 35% and furniture fabrics and other coated fabrics at approximately 27% have the second largest share.

Figure 9.14: Percentage contribution of Hometech products in the international market (2019-20)



Furniture fabrics and other coated fabrics constitute the largest share of the global market at 27.37% and Fibrefill (Polyster staple fibre) at approximately 12% has the second largest share of market.

Figure 9.15: Production vs. Consumption of Hometech segment in the domestic market (Rs. Crores)



India's production of Hometech products has an estimated value of Rs. 13,231 Crores in 2019-20. It is higher than the consumption which is valued at Rs. 12,352 Crores. This gap is likely to increase which indicates good opportunities for Hometech producers to address new export markets.

Table 9.7: Hometech - World and India Market Size 2019-20			
Product Name	**World (US$ Million)**	**India (Rs. Crores)**	**India's share**
Blinds (TT Component)	1,691	1,216	11.04%
Carpet Backing Cloth (CBC)	1,998	319	2.45%
Fibre Fill (Polyester Staple Fibre)	2,270	4,397	29.74%
Filter Fabric (HVAC and Vacuum Cleaner)	925	136	2.26%
Furniture and Other Coated Fabrics	5,380	3,353	9.57%
Mosquito Nets	2,669	956	5.50%
Non-woven Household Wipes	1,014	83	1.25%
Stuffed Toys (Plush Fabric)	1,483	531	5.50%
Ticking Fabric	2,099	832	6.08%
Total	19,654	12,352	9.65%

9.6.1 Blinds

Blinds are an alternative to curtains, and these are used to provide cover and shade for windows to allow only the desired level of sunlight inside. These are made up of blind fabric. The threads and supporters are made up of wood, metal or plastic components. Blinds are used for their properties such as low maintenance, temperature control, opacity and or being fire retardant. Blinds are segmented into residential, commercial and industrial based on their application.

Leading manufacturers of blind fabrics in India are Hunter Douglas India, Alps Industries, Mac Decor and Aerolux India Ltd. Major international players are Comfortex Window Fashions, Shade O Matic, Innovative Openings, Louvolite, Maxxmar Window Fashions, Nien Made Enterprise Co. Ltd., Norman Window Fashions., Roll-A-Shade, Rollease Acmeda, Springs Window Fashions, Liyang Xinyuan Curtain, Advanced Window Blinds, Aspect Blinds, MechoShade Systems, LLC., Timber Blinds Metro Shade, Domir Blinds Manufacturing Inc., Toso Company Ltd., Graber and Budget Blinds.

India's blinds market constitutes 11.04% of the world in the year 2019-20 with market size of Rs. 1,216 Crores, which is likely to grow at a CAGR of 11.6% and touch Rs. 2,100.66 Crores in the year 2024-25. The world market is likely to grow at a CAGR of 3.34% for the next five years and will climb from US$ 1,691 Million in 2019-20 to US$ 1,992.90 Million in 2024-25.

9.6.2 Carpet Backing Cloth (CBC)

Carpet backing is the base material on the back of the carpet made up of polypropylene fabric or jute, cotton, and carpet rayon, in which yarn is tufted or stitched to make carpets. It is tear-resistant, pre-forged, woven or non-woven. The increase in residential and commercial construction activities is projected to boost the demand for carpets and therefore the Carpet Backing Cloth. These are used for residential as well as commercial purposes in hotels and stores.

Key Indian manufacturers in carpet backing cloth are Birla Corporation Ltd., Charminar Nonwovens Ltd., Foam Mattings (India) Ltd. and Indarsen Shamlal Private Ltd.

Key global players in carpet backing cloth are Shaw Industries Group Inc., Tarkett, Interface Inc., Balta Industries NV, Wacker Chemie AG, The Dow Chemical Company, Associated Weavers Europe NV/SA, Amtico International, Ege Carpets and Beaulieu Technical Textiles.

The size of India's market for carpet backing cloth was at 2.45% of world market. India had a market size of Rs. 319 Crores in 2019-20 and it is expected to increase at a CAGR of 2% and is estimated to be valued at Rs. 352.83 Crores in 2024-25. The size of the world market was US$ 1,998 Million and the global market is likely to grow at a CAGR of 4.65% to reach US$ 2,507.79 Million by 2024-25.

9.6.3 Fibre fill (Polyester Staple Fibre)

Polyester Staple Fibre (PSF) is lightweight, wrinkle-free, and weather-resistant. It is used as a key component in various end-use sectors such as apparel, home furnishing, construction and automotive. In home furnishings, it is used as filling in mattresses, pillows, cushions, and insulated quilts.

Cotton has been commonly used for filling home furnishing products, but PSF is now replacing cotton due to its thin and lightweight nature. It also offers antimicrobial properties and offers advanced protection against infections and bad odour. By application, the market can be segmented into textile, home furnishing, automotive, filtration, construction, and miscellaneous industries.

China, India and South Korea are attractive markets due to rising demand from various applications in apparel, automotive and home furnishing due to high and growing population accompanied with growth in their respective country economies.

Some of the leading Indian players are Reliance Industries Ltd., Bombay Dyeing & Manufacturing Company Ltd., Sarla Fibres Ltd., PolyFiber Industries Pvt. Ltd. and Nirmal Fibres Ltd.

Some of the leading global players are William Barnet and Son, LLC, Yizheng Chemical Fiber Company Limited, Märkische Faser GmbH, Toray Industries Inc., Far Eastern New Century Corporation and Nan Ya Plastics Corporation.

The global market for fibrefill was US$ 2,270 Million whereas the Indian market stood at Rs 4,397 Crores in 2019-20. The global market is expected to grow at a CAGR of 6.23% and have a value of US$ 3,070.87 Million whereas the Indian market is expected to grow at a CAGR of 5.7% to reach Rs 5,791.79 Crores in 2024-25.

9.6.4 Filter Fabrics (HVAC and Vacuum Cleaners)

Filter fabrics are used in home electronic devices such as vacuum cleaners, air conditioners and heating ventilation and air conditioner systems (HVAC) and are made from nonwoven fabrics. HVAC units are used to provide cooling and heating solutions for large spaces like offices, shopping malls and institutions.

There are 4 types of filters – pre-filters, medium efficiency filters, high efficiency particulate air (HEPA) filters and ultra low penetration air (ULPA) filters. This distinction is made based on efficiency of particle removal.

Most of the demand for filter fabrics comes from home AC and HVAC used in large spaces. With an increase in health disorders like allergies, headache, asthma, cough and sinus, the demand for filters is expected to rise. Government regulations for efficient air filtration systems to protect factory workers will also contribute to rising demand.

The top filter fabrics producing countries are Germany, China and the United States of America.

The major vendors in the fabric filters market are Ahlstrom-Munksjo, Lydall, Inc., Valmet, Freudenberg Filtration Technologies, Kimberly-Clark, Clear Edge, Fibertex Nonwovens, Hollingsworth & Vose, Johns Manville, Sefar AG, 3M, American Fabric Filter, APC Filtration, Berry Global Inc., Donaldson Filtration Solutions, Eagle Nonwovens Inc., Irema Ireland, MANN+HUMMEL, Norafin Industries, Nordic Air Filtration, Sandler AG, Schweitzer-Mauduit International Inc. and TWE group. Major Indian players are Autotech Nonwovens Ltd., Valmet Technologies Private Limited, Park Non Woven Pvt. Ltd., Khosla Profil Pvt. Ltd. etc.

The global market for filter fabric stood at US$ 925 Million in 2019-20, expected to grow at 5.14% to US$ 1,188.45 Million in 2024-25. The Indian market for filter fabric is estimated at Rs. 136 Crores in 2019-20. It is expected to grow at a CAGR of 12.8% to Rs. 249.41 Crores.

9.6.5 Furniture fabrics & other coated fabrics

The Indian furniture market comprises home furniture, office furniture and contract furniture (mainly in the hospitality industry). Fabrics that are used in furniture designed for seating purposes are called furniture fabrics. They are used for padding or used as coverings. There are thirteen different types of furniture fabrics, with leather and polyester being the most widely used. The coated fabrics can be fabrics used for chemical protective clothing, automatic coated fabric, transportation, awnings and canopies, industrial roofing, furniture and seating.

The Asia Pacific region is the biggest market for furniture and coated fabrics, followed by North America and Europe. India imports furniture fabrics mainly from China, Republic of Korea, Taiwan, United Kingdom, and Italy. Major Indian companies for this product are Devaa Textiles, and Aavaran Creations. Major global companies are Spradling International Inc., Seaman Corporation, Trelleborg AB, Saint-Gobain SA, Sioen Industries NV, Low & Bonar PLC, Serge Ferrari Group, Continental AG, Takata Corporation, Saint-Gobain SA and OMNOVO Solutions Inc.

The global market size of Furniture fabric and other coated fabric was US$ 5,380 Million in 2019-20, estimated to grow at a CAGR of 4.55% till 2024-25 so as to reach a value of US$ 6,720.51 Million. The Indian market was Rs. 3,353 Crores in 2019-20 and is expected to grow at a CAGR of 6.9% for the next five years to reach a value of Rs. 4,689.73 Crores.

9.6.6 Mosquito Nets

Mosquito nets, also known as mosquito bed nets, are fine meshed curtains that are draped over a bed or sleeping area to offer protection against insect bites and stings (including but not limited to mosquitoes). The mesh is fine enough to prevent passage of insects but large enough, so it doesn’t obscure visibility. A net with mesh size smaller than 1.2 mm will block mosquitoes, nets with meshes smaller than 0.6 mm are required for some other insects such as biting midges. Mosquito nets are usually made from cotton, polyethylene, polyester, polypropylene or nylon. Nets made for covering doors and windows can also be made of steel, aluminium or thick unbreakable fibre. New kinds of mosquito nets entering the market are, Mosquito Mesh, Window Mosquito Mesh, Portable Mosquito mesh, Mosquito Screen and Baby Mosquito Net.

Key Indian players are Raj Filters, Fars Wiremesh, RK Ecran, Philer and Spectra Services. African countries are some of the biggest consumers of mosquito nets, specifically insecticide treated mosquito nets, with Niger, Guinea-Bissau and Benin being some of the biggest. Key global players are Insect COP, FUANNA, Mercury, Klamboe, MENDALE and YuanMeng.

In 2019-20, the market for mosquito nets was worth Rs. 956 Crores as compared to the global market which was worth US$ 2,669 Million. The Indian market is expected to grow at a CAGR of 4% to reach Rs. 1,162.92 Crores by 2024-25. The global market is forecasted to grow at 3% and likely to be worth US$ 3,094.10 Million.

9.6.7 Non-woven Household Wipes

Wipes are products made of cloth, tissue or nonwovens which remove dirt or liquid from surfaces on light rubbing. The main purpose of wipes is cleaning, and disinfection and they are largely used for personal care but also for household cleaning and medicinal use. Nonwoven wipes are specifically made from viscose or polypropylene polyester. Nonwoven wipes are available as dry wipes as well as wet (pre-moistened) wipes and these are used in the medical, food service, hygiene product and automotive industry.

North America is the largest market for wipes whereas the demand for wipes is limited in India. Earlier, this limited demand used to be met completely through imports, but now this product is being manufactured domestically with key players being Kimberly Clarke, Ginni Filaments and Proctor & Gamble. Key players globally are Microfiber Corp., KK NonWovens, MLM, Yessor, Freudenberg and Alpha Foam. Majority of nonwoven wipes are manufactured by spun lace technology.

The global market for nonwoven household wipes stood at US$ 1,014 Million in 2019-20 and is expected to grow at CAGR of 6% for next five years when it is forecasted to be worth US$ 1,356.96 Million. The Indian market for nonwoven household wipes is relatively very small at Rs. 83 Crores but it is estimated to grow at a CAGR of 9% and be worth Rs. 126.38 Crores by 2024-25.

9.6.8 Stuffed Toys (Plush Fabric)

Stuffed toys are soft toys made from soft knitted fabrics and stuffed with a soft material. With children as the primary target group, stuffed toys are manufactured in various forms resembling animals, cartoon characters, human beings, dolls, legendary creatures, or inanimate objects. They are often used for display, as comfort objects, or given as gifts during festivities. The fabric used to fill these toys is called plush fabric, which is largely made of polyester and constitutes 25-30% of the finished toy.

Key companies in India for manufacturing stuffed toys are Hanung toys, Pal Plush and Archies. North America is considered to be the largest regional market due to rising demand for custom-made plush toys. Key companies in the global market are Mattel Inc., Bandai Namco Group, LEGO A/S; Hasbro, Inc, Spin Master

Ltd., Build-A-Bear Workshop Inc., Budsies, Aurora World, Inc., Teddy-Hermann GmbH, Margarete Steiff GmbH LLC., Giantmicrobes, Inc. and Simba Dickie Group.

The global market for plush fabric in 2019-20 was US$ 1,483 Million, estimated to grow at 6.96% per year till 2024-25 to a value of US$ 2,076.10. The Indian market for plush fabric in 2019-20 was Rs. 531 Crores constituting 5.5% of world market. It is likely to grow at a CAGR of 12.8% till 2024-25 and forecasted for a value of Rs 971.49 Crores.

9.6.9 Others

9.6.9.1 Ticking fabric

Ticking is the protective fabric covering on the mattress that holds the filling material inside. It is usually made of cotton and comes in a wide variety of colours and styles. These are used in high end mattresses, and require special maintenance. In India, the import/export of ticking fabric is insignificant, but the market is growing.

Jacquard Fabrics India Pvt. Ltd. (part of Stellini Group) is the largest producer of woven mattress ticking fabric with highest woven ticking production capacity in India. Its polyester-polypropylene and polyester-polypropylene viscose woven ticking is used by major mattress manufacturers in the Indian market such as Kurl-On, Sleepwell, Sheela Foam and others.

The Indian market size for ticking fabric was Rs. 832 Crores in 2020 and is expected to grow at a CAGR of 7.9% for the next five years to a value of Rs. 1,217.55 Crores. The global market will rise from US$ 2,099 Million at the rate of 4% till 2024-25 and reach US$ 2,553.75 Million.

9.7 Indutech

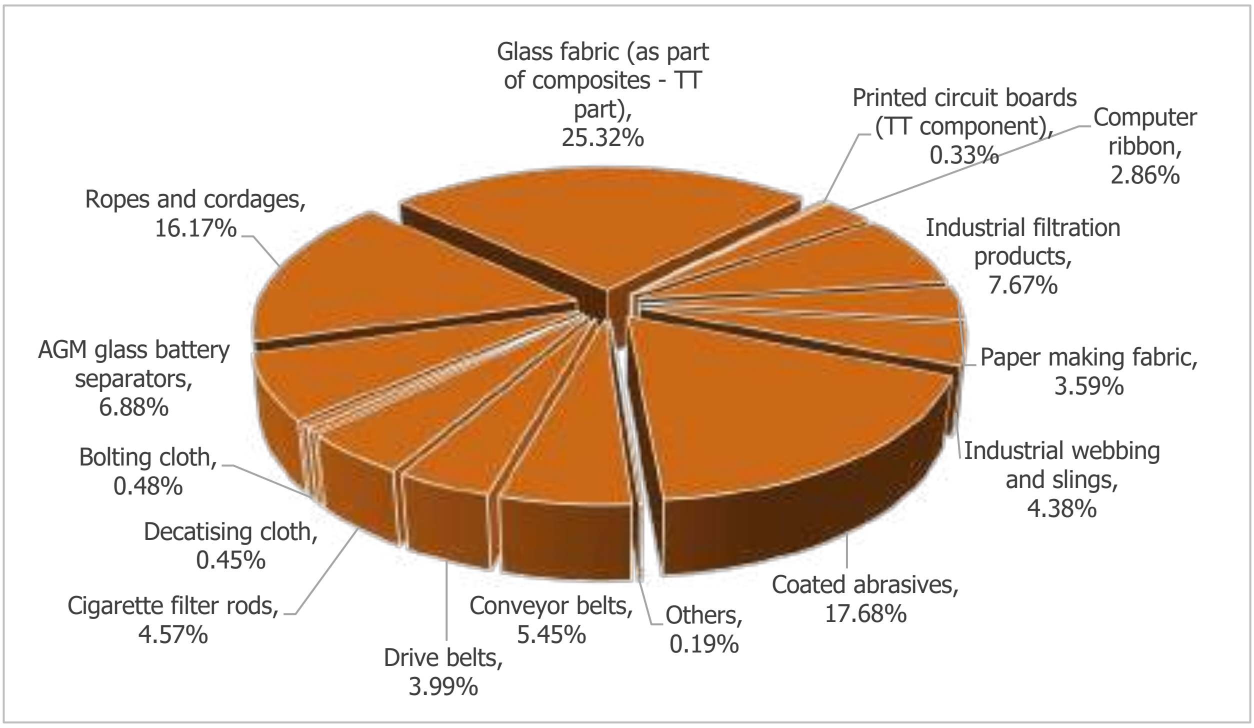
Indutech are technical textiles used in the industrial (manufacturing) applications like filtration, conveying, cleaning etc.

Technical textile products under Indutech segment are as follows:

1. AGM glass battery separators
2. Bolting cloth
3. Conveyor belts (TT component)
4. Decatising cloth
5. Drive belts (TT component)
6. Filtration products
7. Industrial webbings and slings
8. Paper making fabrics
9. Printed circuit boards (TT component)

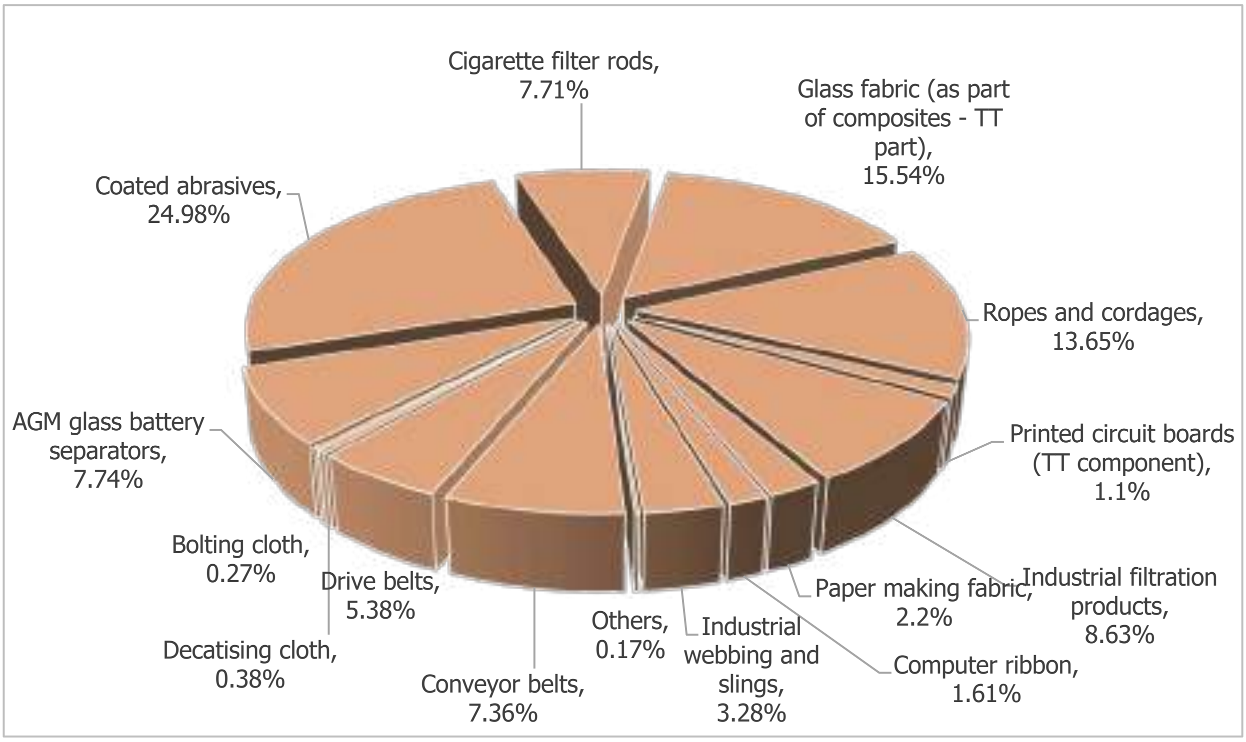
10. Ropes and cordages
11. Coated Abrasives
12. Computer Ribbon
13. Cigarette Filter Rods
14. Glass Fabric (as part of Composites- TT Part)

Figure 9.16: Percentage contribution of Indutech products in the domestic market (2019-20)



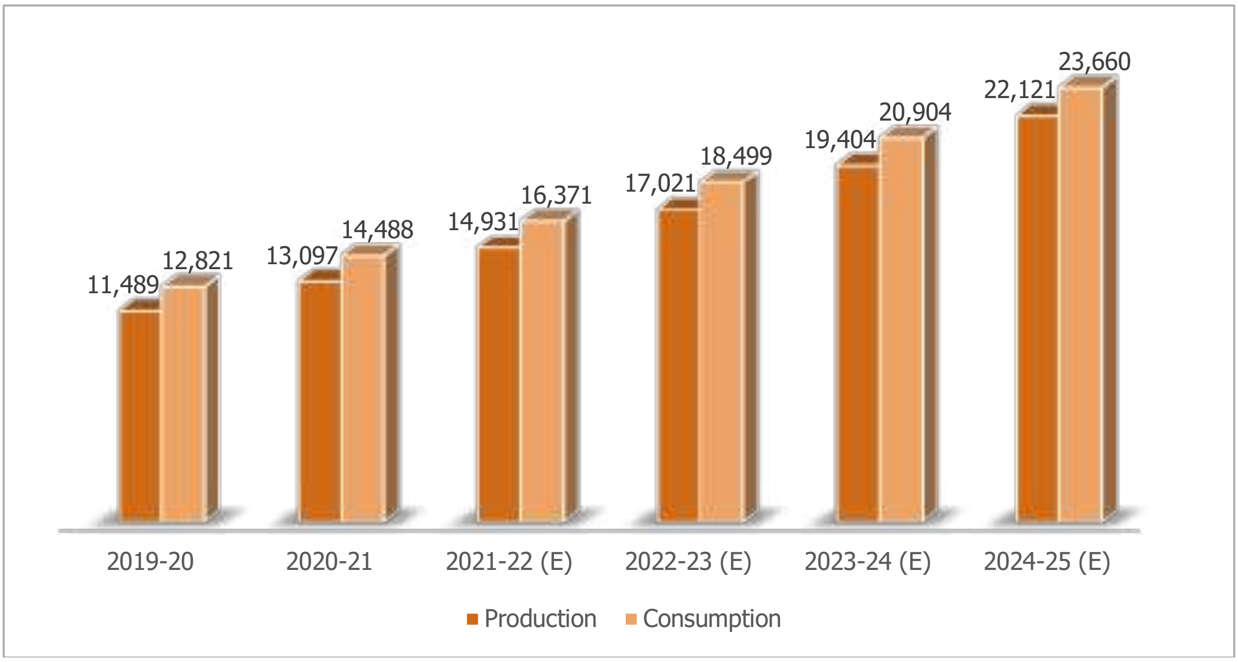
The highest share of domestic Indutech market in terms of value is comprised of Glass fabric (25.32%). Coated abrasives at 17.68% make up the next largest share of the Indian Indutech market.

Figure 9.17: Percentage contribution of Indutech products in the international market (2019-20)



Coated abrasives constitute the largest (24.98%) share of the International Indutech market in 2019-20, followed by Glass Fabric (15.54%).

Figure 9.18: Production vs. Consumption of Indutech segment in the domestic market (Rs. Crores)



The consumption of Indutech products in India exceeds the production (estimated value at Rs. 11,489 Crores in 2019-20). India is a net importer of Indutech and is likely to remain so till 2024-25 except that the trade deficit percentage will be reduced during this period.

Table 9.8: Indutech - World and India Market Size 2019-20			
Product Name	**World (US$ Million)**	**India (Rs. Crores)**	**India's share**
AGM glass battery separators	2,257	882	6.00%
Bolting cloth	78	61	12.01%
Cigarette Filter Rods	2,249	586	4.00%
Coated Abrasives	7,282	2,267	4.78%
Computer Ribbon	469	367	12.02%
Conveyor belts (TT component)	2,146	699	5.00%
Decatising cloth	111	58	8.02%
Drive belts (TT component)	1,569	511	5.00%
Industrial filtration products	2,515	983	6.00%
Industrial webbings and slings	957	561	9.00%
Paper making fabrics	642	460	11.00%
Printed circuit boards (TT component)	322	42	2.00%
Ropes and cordages	3,979	2,073	8.00%
Glass Fabric (as part of Composites - TT Part)	4,531	3,246	11.00%
Others	50	25	7.67%
Total	29,157	12,821	6.75%

9.7.1 AGM glass battery separators

Absorbed glass mat batteries are maintenance free alternative to traditional flooded lead-acid batteries. They provide powerful bursts of starting current and run electronic devices for a longer duration. AGM batteries are non-flammable, have a long shelf life, are safe, and release high energy. They have a significant market in automotive, marine, energy storage, telecom, and off-grid as well as power-backup industries. Battery separator is a porous sheet placed between the positive and negative electrodes in a liquid electrolyte, a gel electrolyte or a molten salt battery. Its function is to prevent physical contact of the positive and negative electrodes while serving as an electrolyte reservoir to enable free ionic transport. According to the structure, the separator can be divided as micro porous and non-woven. The battery separators are made of PVC, PE and non-woven glass mats (Absorbent glass mats or AGM). The glass mats are known as AGM (Absorbable Glass Mat). The battery separator market is dominated by PVC although there is a gradual migration to PE separators. In India, the storage battery industry is slowly shifting from PVC separators to Polyethylene separators. Glass mat with PVC or polyethylene is mostly used in all industrial batteries and in a few cases in automobile batteries depending on the function, customer requirement and price. AGM batteries are preferred option for high-end and advanced fuel-efficient vehicles with large power demands, need for greater reliability and longer life. The product is mostly imported by India.

Leading manufacturers in India are Raman Fibre Science Pvt. Ltd. and Urja Products Pvt. Ltd., which was recently acquired by US-based Hollingsworth & Vose Company (H&V).

Major international players are Clarios, Power Sonic Corporation, Exide Technologies, C&D Technologies, Fullriver Battery, East Penn Manufacturing Company, Universal Power Group, EnerSys, Nippon Sheet Glass Co., Ltd, Ningbo Baiheng Science & Technology Co. Ltd., East Penn Manufacturing Co., FIAMM Energy Technology S.p.A., Fengxin Industrial Co. Ltd., ShanDong Renfeng Special Materials Co. Ltd., B&F Technology Limited, Hollingsworth & Vose, and Hokuetsu Corporation

India's share in the global AGM glass battery separators market stood at 6% with a market size of Rs. 882 Crores during 2019-20. It is expected to grow at a CAGR of 15% and is likely to be worth Rs. 1,774 Crores in the year 2024-25. The size of the world market was US$ 2,257 Million in 2019-20 and it is expected to grow to US$ 2,880.57 Million at a CAGR of 5% for the next five years.

9.7.2 Bolting Cloth

Bolting cloth is a mesh fabric used primarily for screen printing in textile industry. The fabric also has applications in filtration in pharmaceutical industries and in filtering oil. Indian textile industry depends on imported Bolting Cloth to meet nearly 40 percent of its domestic requirements.

Leading international companies manufacturing Bolting cloth are Sefar AG, Bonfilt Industry Co. Ltd., Hebei Hanze International Trade Co. Ltd., Taizhou Haotian Industrial Fabric Co. Ltd., Shijiazhuang Gezi Screen Manufacturing Co. Ltd., TNS Enterprises Inc., Saati S.p.A.. Some of the Indian manufacturers of Bolting cloth are Bombay Bolting Centre, Surat Bolting, Khanna Bolting, Mithil Corporation, Biyani Industrial Textile (P) Limited, Deekay Nylobolt Industries Pvt. Ltd., Tejas Fabrics and Sur Syntex Pvt. Ltd.

The Indian market size for Bolting Cloth was Rs.61 Crores in 2020 and is expected to grow at a CAGR of 4% for the next five years to Rs. 74.22 Crores in 2024-25. The global market will rise from US$ 78 Million at a rate of 3% till 2024-25 and reach US$ 90.42 Million.

9.7.3 Conveyor Belts

Conveyor belts are used to move unit loads individually and bulk loads continuously. Conveyor belts are used in mining, cement manufacturing, power generation, recycling, metal processing and many other industries. Belting fabrics are used for reinforcing conveyor belts. The textile reinforced rubber conveyor belts carcass is made from nylon and polyester blends, providing high strength, along with exceptionally good abrasion and fatigue resistance.

With fast-paced development, Asia Pacific region is likely to dominate the global market for belting fabrics. Investments and growing consumption in the steel industry is also triggering the growth. The key manufacturers of conveyor belting solutions in India are Madura Industrial Textiles, Sempertrans Nirlon, International Conveyor Belting Ltd., Fenner India Pvt. Ltd., Jonson Rubber Industries Ltd., Sanrhea Technical Textiles Ltd., SRF Ltd., Forech India and NRC. Some of the companies that manufacture conveyer belt fabric in India are SRF Ltd., Forech India, NRC Ltd. etc. Some of the global players in the rubber conveyor belt market are Yokohama, Trelleborg, Oxford Rubbers, Garlock, Lutze, Artego, Bridgestone, ContiTech, Bando and Fenner.

India's share in the conveyor belts (TT component) market stood at 5% with a market size of Rs. 699 Crores during 2019-20. It is forecasted to grow at an annual rate of 15% and is likely to be valued at Rs. 1,406 Crores in 2024-25. The world market size was worth US$ 2,146 Million and is expected to be worth US$ 2,674.31 Million as a result of growing at a CAGR of 4.5% till 2024-25.

9.7.4 Decatising Cloth

Decatising cloth, sometimes called *Decatising wrapper* is a technical textile fabric that is used in Decatising machines. The fabric is an integral part of both Open Decatising and Kier Decatising machines that are mainly used for mechanical finishing of woven fabrics. Decatising cloth is mainly consumed by shirting and suiting pieces, with suiting bringing in the higher share of value. Thus, the growth of this segment is tied with the growth of suiting market in India.

Decatising cloth is a polyamide/cotton or polyester/cotton blended woven fabric available in weights ranging from 400 gsm to 600 gsm. Key manufacturers of Decatising Cloth in India are Hrishikesh Textiles, Noor Textiles, Panipat, Marino Textiles and Bombay Dyeing Ltd. About 10% of domestic requirement is imported whereas no exports take place.

The consumption of Decatising Cloth in India is worth Rs. 58 Crores in 2019-20 and is expected to grow at a CAGR of 5% and will be worth Rs. 74.02 Crores by the year 2024-25. The global market is valued at US$ 111 Million in 2019-20 and will increase at CAGR of 3% to log a sale of US$ 128.68 Million in 2024-25.

9.7.5 Drive Belts

A belt drive includes one pulley on each shaft and one or more continuous belts over the two pulleys. These belts are generally made with synthetic rubber matrix enclosed in a fabric reinforced rubber lining. Woven fabric or cord that is reinforced as ply in the drive belt is made of polyester, nylon, and cotton. The transmission belts can be classified as flat, vee, poly-vee and Timing belts.

Main producers of drive belts in India include Fenner India, Pix Transmissions and Goodyear Ltd. Major global belt drive manufacturers are Arntz Optibelt Gmbh, Belt Corporation of America, Dayco Products LLC, Hutchinson Belt Drive Systems, Desch Antriebstechnik Gmbh, Schaeffler Technologies AG & Co. KG, Federal Mogul Co., Belt Technologies Inc., Gates Corporation and Reynold Plc..

Market size of India in the belt drive market is at 5% of the global market. India's market in 2019-20 is worth Rs. 511 Crores, growing at a CAGR of 17% and is expected to grow to a size of Rs. 1,120.34 Crores by 2024-25. The world market size was at US$ 1,569 Million which is estimated to grow at a CAGR of 4.60 % and expand to US$ 1,964.63 Million by 2024-25.

9.7.6 Industrial Filtration Products

Industrial filters are used to remove solid, liquid, or gaseous impurities that contaminate subsequent industrial processes. Based on application, industrial filters can be dry filters (which are used in cement, steel and energy plants) and wet filters (which are used in pharmaceutical and chemical industries). Rapid industrialization and urbanization, and infrastructural development activities in various developed and developing countries, and need for industrial filters to lower or eliminate liquid pollution, are major factors expected to drive market growth. Among the filter media segments, the woven fabric segment accounts for larger revenue share in the global market than the mesh filter media segment.

North America is the largest market for industrial filtration products due to emission regulations and people's high preference for clean indoor air facilities. Its market in India is at a very nascent stage with few manufacturers such as Khosla Profil Pvt. Ltd., Masturlal Chemfab, Industrial filters Ltd., Supreme Industries Ltd., SVM Nonwovens BWF India. Leading international players are Alfa Laval, Donaldson, Danaher, Parker Hannifin, Eaton, Ahlstrom-Munksjö.

India's Industrial filters market is valued at Rs. 983 Crores in 2019-20 and is 6% of the global market. It is expected to be worth Rs. 2,155.18 Crores in 2024-25 after growing at an estimated CAGR of 17%. The world market size stood at US$ 2,515 Million in 2019-20 and it is forecasted to grow at a CAGR of 5% for the next five years and touch US$ 3,209.85 Million in 2024-25.

9.7.7 Industrial webbing and slings

Industrial webbings are lifting equipment made up of polyester, nylon, polypropylene, carbon fibre, para-aramid fibre, UHMWPE and other material such as cotton and jute. For extreme applications, webbing is even available in high-strength materials such as Dyneema® and Kevlar®. They are essential industrial components used for logistics, construction, and freight handling. Some of the properties are high strength, resistance to ultraviolet deterioration, water resistance, quick drying, easy cleaning, high tensile strength, abrasion resistance, stretching and shrinkage resistance, chemical resistance, and mildew resistance. Slings are made out of high tenacity polyester and are thus 100% Technical Textile.

Asia Pacific is the industry leader in terms of demand for use of industrial webbings with India, China and Malaysia leading the industry. For India, imports are greater than exports and most of these happen from China, Sri Lanka, Hongkong and Korea.

Major Indian players are Greenfield Industries, Ferreterro India Pvt. Ltd. and Protherm Engineering Pvt. Ltd. Globally, the market is dominated by American Cord & Webbing Co. Inc. (ACW Co. Inc.), E. Oppermann GmbH, Belt-tech, Narrowtex Australia Pty Ltd, Jiangsu Daxin Webbing Co. Ltd., Ohio Plastics Belting Co., National Webbing Products, Murdock Webbing Company Inc. and Tennessee Webbing Products.

India's Industrial webbings and slings (TT component) market size was Rs. 561 Crores during 2019-20 and it is poised to register a CAGR of 11% for the next five years and expand to be worth Rs. 945.32 Crores by the year 2024-25. During the same corresponding period, the global market is expected to grow from US$ 957 Million in 2019-20 to US$ 1,286.73 Million in 2024-25 at a growth rate of 6.1%.

9.7.8 Paper Making Fabric

Paper Making Fabric consists of large continuous belts of custom designed and custom manufactured, engineered fabrics that are installed on paper machines and carry the paper stock through each stage of the paper production process – pulp created and pressed to a mesh, dewatered, heated, and dried by paper-making machines to make paper web. The types of fabrics are forming fabrics, press fabrics and drier fabrics.

The paper making fabrics are made from polyester and polyamide wires which are woven to produce the fabric. The demand for these fabrics is primarily driven by paper mills. With the advent of technology synthetic material is being used to replace wire fabrics.

Key Indian manufacturers of paper making fabric are Voith paper fabrics Ltd. and Wire and Fabriks SA Ltd. About 30 percent of domestic consumption is meant through imports.

India's market size for Paper Making Fabric is valued at Rs. 460 Crores and it is forecasted to grow at an annual rate of 5% and is likely to be valued at Rs. 587.09 Crores in 2024-25. The world market size was worth US$ 642 Million and is expected to be worth US$ 708.82 Million as a result of growing at a CAGR of 2% till 2024-25.

9.7.9 Printed circuit boards (TT component)

The Printed Circuit Board (PCB) is used to hold electronic components and the electrical connections among them. The technical textile component used in the manufacture of printed circuit board is the woven glass fibre fabric which is used as reinforcement and stuck to the board with epoxy resin. The glass fibre impregnated resin called 'prepregs' is used to bind the copper foils to form copper laminated boards, called laminates. The Technical Textile component of printed circuit board comprises a very small fraction (0.2%) of its value.

The printed circuit board industry in India is yet to catch up with the rest of the World. India's share of production of the world PCB market is at a miniscule 0.3% - 0.5%. Almost the entire requirement of PCB is met through imports. We can expect the market to grow at a healthy rate of 17%, however whether the demand is taken up by imports or domestic production of Technical Textile remains to be seen.

Key manufacturer in the country for glass fibres to be used in PCB is AT&S Limited.

The Indian PCB (Printed Circuit Board) market reached a value of US$ 2.97 Billion in 2020; This equal to Rs. 20,790 Crores. So if TT component is 0.2% then the market size of TT of PCB is 42 Crores in 2019-20 which is poised to grow at a CAGR of 15% to a sale of Rs. 84.48 Crores in 2024-25. The global market for the TT component of PCB is US$ 322 Million in 2019-20 and shall grow at 4% per annum to US$ 391.76 Million. in 2024-25.

9.7.10 Ropes and Cordages

A rope is a group of natural or synthetic yarns, strands or fibres twisted together into a stronger form with high tensile strength and are used for dragging and lifting. They can be made up of natural fibres such as Manila hemp, hemp, linen, cotton, coir, jute, straw, and sisal. Some of the synthetic fibres used to make ropes are polypropylene, nylon, polyesters (e.g. PET, LCP, Vectran), polyethylene (e.g. Dyneema and Spectra), aramids (e.g. Twaron, Technora, and Kevlar) and acrylics.

Asia Pacific is the largest market for ropes and cordages with growing markets in India and China. Leading Indian manufacturers are Garware Technical Fibres Ltd. (earlier Garware Wall Ropes Ltd.), Axiom Cordages (which is an export-oriented unit) and Tufropes Pvt. Ltd. Prominent players in international markets are WireCo WorldGroup, Cortland Ltd., Bridon-Bekaert, Southern Ropes, Magento Inc., Yale Cordage, LANEX a.s., Katradis Marine Ropes Ind. S.A., Dynamica Ropes, Marlow Ropes Ltd. and Van Beelen Industrie en Handel B.V..

The market size for Ropes and Cordages in India is worth Rs. 2,073 Crores during 2019-20. The Indian market is estimated to grow at a CAGR of 10% and touch Rs. 3,338.59 Crores by 2024-25. The global market size was US$ 3,979 in 2019-20 and is forecasted to grow at a CAGR of 4.5% till 2024-25 and reach a value of US$ 4,958.56 Million.

9.7.11 Coated Abrasives

An abrasive material is used to achieve a proper finish of the work piece by rubbing the surface of the work piece. Abrasives are used in industrial applications like grinding, polishing, buffing, honing, cutting, smoothening etc. The coated abrasives are of two types viz. Woven coated abrasives and Non-woven coated abrasives. The base fabric used in abrasives is cotton, polyester and polyester blends which are processed to obtain a suitable coated abrasives backing. The non-woven coated abrasives are made from abrasive grade fibres.

The key manufactures of coated abrasives in India are Carborundum Universal Ltd. (CUMI) and Grindwell Norton Ltd. These two companies contribute towards about 70% of India's market. Wendt India Ltd. and other small manufacturers contribute to the balance production in the country. India's net imports(after deducting exports) is close to Rs. 50 Crores in 2019-20. Prominent global manufacturers are 3M, Saint-Gobain, Bosch, Hermes Schleifmittel, and the KWH Group.

The coated abrasives (TT fabric) market in India is around Rs. 2,267 Crores in 2019-20 and it is expected to grow at a CAGR of 15% to an expected domestic market of Rs. 4,559.75 Crores in 2024-25. The global market for coated abrasives is estimated at US$ 7,282 Million and is likely to reach a value of US$ 9,293.88 after growing at a CAGR of 5% till 2024-25.

9.7.12 Computer Ribbon

The computer printer ribbon is a part of the printer cartridge of a Dot matrix printer (DMP). The ink on the ribbon does get exhausted with use and ribbon is replaced as part of refilling the cartridge. The material used for computer ribbon is fabric made from Nylon 6 yarn. Nearly 25% of domestic consumption is met through imports from Singapore, Japan, China, Mexico and Vietnam.

The consumption of computer ribbon (TT fabric) in India is around Rs. 367 Crores in 2019-20 and it is expected to grow at a CAGR of 2% to an expected domestic market of Rs. 405.20 Crores in 2024-25. The global market for the same is estimated at US$ 469 Million and after growing at a CAGR of 1%, it is likely to reach a value of US$ 492.92 Million after growing at a CAGR of 1% till 2024-25.

9.7.13 Cigarette Filter Rods

Cigarette filters are used to cut down the amount of tar, smoke and other fine particles inhaled by the smokers while smoking cigarettes. It reduces the strong effect of tobacco smoke on the throat. The filter is made from cellulose acetate fibres known as tow. The fibres are bonded together using a hardener called tri-acetin plasticizer. The filter is wrapped in a rolled paper and sealed with an adhesive. Filters are made by the leading cigarette manfacturers like ITC Ltd. India does export a part of the production output of these filters.

Market size of Cigarette Filter Rods (TT component) in India for 2019-20 is Rs. 586 Crores, growing at a CAGR of 8% and is expected to grow to a size of Rs. 861.03 Crores by 2024-25. The size of global market was at US$ 2,249 Million which is estimated to grow at a CAGR of 6% and expand to US$ 3,009.67 Million.

9.7.14 Glass Fabric (as part of Composites-TT Part)

Composites are among the recent addition to materials used in production of a diverse range of items. Composites act as a substitute to metals, plastics and wood for their better characteristics and environment friendliness. They are produced by reinforcing a resin matrix (thermoplastic/thermoset) with fibres like glass fibre, aramid, carbon fibre and/or natural fibres. Unlike conventional materials like steel, aluminium etc., composites are versatile and their properties can be designed as per the structural and functional aspects required. Properties such as stiffness, thermal expansion etc. can be incorporated over a large range by using appropriate fibre, resin and fabrication method. The technical textile material in the composites is the fibre glass, aramid and carbon fibre. The main material for composites is Glass fabric and it dominates the composites industry as a preferred reinforcement fibre, with a share of around 85%-90%. Other reinforcement fibres like carbon fibre and aramid fibre are used to a much smaller extent in India because of constraints placed by their patented technology and high costs.

Main manufacturers of composites in India are Owens Corning India, UP Twiga Glass fibres, Binani Industries Ltd. (Goa Glass fibre), AIMS Composites Ltd., Mahindra Composites Ltd., Tata Composites Solutions Limited and RG Fibrotech. Key global players are 3B-the fibreglass company, Engineered Fibers Technology, LLC, Shanghai Dofiberone Composites Co.,Ltd., and, Chengdu Activated Carbon Group.

India’s market size for Glass Fabric (as part of Composites- TT Part) is valued at Rs. 3,246 Crores and it is forecasted to grow at an annual rate of 14% and is likely to be valued at Rs 6,249.90 Crores in 2024-25. The world market size was worth US$ 4,531 Million and is expected to be worth US$ 6,063.50 Million as a result of growing at a CAGR of 6% till 2024-25.

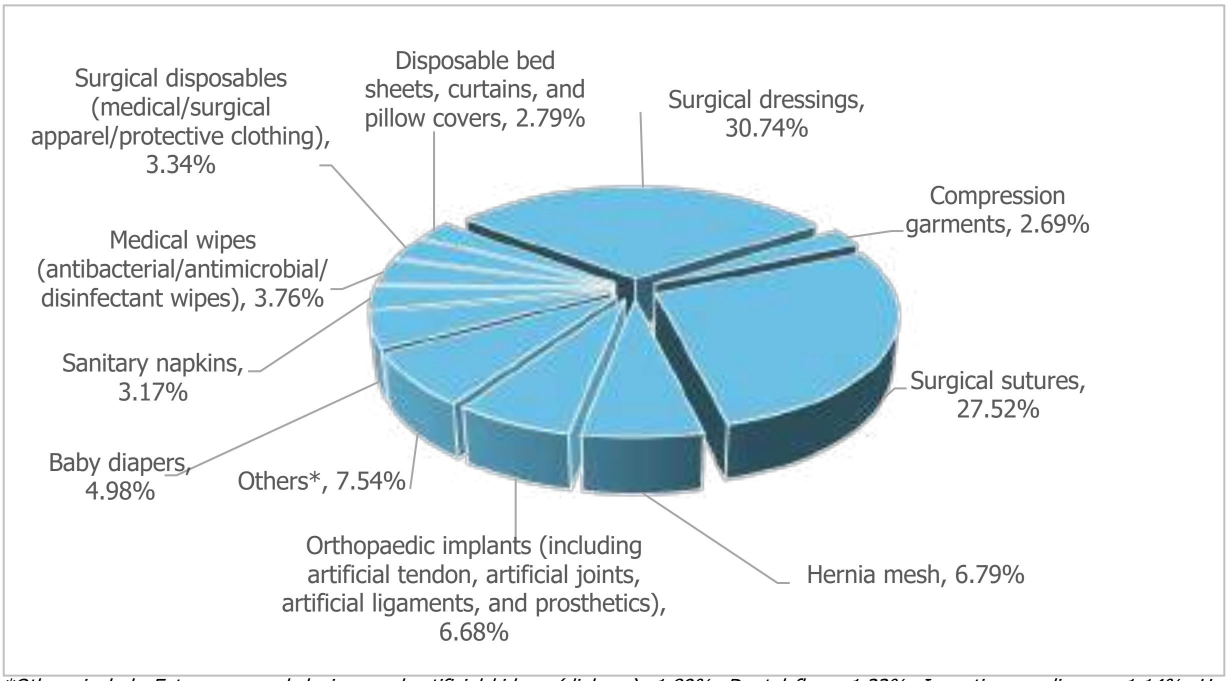
9.8 Meditech

Meditech are the medical application textiles made up of fibre, filament, yarn or fabric through the processes of extrusion, spinning, weaving, knitting, nonwoven, braiding and bonding. Medical textiles are generally used for human hygiene, healthcare, and other medical practice.

Technical textile products under Meditech segment are as follows:

1. Baby Diapers
2. Compression Garments
3. Cotton Buds
4. Extra Corporeal Devices (including Artificial Kidney)
5. Incontinence Diapers
6. Orthopedic implants (including artificial tendon, artificial joints, artificial ligaments and prosthetics)
7. Sanitary Napkins
8. Surgical Disposables (Non woven TT component)
9. Vascular Grafts
10. Medical Wipes
11. Dental Floss
12. Hernia Mesh
13. Disposable Bed-sheets, Curtains and Pillow Covers
14. Heart and soft tissue repair patch (TT component)
15. Surgical Suture
16. Heart Valve (TT component)
17. Underpads (TT component)
18. Surgical Dressings
19. Eyepads (TT component)
20. Compression Stockings

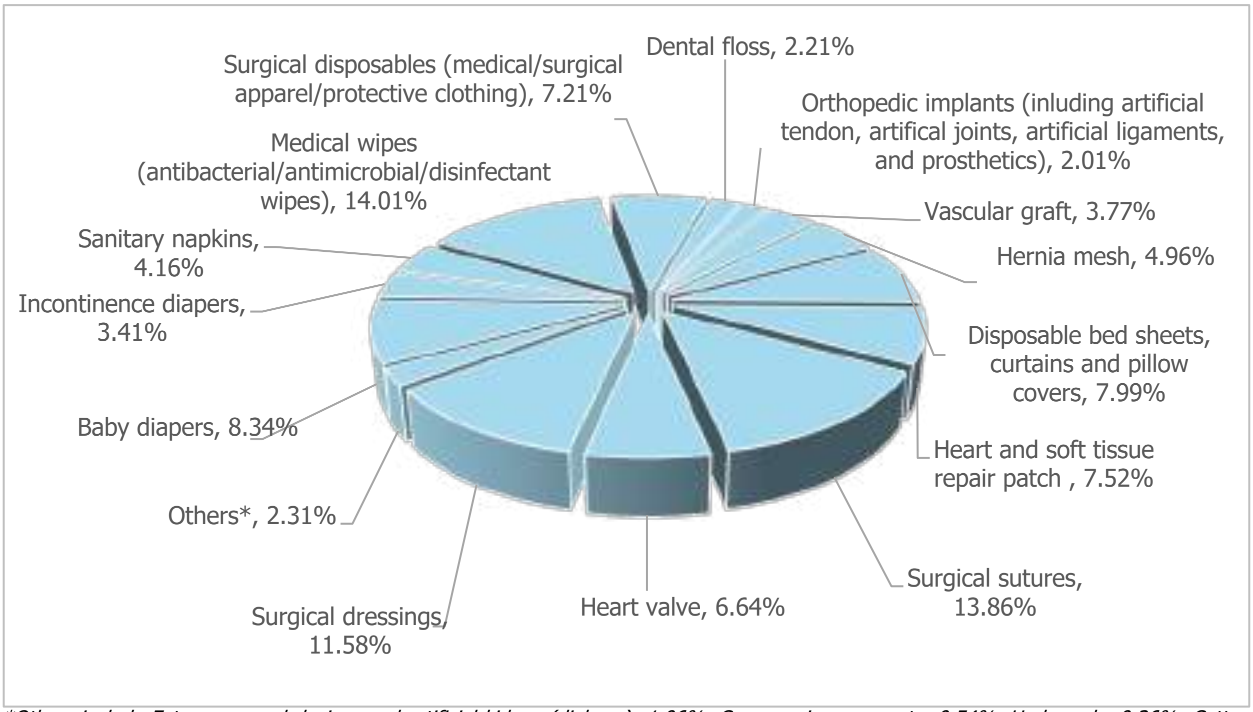
Figure 9.19: Percentage contribution of Meditech products in the domestic market (2019-20)



**Others include Extra corporeal devices and artificial kidney (dialyser)- 1.89%, Dental floss- 1.22%, Incontinence diapers- 1.14%, Heart valve- 0.84%, Vascular graft- 0.82%, Underpads- 0.59%, Compression stockings- 0.17%, Heart and soft tissue repair patch- 0.06%, Cotton buds- 0.04%, Eyepads (TT component)- 0.01%, and Miscellaneous items- 0.76%*

Surgical dressings (30.74%) constituted the largest share of the Indian Meditech market in 2019-20, followed by surgical sutures at 27.52%.

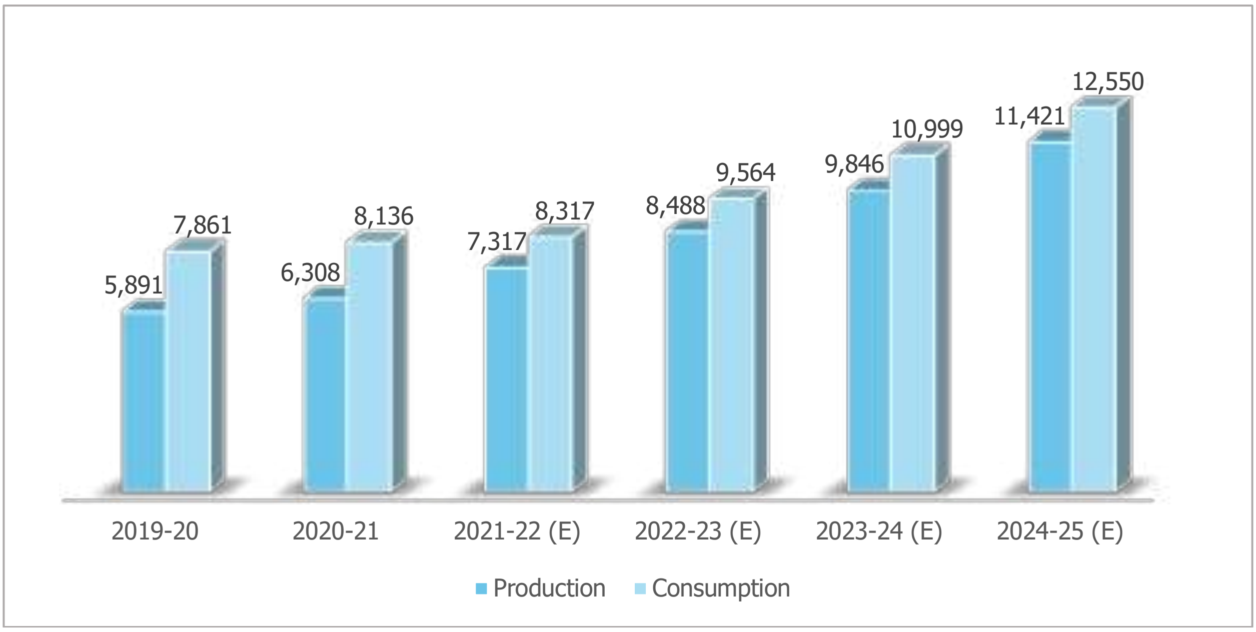
Figure 9.20: Percentage contribution of Meditech products in the international market (2019-20)



**Others include Extra corporeal devices and artificial kidney (dialyser)- 1.06%, Compression garments- 0.54%, Underpads- 0.36%, Cotton buds- 0.12%, Compression stockings- 0.03%, Eyepads (TT component)- 0.01%, and miscellaneous items- 0.20%*

Globally, medical wipes contributed to the largest market share (14.01%), and surgical suture contributed the next largest share at 13.86%.

Figure 9.21: Production vs. Consumption of Meditech segment in the domestic market (Rs. Crores)



Consumption of Meditech products exceeds the production (estimated value for 2019-20 is Rs. 5,891 Crores). India is a net importer and the gap between production and consumption is expected to increase in the next five years.

Table 9.9: Meditech - World and India Market Size 2019-20			
Product Name	**World (US$ Million)**	**India (Rs. Crores)**	**India's share**
Baby Diapers (TT component)	2,104	392	2.86%
Compression Garments (TT component)	135	212	24.06%
Cotton Buds (TT component)	30	3	1.54%
Extra Corporeal Devices and Artificial Kidney	267	148	8.54%
Incontinence Diapers (TT component)	861	90	1.61%
Orthopedic implants (including artificial tendon, artificial joints, artificial ligaments and prosthetics)	507	525	15.90%
Sanitary Napkins (TT component)	1,050	249	3.64%
Surgical Disposables (Non woven TT component)	1,819	262	2.22%
Vascular Grafts	950	64	1.04%
Medical Wipes	3,532	296	1.28%
Dental Floss (TT component)	558	96	2.64%

Product Name	World (US$ Million)	India (Rs. Crores)	India's share
Hernia Mesh	1,250	534	6.56%
Disposable Bed-sheets, Curtains and Pillow Covers	2,015	219	1.67%
Heart and soft tissue repair Patch (TT component)	1,896	5	0.04%
Surgical Suture	3,495	2,163	9.50%
Heart Valve (TT component)	1674	66	0.61%
Underpads (TT component)	90	47	7.93%
Surgical Dressings	2,920	2,416	12.71%
Eyepads (TT component)	2	1	4.61%
Compression Stockings	8	13	25.91%
Others	50	60	18.43%
Total	25,214	7,860	4.79%

9.8.1 Baby Diapers

A diaper is a type of underwear that allows the wearer to urinate or defecate without the use of a toilet. It absorbs or contains the waste and prevents soiling of the external clothing or environment. Diapers are primarily worn by infants, toddlers and children who are not toilet trained or who experience bedwetting.

Baby diapers are made by sandwiching an absorbent pad between fabric sheets. The technical textile component of the diaper is the nonwoven fabric which prevents fluid leakage and gives the diaper its desired shape. Baby diapers are of two types – cloth diapers and disposable diapers. Emerging economies of the Asia Pacific region including China, India, and Brazil and Central and South America promise ample growth opportunities for the baby diapers industry. India imports huge volumes from China. Though India has started exporting to neighbouring countries in recent years, it still remains a net importer of baby diapers. Domestically, Indian diaper market is highly concentrated with top three manufacturers – Procter & Gamble, Unicharm Corporation and Kimberly-Clark Corporation. There are other realtively smaller manufacturers too viz. Essity AB, The Himalaya Drug Company, Nobel Hygiene Pvt. Ltd., Me N Moms Pvt. Ltd., Swara Baby Products Pvt. Ltd., TZMO S.A., The ABENA Group. Major global players are Procter & Gamble (P&G), Kimberly-Clark, Johnson & Johnson, First Quality Enterprises Inc., Hengan International Group Company Ltd., KAO Corp., Philips Healthcare, Drylock Technologies NV, Cotton Babies, The Honest Co. and The Hain Celestial Group.

The baby diaper market in India is expected to grow on account of expanding infant population, increasing disposable income, rising awareness about the hygiene of babies, the growing number of women in the workforce, the rising number of modern nuclear families with working parents and improved economic conditions in India. Demand for diapers is growing steadily across India on account of their benefits such as convenience, increased hygiene and low risk of skin damage. Some brands are enhancing their product offerings so as to attract a larger consumer-base. For instance, manufacturers are introducing diapers with an inner lining containing aloe vera gel, vitamin E, and other skin-friendly compounds often found in diaper rash creams to avoid rashes on the skin. In the last 20 years, the prices of baby diapers have fallen by half – from Rs. 15-18 to Rs. 7-9 per piece, depending on the brand. Penetration of the category remains under 5 percent in the country.

According to Euromonitor, the size of the organised baby diaper market in India is Rs 52.14 billion in the year 2019, with the year-on-year rate of growth pegged at 14% and the nonwoven technical textiles part is 4% of the diaper value. Therefore, the technical textiles component of India's baby diaper market is Rs. 391 Crores during 2019-20. It is projected to grow at a CAGR of 11.9% and be worth Rs. 686.68 Crores in 2024-25. The corresponding global market size was US$ 2,104 Million which is likely to expand at a CAGR of 6% and be valued at US$ 2,815.63 Million by the year 2024-25.

9.8.2 Compression Garments

Compression garments are clothes designed to reduce recovery time and help improve performance. They are usually worn by patients who sustain a burn injury and wear compression garments post-surgery so as to avoid swelling and to ensure proper skin tightening. These are skin-tight apparels, which stimulate blood circulation and stabilise muscles by exerting pressure on specific parts of the body. These garments include compression stockings, sleeves, body shapers, girdles & binders and chin straps. These are also used to manage and prevent various medical disorders such as venous disorders, deep vein thrombosis (DVT), sports & recreational injuries, oncological treatments, and follow-up therapy after surgeries. These are also being used post liposuction surgeries in India. These garments apply pressure on the treated body part and prevent bacterial growth. They are custom made to the size of the patient.

Major players from India are Adidas AG., ASICS Asia Pte. Ltd., Leonisa, LIPOELASTIC, New Balance, Technomed India Pvt. Ltd. and Nomura DND whereas the prominent producers at the global level are Bauerfeind, 3M, Macom Enterprises, Bioflect Medical Group, Leonisa, LIPOELASTIC, Lohmann and Rauscher, Medico International, Essity, Medtronic, Nike, Adidas, Design Veronique, BSN medical, Marena Group, Julius Zorn GmbH, medi GmbH & Co. KG., Sigvaris Management AG. and Medico International Inc.

North America, followed by Europe and Asia Pacific, is the leader in the global compression garments market. The Global compression garment and stockings market is US$ 3,072.85 Million in 2021 and expected to grow at 5.35% to US$ 3,987.62 Million by 2026. Based on the figures and estimates provided by leading global market research agencies, we assume US$ 3 billion as the market size for compression garment and stockings globally in 2019-20. Out of this, 90% of the value (US$ 2.70 billion) will be for compression garments, 5% of this value is the TT component as per the experts. Therefore, the world market size stood at US$ 135 Million and is likely to grow at a CAGR of 5.6% till 2024-25 and touch US$ 177.28 Million in 2024-25. The corresponding market size in India is estimated at Rs. 211.50 Crores during 2019-20 and it is forecasted to grow at a CAGR of 1% so as to be worth Rs. 215.95 Crores by 2024-25.

9.8.3 Cotton Buds

Cotton buds are commonly used for cleaning the ear by removing earwax, providing first-aid, applying and cleaning cosmetics, general skin cleaning, as well as in arts and crafts. Cotton buds consist of small wads of treated and processed absorbent cotton or swabs that are wrapped around a rod made of wood, paper, or plastic. The cotton bud which has a single tip wrapped on one end of a wooden or plastic handle is commonly meant for medical use (cleaning of skin, wounds and application of medicines and ointments) and is the most prominent cotton buds. The cotton buds that are used for non-medical (often household purposes) are usually about 3 inches long, and have cotton-wrapped tips at both ends. The cotton buds are also used to take the DNA samples by scraping cells from the inner cheek in the case of humans. The cotton swabs are used in the construction of the plastic model kits while paintings. They are also frequently used for cleaning the laser diode lens of an optical drive in conjunction with rubbing alcohol. In addition to this, they are used to clear the large parts of the computer such as video cards and fans. There has been a phenomenal rise in use of specialised cotton swabs for drawing samples from nasal and throat area for Covid testing during the period of Corona Virus pandemic. With so many uses, the demand for cotton buds in the market is growing at a rapid rate. Cotton buds or cotton swabs are classified into medical, makeup or industrial cleaning based on their application.

There has been an increasing demand from governments, civil society and customers for replacing plastic used in the rod of the cotton buds with biodegradable material. Rising environmental concerns, consumer shift towards natural products, and risk associated with the chemically synthesized cotton buds has given rise to the demand for 100% organic cotton buds across the globe. Several manufacturers have already introduced environment friendly cotton buds manufactured from chemical free organic cotton and rolled paper as spindle. Globally, companies have replaced plastic sticks with hollow paper sticks.

The Environment Ministry in India has notified the Plastic Waste Management Amendment Rules, 2021, which prohibit specific single-use plastic items which have "low utility and high littering potential" by 2022. List of 12 items that are to be banned from July 2022 include ear buds with plastic sticks. While the industry is working on alternatives to the plastic stick, replacing the plastic sticks with hollow paper sticks would require import of a special kind of wood. And, that would be a costly proposition for India's domestic manufacturers. Due to these challenges, the industry is seeking about three years to find an indigenous solution and transition to a biodegradable alternative. It is also seeking incentives or financial aid from the government for this transition process.

Europe is the largest consumption centre of cotton buds. The market penetration for cotton buds is very low in India as people still consider it to be a luxury product. Two major players in India are Johnson & Johnson Ltd., which sells under its own brand name and Suparshva Swabs India which sells cotton buds under the brand name of Tulips. Key players in the global market are Johnson & Johnson Pvt. Ltd., Muji Europe Holdings Ltd., Unilever Plc., Organyc Italica, H3D, Desert Online General Trading LLC., Daiso Industries Co. Ltd., BAMBAW Azadea Group, Touch Wood Industries, Morrisons Ltd., Tesco Supermarkets Ltd., ASDA, Aidi Stores Ltd., LIDL, Boots Company Plc., Superdrugs Store Plc. etc.

According to Verified Market Research, The Global Swab Market was valued at USD 722.09 Million in 2019 and is projected to reach USD 1258.91 Million by 2027. India has a market size for TT component of cotton buds (Total market about Rs. 50 crores) of Rs 3 Crores (4% of total market for cotton buds) during 2019-20. It is expected to grow at a CAGR of 1% to reach a market of Rs. 3.06 Crores in 2024-25. The corresponding global market size is estimated at US$ 30 Million during 2019-20 and it is likely to grow at a CAGR of 3.5% to reach an estimated sale of US$ 35.63 Million in 2024-25.

9.8.4 Extra Corporeal Devices and Artificial Kidney (Dialyser)

Those medical devices which support the patient from outside and are not implanted inside the body are known as extra corporeal. The devices which are under this category are Dialyser (also called Artificial Kidney), Artificial Liver and Artificial Lungs. The membrane or dialysers are 100% Technical Textile products made up of polysulphane and polyacetate. A bioartificial liver device (BAL) is an artificial extracorporeal liver support (ELS) system for an individual who is suffering from acute liver failure (ALF). Artificial lung gadgets are used in babies and youngsters with lung disorders namely, pneumonia, meconium inhalation condition and various other respiratory malfunctions. Along with utilizing conventional procedures (upper bar), artificial lung (AL) support is initiated when the other treatment options, including mechanical ventilation (MV) are of no help in improving the patient's condition.

India is a net importer of these devices. Nipro India Corporation Pvt. Ltd, a subsidiary of Nipro Corporation Japan has set up an artificial kidney manufacturing plant in Shirwal, Pune. This is the only manufacturing plant of artificial kidneys in India. Syntho Chirals Lifesciences Private Limited is the manufacturer of bio-artificial liver support system. NIpro Corp Japan, Kawasumi Laboratories Inc., US Kidney Research Corporation (USKRC), AWKAK Technologies Pte. Ltd., Asahi Kasei Medical Vo. Ltd. and Blood Purification Technologies Inc. are some of the major global manufacturers of dialysers.

The key players of the global Artificial Lungs market are ALung Technologies, Breethe, Haemair, Lung Biotechnology PBC, McGowan Institute for Regenerative Medicine, MedArray, Michigan Critical Care Consultants, Miromatrix Medical, The Charles Stark Draper Laboratory and Xenios.

India's market for TT component (membranes and filter material) of Extra Corporeal devices is worth Rs. 148.50 Crores during 2019-20. It is expected to grow to Rs. 295.61.34 Crores, progressing at a CAGR of 14.8% for the next five years. The world market size is estimated at US$ 267 Million in 2019-20 and it is likely to be growing at a CAGR of 5% to expand to US$ 340.77 Million by 2024-25. This has been arrived at based on Market research reports of MR agencies such as Allied as well as Euromonitor.

9.8.5 Incontinence Diapers

Incontinence diapers also known as adult diapers, are single use products designed to absorb and retain fluids. These diapers help in coping with loss of bladder control in adults. They are widely used by adults experiencing mobility impairment, incontinence, diarrhoea and dementia. It is manufactured using polyacrylate granules, polythene films, breathable fabrics and super-absorbent chemicals. The non-woven material is placed on top for a dry feeling. Based on type, they can be categorised into pad type, pant/pull-up type, and tape on diapers. North America is the global leader in adult diaper market. Developing countries, especially China and India, are poised for high growth in demand due to shifting lifestyles and habits as well as rising occurrence of incontinence among their geriatric population.

The Indian market is dominated by Chinese imported adult diapers and the local manufacturers export mostly to neighbouring countries like Sri Lanka, Nepal and Bangladesh. Major manufacturers of Incontinence Diapers in India are Nobel Hygiene Pvt. Ltd. (Brand name- Friends Adult Diaper), Fibriltex Pvt. Ltd. (Care4 brand), and Walmark Meditech Pvt. Ltd. The leading global players in this industry are First Quality Enterprises Inc., Kimberly-Clark Corporation, Attends Healthcare Products Inc., Procter & Gamble and Unicharm Corporation

As per the figures estimated by leading MR agency, Orion, the adult diapers market size for the world was valued at US$ 13.3 Billion in 2018 and was expected to reach US$ 24.1 Billion by 2026, registering a CAGR of 7.8% from 2019 to 2026. Therefore, the estimate for 2019-20 was US$ 15.51 Billion. Out of this 5.5% is TT component amounting to US$ 861 Miillion in 2019-20. It will grow to US$ 1,253.42 Million by 2024-25. The Indian market for TT component of incontinence diaper is estimated at Rs. 90 Crores in 2019-20 but will grow at a CAGR of 14.8% to log a likely consumption of Rs. 179.16 Crores in 2024-25.

9.8.6 Orthopaedic implants (including artificial tendon, artificial joints, artificial ligaments and prosthetics)

An orthopaedic implant is a medical device manufactured to replace a missing joint or bone or to support a damaged bone while ensuring its stability and proper anatomical position. The medical implant is mainly fabricated using stainless steel and titanium alloys for strength and the plastic coating that is done on it acts as artificial cartilage. The most commonly used implants are Orthopedic Implants Plates, Locking Plates, Bone Screws, Variable Angle Locking Plates, Bone Plates, Interlocking Nails, Wires & Pins, and Hip Prosthesis, etc. The types of materials that are most often used in prosthetics are metals, polymers, and ceramics. The most commonly used polymer in prosthetics is high-density polyethylene. It is the best material for prosthetic limbs.

Major global competitors in prosthetic market are Aikang Medical Holdings Co.,, Ltd., Arthrex, Inc., B. Braun Melsungen AG, DePuy Synthes, DJO Global Inc., Exactech, Inc., Globus Medical Inc., JRI Orthopaedics Ltd., Medtronic PLC, NuVasive Inc., Smith & Nephew PLC, Stryker Corporation and Zimmer Biomet Holdings Inc.. Leading Indian manufacturers of artificial joints are TTK Healthcare in collaboration with Sri Chitra Tirunal, Zealmax Innovations Private Ltd., Orthotech.

The global market for Artificial Joints estimated at US$ 19.2 billion in the year 2020, is projected to reach a revised size of US$ 26.6 Billion by 2027, growing at a CAGR of 4.8%. The global prosthetics & orthotics market size was estimated at USD 6.11 billion in 2020 and is expected to reach USD 6.39 billion in 2021. The TT component of the total market is 2% of sum of US$19.2 billion and US$ 6.11 billion. Therefore, the global market size of TT component of orthopaedic implants in 2019-20 was US$ 507 Million that will grow to US$ 631.81 Million due to its growth at a CAGR of 4.5 % till 2024-25. The market size in India was valued at Rs. 525 Crores in 2019-20 and that will grow at a CAGR of 14.8% to Rs. 1,045.09 Crores by 2024-25.

9.8.7 Sanitary Napkins

Sanitary napkin is a feminine hygiene product which is used by women to absorb the menstrual flow and prevent it from staining the body and the clothes and thus improving intomate hygiene. Sanitary napkins are made by inserting an absorbent pad between fabric sheets. The technical textile component of the sanitary napkin is the non-woven fabric which prevents leakage of menstrual discharge.

Most of the raw materials that go into making good quality sanitary napkins are not available in India, and hence Indian manufacturers have to rely on imports with import duties up to 10% followed by IGST, which add to the cost of the final product.

Sanitary napkins market in India has so far been dominated by multinational companies like Procter and Gamble, Johnson and Johnson Ltd. and Kimberly Clark Lever Pvt. Ltd. The last few years have seen Indian manufacturers also entering this space. Brands such as Stayfree and Carefree from Johnson & Johnson Ltd.

and Whisper from Procter & Gamble cover close to 85-90% of the sanitary napkins market. The remaining market is shared by Kimberly Clark Lever's brand Kotex and Gufic Biosciences' brand Shapers. Each of the domestic companies such as Royal Hygiene Care, Actifit India Pvt. Ltd., Dima Products Pvt. Ltd. and Kaul Impex. Pvt. Ltd. have a small share of the market. At the global level, some of the major players are Procter & Gamble, Hengan International Group Company Limited, Kimberly-Clark Corporation, Edgewell Personal Care Company and Kao Corporation.

According to a new report published by Allied Market Research titled, "World Feminine Hygiene Products Market-Opportunities and Forecasts, 2015-2022," the global feminine hygiene products market is expected to garner revenue of US$ 42.7 billion in 2022. Therefore, for this analysis, the estimated global sale of feminine hygiene products will be US$ 42 billion in 2020. The TT component of this would be approximately 2.5% of the value as per the costing professional from the industry. Therefore, the global market size for TT component of sanitary napkins in 2019-20 is estimated at US$ 1,050 Million and it is likely to grow at a CAGR of 5% and reach US$ 1,340.10 Million in 2024-25. India's corresponding market size is Rs. 249 Crores during 2019-20. It is forecasted to grow at a CAGR of 11.9% to reach a level of Rs. 436.74 Crores till 2024-25.

9.8.8 Surgical Disposables (Medical/Surgical Apparel/Protective clothing)

Surgical disposables are used by hospitals and pharmaceutical companies to maintain hygienic and sterile operations. They constitute surgical gloves, protective face masks, head wear, scrub suits, chemotherapy gowns, footwear, drapes, aprons, boots, coveralls, eye gear and surgical gowns. They can be disposable as well as reusables. Majority of Indian hospitals use cotton reusable surgical wear that needs to be sterilised after every use. The growth of the market for surgical disposables is attributable to the increasing number of surgical procedures, rising incidence of Hospital Acquired Infections (HAIs), growing prevalence of chronic diseases leading to longer hospital admission, and the impact of COVID-19 outbreaks across the globe.

Leading global players are 3M, Ansell, Kimberly-Clark Worldwide, Inc., Delta Plus, Alpha Pro Tech, Cardinal Health, Halyard Health, Lakeland Inc., Derekduck Industries Corp.,

Some of the prominent global players in the medical disposables market are Medline Industries Inc., Smith & Nephew PLC, Bayer AG, BD, 3M, Ansell, Kimberly-Clark Worldwide Inc., Delta Plus, Alpha Pro Tech, Plasti Surge Industries Pvt. Ltd., Tronex International Inc. and Cardinal Health. Producers of surgical disposables in India are Ahlstrom Fibercomposites India Pvt. Ltd., 3M India, Thea-Tex Healthcare Pvt. Ltd., Mediklin Healthcare Ltd., Magnum Medicare Pvt. Ltd., Sivshree Meditex India Pvt. Ltd. and Surgiwear India Ltd.

The global medical disposables market size was valued at USD 318.3 billion in 2020 and is expected to expand at a compound annual growth rate (CAGR) of 16.7% from 2021 to 2028. The surgical disposables market is 11% of this and the TT component is a little over 5% of that 11% as per the experts. Therefore, the world market for surgical disposables in 2019-20 is US$ 1,819 Million. It is likely to grow at 8% till 2024-25 and expected to have a global market size of US$ 2,672.71 Million by 2024-25. The Indian market for Surgical disposables is Rs. 262.50 Crores in 2019-20 and it is expected to increase with a CAGR of 10% and likely to record sales of Rs. 422.39 Crores in 2024-25.

9.8.9 Vascular Graft

A vascular graft is a surgical device that redirects blood flow from one area of the body to another by reconnecting the blood vessels. Vascular grafting is most commonly done to bypass a complete or partial blockage in an artery in order to improve blood flow to the organ supplied by the diseased artery. Synthetic vascular graft materials are used to patch injured or diseased areas of arteries, for replacement of whole segments of larger arteries such as the aorta, and for use as sewing cuffs (as with the heart valve). Expanded polytetrafluoroethylene, Dacron® and polyurethane are the material that are often used as synthetic vascular grafts. Polyurethane is better able to match the compliance of native vasculature.

Major global manufacturers of vascular graft are Medtronic PLC, Terumo Corporation, LeMaitre Vascular Inc., Getinge AB, Cook Medical, C.R. Bard, W.L. Gore and Associates Inc., Shanghai Suokang Medical Implants Co. Ltd. and Getinge AB. TTK Healthcare in collaboration with Sri Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum manufactures vascular grafts in India.

According to Grandview research study, The global vascular grafts market size was valued at USD 2.01 billion in 2018 and is expected to witness a CAGR of 6.4% over the forecast period. So the size of Vascular Graft in 2020 is likely to be US$ 2.3 Billion and growth at 6.4%. The value of the global technical textile component sale will be US$ 950 Million and it will grow at 6.4% to be worth US$ 1,295.48 Million by 2024-25. The corresponding sale in India is worth Rs. 64.50 Crores in 2019-20, it will experience a CAGR of 10% and is likely to reach a domestic sale of Rs. 103.79 Crores in 2024-25.

9.8.10 Medical Wipes (Antibacterial/Antimicrobial/Disinfectant wipes)

Medical Disinfectant wipes are single use products made of tissue, paper, or nonwoven fabric and moistened with antibacterial solution, typically packed in canisters or tubes with a dispenser to keep the antibacterial wipe moist, and to be able to pull out a single wipe at a time. Medical wipes are used for cleaning and disinfecting the human body, general object surfaces, medical device surfaces and other object surfaces. Healthcare wipes are of numerous types including pre-injection wipes, non-invasive antiseptic wipes, skin cleaning wipes, macerator-friendly body wipes, and bath wipes. They can also be classified into sanitising wipes, skin care wipes, equipment cleaning wipes and wound cleaning wipes.

Due to the high healthcare awareness of their people, the USA and Europe are two leading markets for wipes. Due to their fast growing economies, increasing incomes and healthcare awareness, China and India are the fastest growing markets for such products. Latin America, Middle East and Africa are the least lucrative regions for the antibacterial wipes industry as people of these regions prefer to use antibacterial solutions over costly antibacterial wipes due to better affordability. India is a net importer of antibacterial wipes with major imports from China.

There are many global players such as Claire Manufacturing, CleanWell LLC, Colgate-Palmolive Company, Dreumex USA Inc., Reckitt Benckiser, The Clorox Company, Kimberly-Clark, GAMA Healthcare, Parker Laboratories and 3M as well as some others which are prominent in Medical Disinfectant Wipes industry. Rising global awareness regarding sanitation and personal hygiene and increasing cross-contamination problems are expected to drive the demand for healthcare wipes. Major Indian players in the wipes industry are Johnson & Johnson, Pristine Care Products Pvt. Ltd, Ginni Filaments Ltd, Kimberly-Clark, Himalaya Health Care Pvt. Ltd., Kara Wipes by Aditya Birla Group and Tainwala Personal Care Pvt. Ltd. and Precot Meridian Ltd.

The global Medical Disinfectant Wipes market was valued at US$ 3,532 million in 2020 and will reach US$ 4,726.61 million by the end of 2025, growing at a CAGR of 6% during 2020-2025. India’s market size for medical wipes was valued at Rs. 295.50 Crores during 2019-20. It is likely to grow at a CAGR of 7.1% to be valued at Rs. 416.62 Crores by 2024-25.

9.8.11 Dental Floss

Dental floss is a soft nylon thread used to remove food and dental plaque from between teeth where toothbrush is not reachable. Based on type and usage, dental floss are classified into waxed floss, unwaxed floss and dental tape. Waxed floss occupies a large market share because of its applicability in effective plaque removal. These waxed dental flosses have added advantages as they contain essential oils and enzymes, resulting in effective plaque removal. In addition, waxed dental floss is also available in a polymer coating, which prevents shredding and provides effortless plaque removal. It is expected to hold a significant market share for some years. The major reason for the growth of this segment is the rise in oral problems. There are latest innovations wherein producers are focused on investing in natural wax ingredients to produce and commercialise natural dental floss, made up of three natural waxes, namely, jojoba, carnauba, and beeswax. This is causing a further increase in growth of the market.

Increasing consumer awareness regarding oral care and hygiene can be attributed to the increasing demand, with North America being the largest market.

Major quantity of the Dental Floss is marketed in India by Colgate and Palmolive (India) Ltd., P&G under the brand Oral B, ICPA Health Products Pvt. Ltd. and Sinhal Metal Industries Ltd. Some of the companies that are dominating the global market are 3M Co., Procter & Gamble, Colgate-Palmolive Company, Johnson & Johnson, Prestige Consumer Healthcare Inc., Dr. Fresh LLC, Lion Corporation, Church & Dwight Co. Inc., Shantou Oral Health Co. Ltd., Water Pik Inc., Koninklijke Philips NV, Unilever Group and The Humble Co.

India’s has an estimated market size for dental floss (TT) at Rs. 96 Crores during 2019-20 and it is expected to grow at a CAGR of 10 % and be valued at Rs. 154.48 Crores by 2024-25. The size of the world market size was US$ 558.12 Million in 2019-20 and it is expected to grow at a CAGR of 5 % to touch US$ 712.32 Million by 2024-25.

9.8.12 Hernia Mesh

Hernia Mesh is used in hernia repair and abdominal wall replacement, where mechanical strength and fixation are very important. The functionality of the mesh is customised by adjustment of porosity and the texture of the mesh. There are two types of mesh, the woven and the knitted. Polypropylene or Polyester are often the material used in making the mesh. GOR-TEX is also used for making mesh for hernia repair. Main factors that are determining market growth are increasing incidence of hernia, favorable reimbursement policies and technological advancements related to repair devices.

The global hernia repair devices market size was valued at US$ 3.49 billion in 2020 and is expected to expand at a compound annual growth rate (CAGR) of 5.65% from 2021 to 2028. Hernia Mesh dominated this industry with 76.1% of sales. Therefore, global sale of Hernia mesh in 2019-20 is estimated at US$ 2,655.89 Million out of which TT component of synthetic Hernia Mesh is assessed at US$ 1,250 Million in 2019-20. This is likely to grow at a CAGR of 5% and be valued at US$ 1,595.35 Million. Corresponding to this, the Indian market for TT element of Hernia Mesh is Rs. 534 Crores in 2019-20 and it will grow annually at a rate of 5.2% to reach a value of Rs. 688.01 Crores in 2024-25.

9.8.13 Disposable Bed Sheets, Curtains and Pillow Covers

Disposable bed sheets, curtains and pillow covers are innovative products which are specially designed to provide comfort and infection control. Disposable bed sheets, curtains and pillow covers are one time use materials. The disposable bed sheets reduce cross-contamination risks that come from laundering linen. They are meant for hygiene and cleanliness purposes and are used in hospitals, diagnostic centres, nursing care facilities, standalone clinics, beauty parlours, massage centres and very recently by 'at home' beauty and spa services. There is a heightened demand across the world for hypoallergenic and eco-friendly disposable bed sheets in hospitals, nursing homes and stand-alone clinics. Increasing awareness about health and hygiene in India has led to a surge in growth of these products. The time taken by nursing staff to change disposable linen is less than 10% of the time it takes to change conventional linen and that has led to increasing use of disposable linen.

India's import-export scenario for these medical disposable linen products is the similar to that of surgical disposables. Leading Indian players for disposable linen are Ahlstrom Fibercomposites India Pvt. Ltd., 3M Healthcare India, Thea-Tex Healthcare Pvt. Ltd., Mediklin Healthcare Ltd., Magnum Medicare Pvt. Ltd., Sivashree Meditex India Pvt. Ltd., Surgiwear India, Dispoline, Medline Industries Inc., BM plus spol. s r.o., Raaj Medisafe India Ltd., Jackson Care Product, EconoGroup, Venus Safety and Health Pvt. Ltd. and Beaucare DermeandCo. . Globally, the market is led by Unitex Textile Rental Services Inc., Emes Textiles Pvt. Ltd., Angelica, Healthcare Services Group Inc., ImageFIRST, Tetsudo Linen Service Co. Ltd., Celtic Linen, Medline Industries, Hygeco Group, Hartmann Group, Haines, Cardinal Health, Mlnlycke Health Care AB, The 3M Company, Ecolab, Z Plus Disposable, Wuhan Morntrip Trading (Xiantao Tongda Non-woven Products), Dispotech, SABIC, Teqler, SHNGEN, Changzhou Care-De Sanitary Material and Swisslog Holding Ltd.

Based on the market research by leading global agencies, the global disposable medical linen market will grow from US$ 2,015 Million in 2020 to US$ 3,143.23 Million in 2025 at a CAGR of 9.3%. The India Disposable Medical Linen Market size was estimated at Rs. 219 Crores in 2020 and expected to reach Rs. 282.16 Crores in 2021 at a Compound Annual Growth Rate (CAGR) of 5.2%.

9.8.14 Heart and soft tissue repair patch

The heart and soft tissue repair patches are used in tissue repair procedures such as soft tissue, dural and vascular repairs and reconstructions. Repair of inguinal hernias is one of the most commonly performed general surgeries. Increasing prevalence of hernias is expected to lead to increase in market growth. Due to increase in detection of congenital heart diseases such as ventricular septal defect, atrial septal defect and common atrium, the cardiovascular and soft tissue repair patches market is expected to grow rapidly.

Cardiovascular and soft tissue patches are manufactured from Dacron, ePTFE and biomaterial.

The main global players in cardiovascular and soft tissue repair patches market are Cryolife, Edwards Life Sciences, Bard Peripheral Vascular, Baxter, Admedus, Neovasc and Southernlight Biomaterials. India imports these products to meet its requirement.

Global Cardiovascular and Soft Tissue Repair Patches (TT component) market size will grow from US$ 1,896.4 million in 2020 at a CAGR of 4.6% to US$ 2,374.59 Million in 2025. India is still a nascent market for such patches and the estimated annual sale of Rs. 4.50 crores in 2019-20 will increase to Rs. 7.24 Crores in 2024-25 due to a forecasted CAGR of 10% for this period.

9.8.15 Surgical Sutures

Surgical sutures also known as stitches are strands of surgical threads used to join blood vessels or tissues and reduce the risk of bleeding and wound infection, enhance wound healing, improve scar aesthetics and minimise tissue injury. They are used to close wounds such as skin ulcers, neuropathic ulcers, paediatric cardiac surgery and diabetic ulcers. The sutures are made of natural or synthetic materials. Natural material includes silk, linen and catgut, synthetic materials include nylon, polypropylene, and polybutester. The surgical sutures are classified into two categories – absorbable suture that dissolves in the body and does not require removal and non-absorbable suture that are sterilised sutures requiring removal after a specified time. Based on the type of filament, the sutures market has been segmented into monofilament and multifilament sutures. Multifilament accounted for the maximum market share. Based on application, the surgical sutures market is divided into ophthalmic surgery, cardiovascular surgery, orthopedic surgery, neurological surgery, and others. Cardiovascular surgery accounted for the largest market share.

The market for surgical sutures is experiencing steady growth due to increasing number of surgical procedures being performed worldwide. Increase in prevalence of injuries and diseases in animals and rise in awareness among pet owners for better treatment options are expected to enhance the growth of the market for sutures. In addition to this, increase in population of livestock and upsurge in demand for dairy & meat products are also driving the market. Increasing medical tourism is another key factor for the rise in the number of surgical procedures. Asia Pacific is an emerging market with China, Japan, and India being the major markets.

India is a net importer of surgical sutures. The surgical sutures market in India is dominated by Johnson and Johnson Ltd. with its flagship Vicryl brand that has a market share of 60-65%, followed by other companies such as Centennial Surgical Suture Ltd., Sutures India Ltd., Futura Surgicals Pvt. Ltd. and Lotus Surgical Pvt. Ltd. Leading global companies are Medtronic, Ethicon, Smith & Nephew, Internacional Farmacéutica., Péters Surgical, and Integra LifeSciences.

As per Euromonitor, the global surgical sutures market is projected to reach US$ 4.9 billion by 2026 from US$ 3.7 billion in 2021, at a CAGR of 6% from 2021 to 2026. Based on these calculations, the global market for surgical suture in 2019-20 is worth US$ 3,495 Million and it shall touch a figure of US$ 4,677.10 Million in 2024-25. The market size of suture in India is estimated at Rs. 2,163 Crores in 2019-20 and expected to grow at a CAGR of 10% till 2024-25 when it is likely to be worth Rs. 3,480.46 Crores.

9.8.16 Heart Valve

A Heart Valve allows blood to flow in only one direction through the heart. Blood passes through a valve before leaving every chamber of the heart. These valves help to prevent the backward flow of blood. Key global companies that make Heart Valves are Abbott, LivaNova PLC, CryoLife Inc., Edward Lifesciences Corporation, Medtronic, Boston Scientific Corporation and Micro Interventional Devices Inc.. TTK Healthcare Ltd. manufactures heart valves in India.

A well-researched report by Fortune Business Insights pegs the market value of global market of heart valves at US$ 6.58 billion in 2018 and forecasts a CAGR of 11.7% between 2019 and 2026. Based on this, the global market for Heart Valves in 2019-20 is estimated at US$ 8,151 Million. The technical textile component is 20% of this and is at US$ 1,674.24 Million in 2019-20. It will grow to US$ 2,911.28 Million due to a CAGR of 11.7%. The corresponding market size for India is estimated at Rs. 66 Crores in 2019-20 and based on a forecasted CAGR of 10%, it is likely to grow to Rs. 106.20 Crores in 2024-25.

9.8.17 Underpads

The Hospital Underpad is a disposable nonwoven product used in hospitals as well as at home where continuous or intermittent absorbing of fluid is required. Hospitals, nursing homes, and day care centers use underpads to protect mattresses, cribs, chairs, sofas, recliners, wheelchairs and all sorts of products that they don't want to get wet. Basically, anytime a wetness episode becomes prevalent, an underpad can keep the area dry. These products are very popular in developed countries. They are largely imported into India for domestic consumption and their usage is limited which may be due to less awareness about their benefits.

The main manufacturers of Underpads in India are Pioneer Hygiene Sales Private Limited, Jajoo Surgicals Pvt. Ltd., Jackson Care Product, Kerg International Export Private Limited, Nobel Hygiene Pvt. Ltd., Kamal Healthcare Products Private Limited, Sara Healthcare P Ltd., TZMO SA, Realcare Hygienic Products Private, Paramount Surgimed Ltd. The key global players are Medline, Attends Healthcare, Avkare Inc., Becton Dickinson, Briggs Corporation, Cardinal Health, Care Line Inc. Dynarex Corporation, Ehob, Encompass Group, Fisher Scientific, Fresenius USA, Kimberly-Clark Corporation, Medtronic and Patterson Medical.

The world market for underpads in 2019-20 is valued at US$ 90.41 Million and it is likely to grow at a CAGR of 5% for next five years and reach a value of US$ 115.39 Million. The size of market in India is about Rs. 46.50 Crores in 2019-20 and Rs. 74.82 Crores in 2024-25. The expected CAGR is 10% during the five year period.

9.8.18 Surgical Dressings

Surgical dressing comes in the form of bandage or self-interactive material that cushions the blow of injuries by applying compressed pressure to a wounded area that promotes healing and guards against further harm.

The dressings are divided into acute wounds segment and chronic wounds segment. Some of the materials under surgical dressings are rolled bandages, crepe bandages, plaster-of-paris bandages, absorbent gauze pack, plaster, absorbent pads, surgical pads, cotton lint and eye pads.

The USA and Canada have dominated the surgical dressings market but countries such as India, Singapore and China are growing substantially due to the changing lifestyles and medical tourism. There is a strong demand for dressings in the country and due to lack of indigenous manufacturers of such dressings in India, these are mostly imported.

Some of the key players operating in the wound dressings market in India include 3M Co., Smith & Nephew PLC, Johnson and Johnson Services Inc., and B. Braun Melsungen AG. Leading global players are Medline Industries Inc., Smith & Nephew, Advancis Medical, Acelity, Medtronic, Alliqua Biomedical Inc., 3M, Coloplast, ConvaTec, and Inc. Mölnlycke Health Care AB.

The global surgical dressing market was valued at US$ 2.92 Billion in 2020 and is expected to grow at a CAGR of 5.7% during the period upto 2024-25 and log expected sales of US$ 3,852.63 Million. India's surgical dressings market size was estimated at Rs. 2,416.50 Crores during 2019-20 and it is expected to grow at a CAGR of 10% and be valued at Rs. 3,888.36 Crores by 2024-25.

9.8.19 Eyepads (TT component)

Eye pad is a patch of cotton that is worn over the eyes to prevent eye infections after ophthalmic surgery or procedure. Health Spas also tie these on their clients during some of the therapies. Eye Pads usage is India is subject to eye surgeries and the usage by spas. Each eye pad consumes about 2.5-3 gms of non woven (TT component).

India has a market size for TT component of eye pads of Rs. 0.60 Crores during 2019-20. It is expected to grow at a CAGR of 2.3% to reach a market of Rs. 0.67 Crores in 2024-25. The corresponding global market size is estimated at US$ 2.05 Million during 2019-20 and it is likely to grow at a CAGR of 3.5% to reach an estimated sale of US$ 2.43 Million in 2024-25.

9.8.20 Compression Stockings

Compression stockings are elastic hosiery garments applied to lower limb to achieve graduated compression. They are used for management of venous hypertension, lymphedema, and venous ulcers to reduce edema and aid return of venous blood to the heart. There has been a rapid increase in customer awareness and that has been one of the major reasons for growth of garments and stockings market. The demand for compression garments and stockings has also increased because athletes and sportspersons wear them to avoid any kind of possible injury during an event.

Prominent producers of Compression stockings both at India as well as world level are Adidas AG. and Nike.

The global sale of compression stockings in 2019-20 is US$ 300 Million out of which about US$ 8-9 Million is the technical textiles component (say US$ 8 Million conservatively) in 2019-20. It is likely to grow at a CAGR of 8% to log sales of US$ 11.75 Million in 2024-25. The sales in India are assessed at Rs. 13.50 Crores in 2019-20 and likely to grow at CAGR of 1.4% and record a value of Rs. 14.45 Crores by 2024-25.

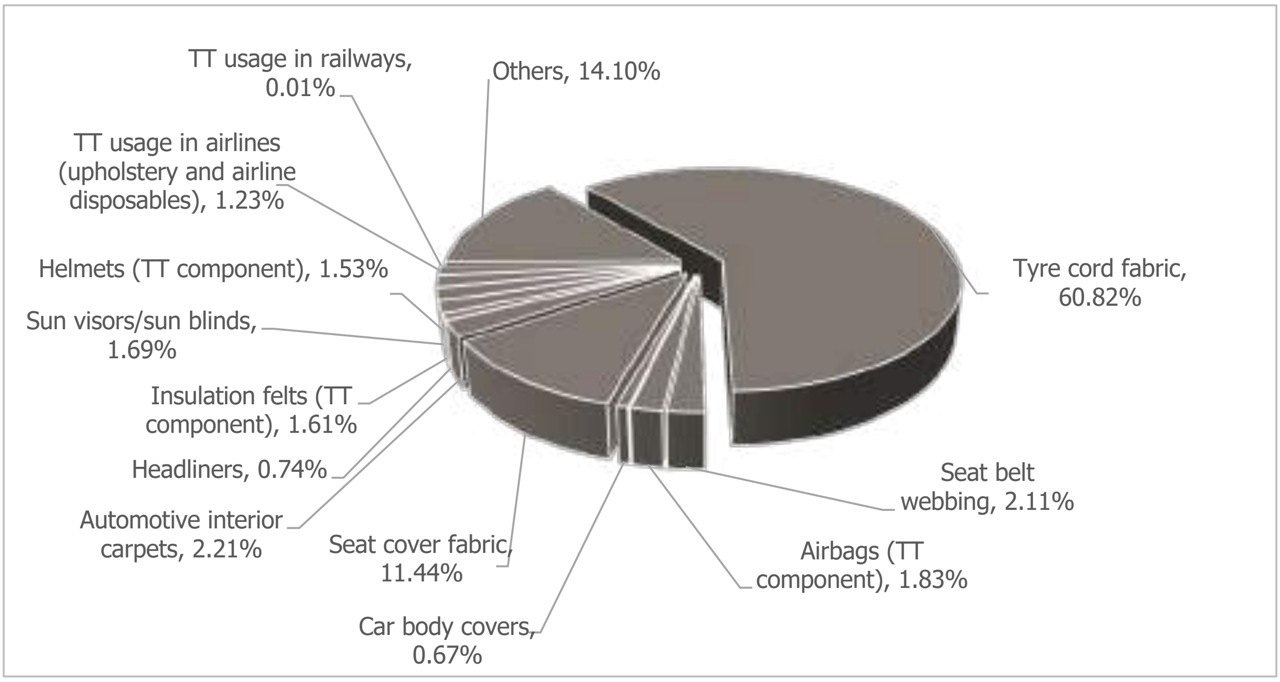
9.9 Mobiltech

Mobiltech has applications in automobiles, railways, ships, aircrafts and spacecrafts. Mobiltech products can be subdivided according to their visibility into two types - visible components and concealed components. The visible components include seat upholstery, carpets, seat belts, headliners, airbags etc. The concealed components include noise vibration and harness (NVH) components, tyre cords, liners, etc.

Technical textile products under Mobiltech are as follows:

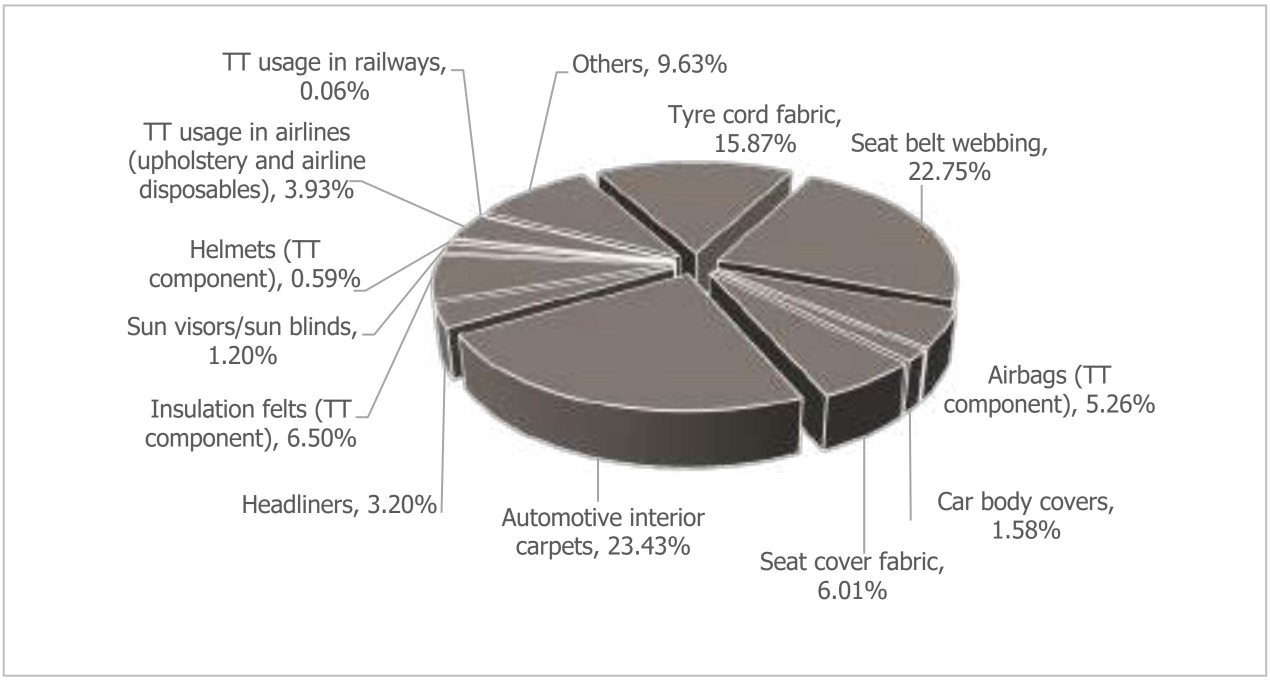
1. Airbags (TT component)
2. Automotive interior carpets
3. Car body covers
4. Headliners (TT Component)
5. Helmets (TT Component)
6. Insulation felts
7. Seat belt webbing (TT component)
8. Seat cover fabrics
9. Sun visors / sunblind (TT component)
10. TT usage in airlines (upholstery and airline disposables)
11. TT usage in railways
12. Tyre cord fabric

Figure 9.22: Percentage contribution of Mobiltech products in the domestic market (2019-20)



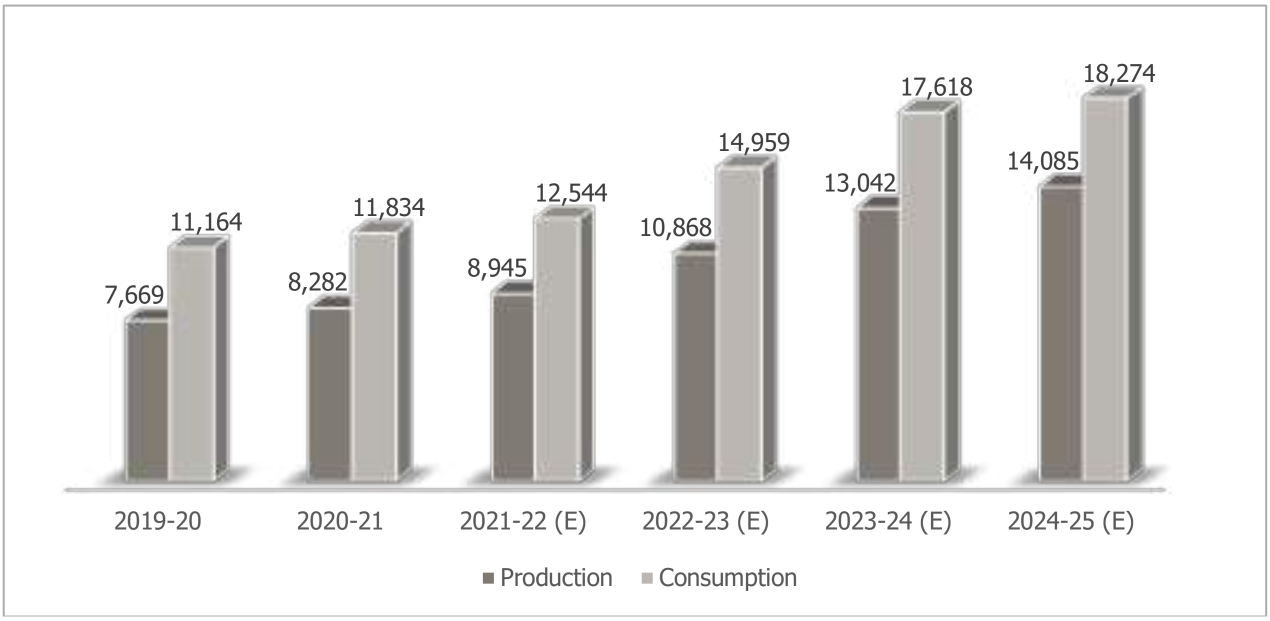
Tyre cord fabric, the product with the largest share makes up nearly 61% of the domestic Mobiltech market in terms of value of technical textile component.

Figure 9.23: Percentage contribution of Mobiltech product in the international market (2019-20)



It is evident from the figure presented above that the product-wise share of international market is more evenly spread across all of Mobiltech products.

Figure 9.24: Production Vs Consumption of Mobiltech segment in the domestic market (Rs. Crores)



The consumption of Mobiltech products in India exceeds their production (estimated value Rs. 7,669 Crores in 2019-20) and despite the percentage trade gap likely to become smaller, India will continue to remain a net importer of Mobiltech products for the next five years. However, the rapid expected growth in mobility market will attract significant capacity addition in India's domestic Mobiltech industry.

Table 9.10: Mobiltech - World and India Market Size 2019-20			
Product Name	**World (US$ Million)**	**India (Rs. Crores)**	**India's share**
Airbags (TT component)	1,910	204	1.64%
Automotive interior carpets	8,515	246	0.44%
Car body covers	576	75	2.00%
Headliners (TT Component)	1,162	82	1.09%
Helmets (TT Component)	216	171	12.17%
Insulation felts (TT Component)	2,361	179	1.17%
Seat belt webbing	8,267	236	0.44%
Seat cover fabrics	2,184	1,278	18.98%
Sun visors / sunblind	437	189	6.63%
TT usage in airlines (upholstery and airline disposables)	1,428	138	1.48%
TT usage in Railways	20	2	1.23%
Tyre Cord Fabric	5,769	6,790	18.08%
Others	3,500	1,574	6.90%
Total	36,345	11,164	4.72%

9.9.1 Airbags (TT Component)

Airbags are gas-inflated cushions built into the steering wheel, dashboard, door, roof or seat of a vehicle that use a crash sensor to trigger a rapid expansion to protect passengers from the impact of an accident. Airbags are of three types – frontal, side and knee. The market is also segmented based on the airbag type as Driver Airbag, Passenger Airbag, Side Airbag, Curtain Airbag, and Others. Curtain airbag has been the largest consumer of airbag fabrics in the automotive industry. This airbag type is also likely to witness the highest growth during the forecast period. Based on the yarn type, the market is segmented as Polyamide Yarn and Polyester Yarn. Polyamide 6.6 is the most widely used yarn for making airbag fabrics and is likely to remain the most dominant yarn type in the market. However, polyester yarn is expected to grow at a faster rate over the next five years, owing to its lower cost and increasing adoption in the knee and curtain airbags, mainly in the USA and Europe. The market in India for airbags is still underdeveloped but it is expected to grow due to mandating of stricter passenger safety norms for the automobile industry.

The Indian airbag industry is serviced by Toyoda Gosei, Minda India Pvt. Ltd., Autoliv India Pvt. Ltd., Rane TRW Steering Systems Ltd., Takata India Pvt. Ltd., Mobis India Ltd., Ashimori India Pvt. Ltd., Denso International India Pvt. Ltd., Bosch Ltd., Continental India Pvt. Ltd. and Daicel Chiral Technologies India Pvt. Ltd. . The airbag fabric is produced by Indorama Ventures Ltd. Globally, the market is dominated by players such as Autoliv, Joyson Safety Systems, ZF Friedrichshafen, Toyota Gosei, Hyundai Mobis, UTT Beteiligungsgesellschaft GmbH (Airbag fabric) and Denso.

The market for airbag fabrics is estimated to reach an estimated US$ 2,311.5 Million in 2024. Therefore, the likely sale of 2019-20 is US$ 1,910 Million (obtained by discounting expected sale of 2024 at the rate of 5.4% to get present value). The global market for TT component of airbags was estimated at US$ 1,910 Million whereas the Indian market stood at Rs. 204 Crores in 2019-20. The global market is expected to grow at a CAGR of 5.4% and is expected to be worth US$ 2,484.49 Million by 2024-25 whereas the Indian market is expected to grow at a CAGR of 23.4% and touch a market size of Rs. 583.38 Crores in the same year.

9.9.2 Automotive Interior Carpets

These are nonwoven technical textiles products which are produced primarily from polypropylene fibres. These are characterised by high durability, tensile strength, high abrasion resistance, low inflammability and good compression recovery along with low weight. These provide insulation, reduced noise, cushioning to the feet of the driver and the passengers, avoid corrosion of the vehicle floor and prevent water and dirt from entering the cabin. The carpets also improve the aesthetic appearance of interior of the vehicle. China and India are among the major producers. Key destinations of Indian automotive interior carpets are China, Hong Kong, Taiwan, UK, Germany, and USA.

Leading manufacturers in India are Uniproducts India, Bajaj Carpets, Hitkari Fibres and Supreme Nonwoven. Major global players are Auto Custom Carpets Inc., Dorsett Industries, Hyosung Advanced Materials, Tru-Fit Automotive Products Ptd./Ltd., Toyota Boshoku Corporation, Gahh LLC, Magna International Inc. and Lear Corp.

Based on the Market Research estimates by leading agencies, the global market for technical textile component of automotive interior carpets was US$ 8,515 Million whereas the Indian market stood at Rs. 246.40 Crores in 2019-20. The global market is expected to grow at a CAGR of 4 % to US$ 10,359.80 Million in 2024-25 whereas the Indian market is expected to grow at a CAGR of 17.1% till 2024-25 and reach a market value of Rs. 542.80 Crores in 2024-25.

9.9.3 Car body covers

Car covers are a fabric sheet roughly shaped like a car and these are used for protecting the car from any damage. Car covers mainly offer support in protecting the vehicle from bird droppings, sap, dirt, dust, tree leaves, moisture, UV rays, salty air, and other impurities. Furthermore, car covers aid in defending the car from damaging sun rays, which may impair the inside electronic system of the car, such as air conditioning, car stereo, and internal devices. The covers are made from a variety of fabrics including canvas covers, HDPE, PVC reinforced cotton material and nylon. Car covers can be universal or custom made. While Europe and North America account for a majority share of the market, increasing disposable income and rising living standards across developing countries have given a boost to the car covers market.

India has a relatively small share of the global market, and the demand is domestically met by few players like Coverwell India Ltd., Sri Rama Enterprises Ltd., Shakti Overseas Ltd., TPH Covers Pvt. Ltd. and Hemal Enterprises.

Major leading companies globally are Covercraft Industries LLC., Coverking Inc., Budge Industries, Polco Pvt. Ltd., Confezioni Andrea Italia SRL, Lund International Inc. (Rampage Products), California Car Cover Co., MacNeil Automotive Products Ltd., Classic Additions Ltd. and Lanmodo.

In 2019-20, the Indian market for car body covers was estimated to be worth Rs. 75.20 Crores as compared to the global market which was worth US$ 576 Million forecasted to grow at CAGR of 3% till 2024-25 when expected market size is likely to be US$ 667.75 Million. Even though the current market size of Indian market is 2.51 % of the size of global market, the Indian market is expected to grow at a CAGR of 9.7% to reach Rs. 119.97 Crores by 2024-25.

9.9.4 Headliners (TT component)

A headliner is a foam-backed cloth covering, attached to a vehicle ceiling with a strong adhesive. It provides safety, gives comfort, offers heat insulation and provides resistance to water and noise absorption. In addition to the automobiles, these are also used in spacecraft, boats, aeroplanes, satellites, and trains. A typical headliner consists of multiple layers, including foam material that's usually polyurethane. Many headliners consist of a tricot knit fabric that is napped to provide a soft touch and uniform appearance. The fabric is adhered to melted polyurethane foam. The foam is sprayed or glued to a headliner board that mounts to the inside of the roof, which can make the headliner softer to the touch. Perforated vinyl, synthetic cloth, cotton-napped cloth and foam-backed cloth are some of the cloth headliners that are frequently utilized.

Leading manufacturers of headliners in India are Krishna Maruti Ltd. and Multivac India. Major players in the international market are Grupo Antolin-Irausa S.A., Toyota Boshoku Corporation, Kasai North America Inc., Sage Automotive Interiors, Motus Integrated Technologies, UGN Inc., International Automotive Components (IAC) Group, S.A.Howa Co. Ltd., UGN Inc., SA Automotive, Hayashi Telempu Corporation, Freudenberg Performance Materials, Inteva Products LLC and IMR-Industrialesud SpA.

India’s market size for TT component of headliners (7% of value) is worth Rs. 82.40 Crores in 2019-20 and is estimated to have a CAGR of 15% for the next five years and in 2024-25, value of annual sale in Indian market is expected to be Rs. 165.88 Crores. The size of the world market is at US$ 1,162 Million which will grow at a CAGR of 4.8% to touch US$ 1,468.97 Million by 2024-25.

9.9.5 Helmets (TT Component)

Helmets provide safety to two-wheeler automobile users by protecting the riders from head injury in the event of an accident. It has a hard outer shell, adjacent padding, and a chin strap to hold it in place. A good quality helmet is one which provides a high degree of protection, clear vision while driving and is breathable.

China has been a leading country in the production of helmets. Australia, India, and South Korea also have a significant share of manufacturing facilities and demand. Some of the biggest Indian helmet brands are Vega Aerostar, Steelbird, Studds and Wrangler. Some of the largest helmet manufacturing companies in the world are Arai Helmet Ltd., Chih Tong Helmet Co. Ltd., Lazer S.A. and Nolangroup S.p.A.

The market for helmets (TT component) in India was worth Rs. 171.20 Crores in 2019-20 and is expected to touch Rs. 360.60 Crores in 2024-25 due to a CAGR of 16%. The global helmet market was worth US$ 216 Million and is expected to grow at a CAGR of 6% to reach US$ 289.06 Million in 2024-25.

9.9.6 Insulation Felts (TT Component)

Internal combustion engines generate a lot of heat throughout their combustion cycle. This can have a negative impact when it reaches various heat-sensitive components such as sensors, batteries, and starter motors. As a result, thermal insulation is essential to prevent the heat from the exhaust from reaching these components. High-performance cars usually use thermal insulation as a means to improve engine performance. Insulation felts are also known as NVH products (noise, vibration, and harshness parts). These are meant for acoustic and thermal insulation inside the vehicle and to control noise emission on the outside. They differ according to their application as floor modules, truck modules, wheels, roof module, and engine casing module. Based on products, the market is bifurcated into PU Foam, Glass Wool, Elastomeric Foam, and Others. Elastomeric foam followed by PU foam segment is accounted to hold the largest market share of automotive insulation market.

The Asia Pacific region has emerged to be a major market followed by Europe, Middle East and Africa, North America and Latin America. Leading Indian producers are Uniproducts India and Supreme Treves Pvt. Ltd. While globally the market is dominated by ASF SE, 3M Company, Mitsui Chemicals, The DOW Chemical Company, ExxonMobil Inc., Sumitomo Riko Company Ltd., Covestro AG, Huntsman Corporation, Celanese Corporation, Lanxess AG and Borgers AG.

The global market for insulation felts in 2019-20 was worth US$ 2,361 Million in 2019-20 which is likely to grow at a CAGR of 5.33% to US$ 3,060.95 Million in 2024-25. The Indian market for insulation felts is relatively small and is worth Rs. 179.20 Crores. It is forecasted to grow at a CAGR of 16% till 2024-25 to reach a market size of Rs. 377.45 Crores annually. There are negligible exports from India for insulation felts, thus domestic consumption is the market size.

9.9.7 Seat Belt Webbing

Seatbelts are woven narrow fabric made from nylon filament yarns or high tensile polyester filament yarn meant to secure passengers in a vehicle against harmful movements during collision or similar incidents, thus minimising injuries during accidents.

The Asia Pacific region dominates the automotive seat belt market due to the presence of a large number of vehicle manufacturers and rising vehicle manufacturing facilities all over the region. The market size and production facilities in India are relatively low when compared to global seatbelts market.

Some of the Indian manufacturers are Goradia Industries, KSS Abhishek Safety Systems Pvt. Ltd. and Takata India Pvt. Ltd. Major global players in automotive seat belt market are Autoliv Inc., Robert Bosch GmbH, Denso Corporation, Continental AG., Hyundai Mobis., Toyoda Gosei Co. Ltd., Tokairika Co. Ltd., Beam's Seatbelts, Belt-Tech, Louis Berger, Far Europe Inc., GWR and Seatbelt Solutions LLC.

India’s size of seatbelts market (TT component) is assessed at Rs. 236 Crores in 2019-20. It is expected to grow at a CAGR of 16% and expand to Rs. 497.09 Crores by 2024-25. The world market size in 2019-20 is valued at US$ 8,267 Million and which is likely to grow at a CAGR of 6% to touch US$ 11,063.11 Million by 2024-25.

9.9.8 Seat Cover Fabrics

Car seat covers are meant to protect the original vehicle seat while providing comfort to the driver and passengers. Resistance to abrasion, light and UV radiation are important for seat cover fabrics. They are generally made up of polyester, real leather, artificial leather, and polymer foils. India and China have a high demand for seat cover fabrics.

Leading Indian manufacturers of seat covers are Krishna Maruti Ltd., Saddles India Pvt. Ltd. Globally, the market is dominated by Johnson Controls Inc., Coverking, Faurecia, Lear Corporation, Katzkin Leather, Zhejiang Tianmei Auto Seat Cover Co. Ltd. and EuWe Group.

The seat cover fabrics market in India has a market size of Rs. 1,277.60 Crores in 2019-20. The likely CAGR for seat covers market in India is going to be 15.8% to make the annual sales reach around Rs. 2,667 Crores in 2024-25. The global seat covers market was worth US$ 2,184 Million and it is expected to grow at a CAGR of 4.98% so as to log a sales of US$ 2,784.75 Million in 2024-25.

9.9.9 Sun visors/sunblind

A Sun visor/Sunblind is meant to be a sunroof on the front portion of the roof panel inside the vehicle cabin that protects the driver and co-driver from direct sunlight and improves the visibility of the driver. It maintains the interior temperature of the vehicle by blocking sun rays from entering inside the vehicle. It is composed of several components such as mirror, padding, electric cable, flap, frame, and lights. It is made of mouded substrates, metals, plastics, and fabrics. An increase in adoption of electric vehicles is expected to boost the demand for sun visors as these offer protection to electric components inside such vehicles.

Sunvisors India Pvt. Ltd. and Sun-N-Shade Sunvisors Pvt. Ltd. are two Indian players in the sunblind industry. Leading global players are Irvin Automotive Products Inc., Grupo Antolin, Grios s.r.o., Ototrim Sanayi ve Ticaret A.Ş. Panel, Atlas Holding, Kasai Kogyo Co. Ltd., Howa Textile Industry Co. Ltd., Fompak, KB Foam Inc., Dongfeng Electronic, Kyowa Sangyo, Daimei, KOBO GmbH & Co KG, Hayashi, IAC, Takata, Yongsan, BRACE, Vinyl Specialities, Grios Sro, Mecai and Gumotex.

In 2019-20, the Indian market for sun visors / sunblinds (TT component) was worth Rs. 188.80 Crores as and the global market was worth US$ 437 Million. The Indian market is expected to grow at a CAGR of 19.3% to a size of Rs. 454 Crores by 2024-25 and global market is likely to witness a CAGR of 2% and it will grow to a size of US$ 482.48 Million by 2024-25.

9.9.10 TT usage in airlines (upholstery and airline disposables)

Technical textiles are used in airlines industry. The upholstery and disposable items used in the aircraft contain a sizeable proportion of technical textile component.

The global market for TT used in airline was estimated at US$ 1,428 Million in 2019-20 and is expected to grow at 2% to record a figure of US$ 1,576.63 Million in 2024-25. The consumption in Indian market for these items was worth Rs. 137.60 Crores and it is estimated to grow at a CAGR of 8.8% and be valued at Rs. 209.26 Crores in 2024-25.

9.9.11 TT usage in Railways

The seat covers in railways require a backing fabric which is the technical textile part. As per the railway sources, India has a market size of Rs. 1.60 Crores in 2019-20. The likely CAGR for this market in India is going to be 9.7% to make the annual sales reach around Rs. 2.55 Crores in 2024-25. The global seat cover backing cloth market in railways was estimated to be worth US$ 20 Million and it is expected to grow at a CAGR of 2% so as to log sales of US$ 22.08 Million in 2024-25.

9.9.12 Tyre Cord Fabric

Tyre cord fabric is an industrial fabric made up of high tenacity synthetic yarn cord. It provides reinforcement to the tyre by strengthening its fundamental properties such as shape, load carrying capacity, abrasion resistance etc. Different materials of tyre cord fabrics are nylon, polyester, rayon and other aramid fibres, polyethylene napthalate (PEN), and hybrid. Nylon is the most widely used fabric followed by polyester.

Asia Pacific is the key market for tyre cord fabrics, globally, followed by Europe and North America. The growth of tyre cord fabrics market is influenced by rising automotive tyres aftermarket due to the increasing average life of vehicles and stringent emission regulations in Europe and North America.

Some of the major domestic players of nylon yarn are SRF Limited and Century Enka Ltd. Rest of the country's nylon tyre yarn demand is met through imports from countries like Russia and China. Major international players are Indorama Ventures Company Ltd., Kolon Industries Inc., Hyosung Corporation, SRF Ltd., Kordsa Teknik Tekstil A.S., Teijin Ltd., and Toray Industries Inc.

The global market for tyre cords was US$ 5,769 Million in 2019-20 and is expected to grow at 4% and gross a sale of US$ 7,018.87 Million in 2024-25. The Indian market for tyre cords was worth Rs. 6,790.40 Crores and it is estimated to grow at a CAGR of 8.8% and be valued at Rs. 10,326.95 Crores in 2024-25.

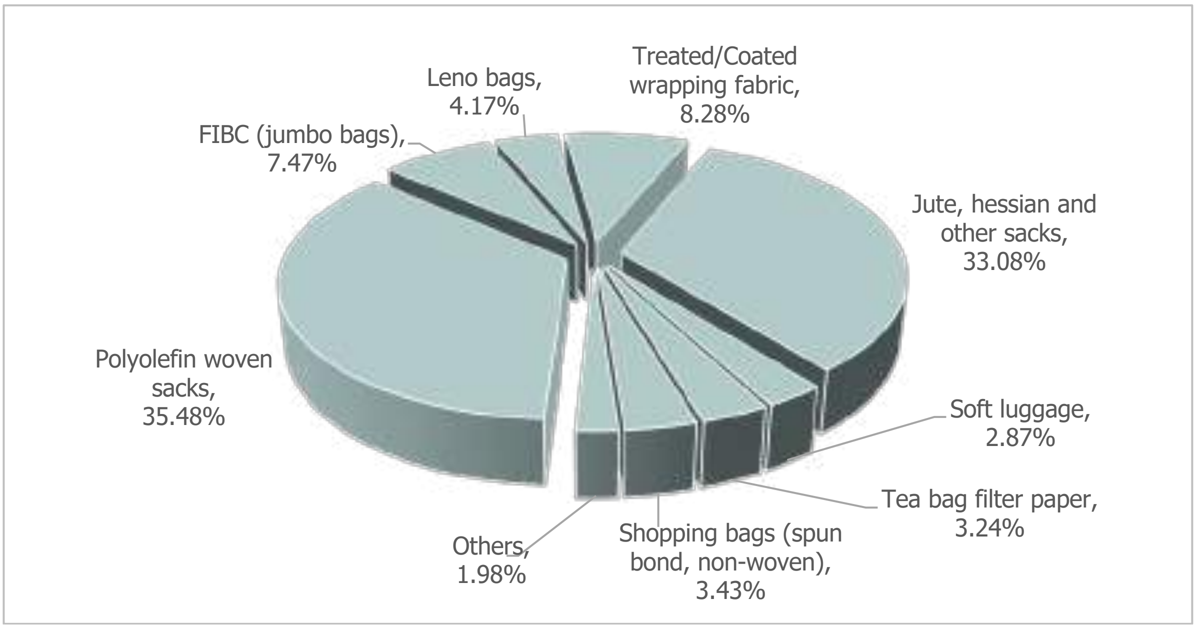
9.10 Packtech

Packtech includes flexible packing material made of textile used for packing various goods for industrial, agricultural, consumer and other purposes. It ranges from polymer-based bags used for industrial packing to jute-based sacks used for packaging food grains and packaging used for tea.

Technical textile products under Packtech segment are as follows:

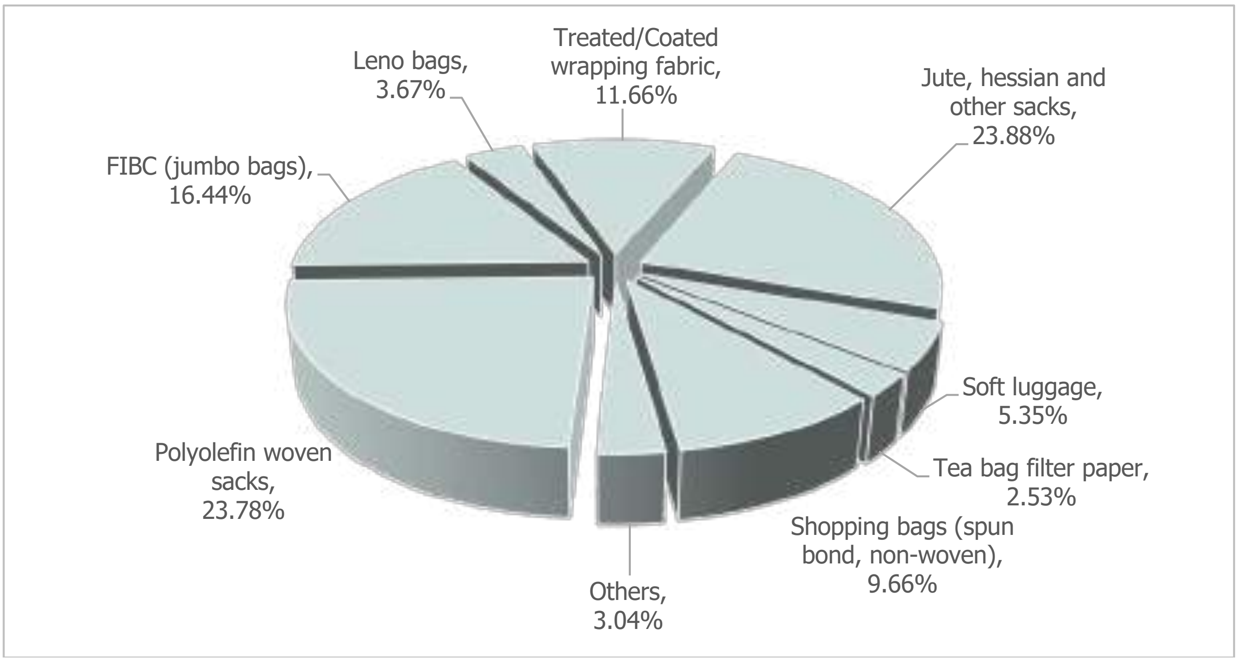
1. FIBC (Jumbo Bags)
2. Jute Hessian and Sacks
3. Leno Bags
4. Polyolefin woven sacks
5. Soft luggage
6. Tea bags filter paper
7. Treated/ Coated Wrapping Fabric
8. Shopping Bags (Spun Bond, Non -Woven)

Figure 9.25: Percentage contribution of Packtech products in the domestic market (2019-20)



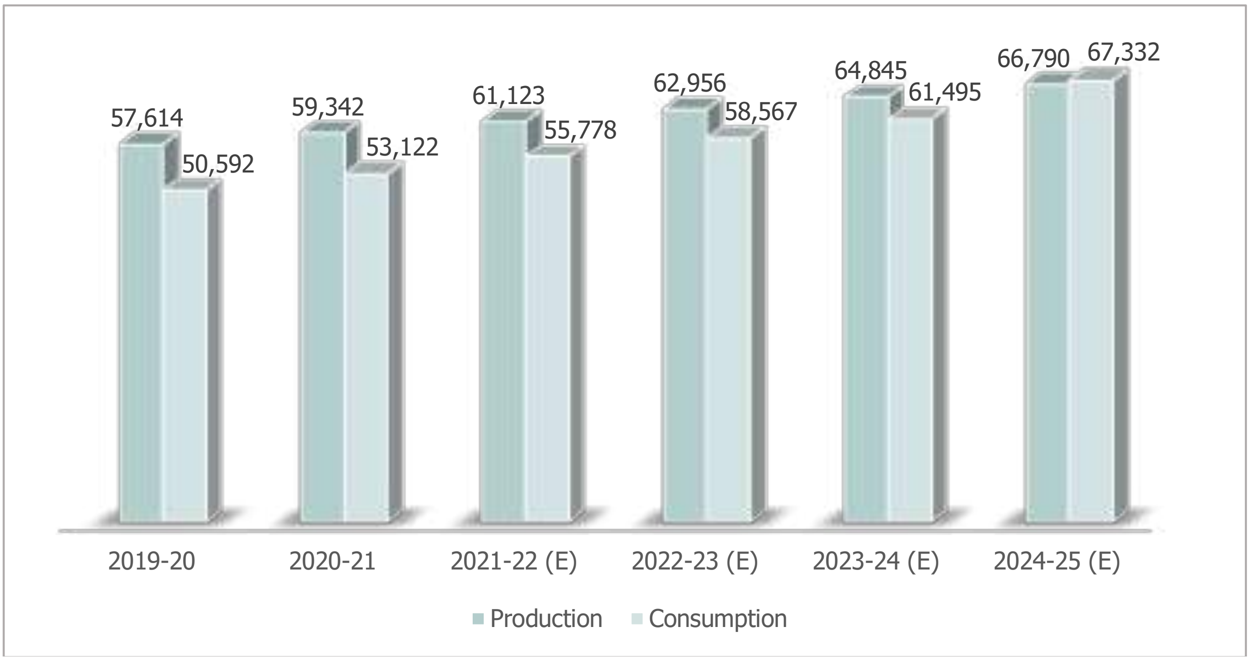
During 2019-20, the largest share of the domestic Packtech products market comprised Polyolefin woven sacks (35.48%). The product category comprising second largest share was Jute, hessian and other sacks and it made up nearly a third of the Indian market.

Figure 9.26: Percentage contribution of Packtech products in the international market (2019-20)



Jute Hessian and other sacks at a market share of 23.88% and Polyolefin woven sacks products at 23.78% made up the two largest slices of the market in terms of value in the year 2019-20.

Figure 9.27: Production Vs Consumption of Packtech in the domestic market (Rs. Crores)



The production of Packtech items in India is valued at Rs. 57,614 Crores in 2019-20 and it is valued at more than what is consumed (Rs. 50,592 Crores) in India. India is a net exporter of Packtech products as of 2019-20. However, the forecast suggests that due to the likely stagnation in traditional Packtech exports from India and increase in imports of synthetic Packtech items, India may become a net importer of Packtech products in the years to come.

Table 9.11: Packtech - World and India Market Size 2019-20

Product Name	World (US$ Million)	India (Rs. Crores)	India's share
FIBC (Jumbo Bags)	4,537	3,778	12.79%
Jute Hessian and Synthetic Sacks	6,589	16,735	39.00%
Leno Bags	1,013	2,112	32.02%
Polyolefin woven sacks	6,562	17,950	42.01%
Soft luggage (TT Component)	1,476	1,450	5.09%
Tea bags filter paper	699	1,641	36.05%
Treated/ Coated Wrapping Fabric	3,217	4,190	20.00%
Shopping Bags (Spun Bond, Non - Woven)	2,666	1,736	10.00%
Others	838	1,000	18.32%
Total	27,597	50,592	28.15%

9.10.1 FIBC (Jumbo Bags)

Flexible intermediate bulk containers (FIBC), popularly known as jumbo bags, are one of the most cost effective and ideal types of packaging for shipping and storing dry bulk products. Made up of either tubular or flat polypropylene (PP) woven fabrics, these fabrics can be coated or uncoated and vary in terms of weights depending upon the requirements of the safe working load (SWL) or safety factor (SF) of up to 1800 Kg.. They are commonly used to store dry and flowable products such as grains, seeds, salts, chemicals, sands, clays, cement, and others. FIBC majorly finds application in various end-use industries including food, chemical, pharmaceutical, building & construction, mining, and others.

Primary FIBC markets are the United States of America, European countries, Japan, China, India, Korea, Africa and others. Indian manufacturers include Flexituff Ventures International Ltd., Isbir Mewar Bulk Bag Private Ltd., Rishi FIBC Solutions Pvt. Ltd., Emmbi Industries Limited, Kanpur Plastipack Ltd. and Alpine FIBC Pvt. Ltd. Some of the global manufacturers are Global-Pak, BAG Corp., Greif and Conitex Sonoco, Berry Plastics, AmeriGlobe, LC Packaging International BV, RDA Bulk Packaging, Sackmaker, Langston, Taihua Group, Halsted, Intertape Polymer, Lasheen Group, MiniBulk, Bulk Lift, Wellknit, Dongxing, Yantai Haiwan, Yixing Huafu, Changfeng Bulk, and Shenzhen Riversky.

According to a new (2020) report by Grand View Research Inc., the global flexible intermediate bulk container (FIBC) or Jumbo Bags market size is projected to reach US$ 6.4 Billion by 2026 from its current level of US$ 4,537.37 Million, progressing at a CAGR of 5.9% over the forecast period. In keeping with this forecast, the global market size in 2024-25 is likely to be US$ 6,042.94 Million. Based on the estimates provided by Indian producers, the estimated consumption of FIBC in India is Rs. 3,778 Crores during 2019-20 and is expected to increase at a CAGR of 4% and reach Rs. 4,596.51 Crores by 2024-25. India has captured about one-third of the share of the world trade of FIBC even as the size of Indian market is about 13% of the world market.

9.10.2 Jute, Hessian and other Sacks

The global jute bag industry is currently at a nascent stage with encouraging growth aspects. The demand for jute bags has witnessed a surge over the past few years, particularly in the European Union. This can be attributed to the growing environment consciousness in the region. The imports of jute bags in non-producing countries have also been facilitated by the ban on plastic packaging materials and bags. Additionally, the benefits offered by jute bags such as their biodegradability, durability, low cost, high strength, etc. have further supported the market growth.

Hessian is a breathable woven fabric made up of jute plant skin or sisal fibres that resists condensation and associated spoilage of contents. Hessian is used in shopping bags, promotional bags, door mats, weather protection sheets, ropes, book covers or pouches, gifts etc. It is 100% bio-degradable and recyclable. Hessian products include hessian bags (food grain bags, shopping bags, promotional bags etc.), hessian mats, ropes, yarn etc. Plastic (Polypropylene (PP)) bags are the substitute for hessian bags. But the negative environmental effects of plastic bags give credibility to hessian bags over plastic bags. Hessian bags are food grade, anti-static, easily allow fresh air (can keep food grains fresh). The Hessian fibres are often used to make gunny sacks to ship agricultural produce. They are also used as wet covering to prevent rapid moisture loss in the setting of cement and concrete in the construction industry and as sandbags for flood mitigation in temporary embankments against floodwaters or field fortifications.

Jute is cultivated in India, Bangladesh, East Asia and some parts of Latin America. Bangladesh, India and Thailand account for over 90 percent of world jute production. India alone contributes for more than 70 percent of the global hessian production. Jute industry alone provides employment to 3.7 lakh jute mill workers in India of which 2.5 lakh are present in West Bengal state (source: The Economic Times, May 20, 2021). In 1987, India passed the Jute Packaging Materials Act (JPMC), which made it compulsory for the central government to purchase hessian or jute bags for supply and storage of food grain, sugar, fertilizer and cement. Cement and fertilizers have now been removed from the list. And again in 2015, India once again made and approved mandatory use of jute or hessian packaging for food grains and sugar. HDPE/PP bags are cost competitive for jute or hessian packaging. Per kg cost of hessian bags costs around US$ 0.5 (Rs. 30), while the cost of HDPE/PP bags is US$ 0.2 (Rs.12) per kg. As the government is bringing various schemes and programs to educate public to use the jute or hessian packaging, the hessian packaging market is expected to grow at a healthy growth rate.

Leading manufacturers of jute hessian in India are AI Champdany Industries Ltd., Bangalore Fort Farms Ltd. and Budge Budge Company Ltd. The dominant players in the global hessian packaging market are Birla Corporation Ltd., Cheviot Co. Ltd., Gloster Limited, AI Champdany Industries Ltd., Ludlow Jute & Specialities Ltd., NYP Corp., S.L.Packaging Pvt. Ltd., Kankaria Group, India Glazes Ltd., Naylor Bag and Supply, and Gyaniram Agarwal & Company Ltd.

The global jute bag, Hessian bags and other similar synthetic bags market is likely to have reached a value of US$ 6.59 Billion in 2020 and is likely to grow at a CAGR of 4% in the coming years so as to clock an estimated sales of US$ 8,016.53 Million in 2024-25. The market in India for all the bags of this category are expected to have a sale of Rs. 16,735 Crores in 2019-20 and this is likely to witness a CAGR of 5% to reach a figure of Rs. 21,358.57 Crores in 2024-25.

9.10.3 Leno Bags

Leno bags are emerging as a better substitute to jute bags and are being increasingly used for packing and preserving vegetables and fruits such as onions, potatoes, corn, pineapples, mangoes, coconuts etc. There are many reasons for this preference. In Jute and Hessian bags, agricultural produce starts decaying after a certain point of time due to the high moisture-absorption characteristic of jute. There is no such risk in leno bags. Also, the market price of a leno bag is less than a Jute or Hessian sack. Leno bags offer easy visual inspection of content stored inside it which isn’t possible in other bags. Additionally, nowadays, the manufacturers of leno bags are ensuring that the bags are produced in such a way which acts as a barrier against fungus and insects. These are light in weight and have appreciable tensile resistance. They provide advantages such as ease in storage and handling of products and are chemically inert. They are also reusable and recyclable which makes them environment friendly. Traditionally flat bags were the primary choice of food product packaging but with advancement in material usage leno bags are significantly preferred for food packaging which requires oxygen in order to increase the shelf life. Leno bags are made of polypropylene (PP), polyethylene (PE) and polyamide (PA). BOPP polymer material is extensively replacing the polyamide material as it offers product strength. Development in leno bags with fabric coating has resulted in increasing the physical strength of the product thus ensuring a high demand for customized packaging solution to the food manufacturers.

India and China dominate the global market for leno bags. There has been a rise in demand and consumption in Europe and North America. Most of the key players operating in the global leno bags market are from India including CTM Technical Textiles Ltd., Trinity Packaging, Meher International, Skill Dye Chem Pvt. Ltd., Balaajie Packaging, Kalna Hessian Bags Supply Co., Manokamna Polypack, Prime Industries, S.P.P. Food Products Pvt. Ltd., Pack World, Megaflex Plastics Ltd., Innovative Polypack, Kalyani Polymers P Ltd., Singhal Industries Private Limited, Mantram Technofab Private Limited, Sunbeam Lenopack Pvt. Ltd., Jaidayal Hitex Private Limited, Leno Pack Industries Ltd. and Key Vee Monotex Pvt. Ltd. The main producers from outside India are Yilsan Plastic Packaging Industry & Trade Co. Inc., Tan Dai Hung Plastic J.S. Co., LC Packaging and Emballage Coderre Packaging Inc.

India's market size for Leno bags in 2019-20 is estimated at Rs. 2,112 Crores and is expected to grow at a CAGR of 15% to reach Rs. 4,247.99 Crores by 2024-25. The world market size is estimated by the industry at US$ 1,013 Million and is forecasted to grow at a CAGR of 6% to log sales of US$ 1,355.62 Million in 2024-25.

9.10.4 Polyolefin Woven Sacks

Polyolefin is a thermoplastic resin material, produced by the polymerisation of propylene. It is one of the best and the most cost-effective packaging solutions for industries like cement, fertilizer, sugar, chemicals and food grains. Polyolefin bags and sacks market is classified as laminated polypropylene woven bags and non-laminated polypropylene woven bags. Based on the end use, the market is segmented into building & construction, agriculture & allied industries, food, retail and shopping and others. The USA. and Germany are the biggest markets for the polypropylene woven bags & sacks industry.

Some of the leading Indian manufacturers are Ganpati Plastfab Ltd., Vardhaman Mills, Silvassa Woven. Major global players are Printpak Inc., Emmbi Industries Ltd., Al-Tawfiq Company, Uflex Ltd., Mondi Group plc., Muscat Polymers Pvt. Ltd., United Bags Inc., Berry Global, Conitex Sonoco USA, Anduro Manufacturing, Polytex, ProAmpac, Hood, Morris Packaging, Commercial Packaging, Vietnam HOAHA Co. Ltd., ObourPlast, C.P. Poly-Industry Co. Ltd., Tan Dai Hung, Uflex, Palmetto Industries, Yameida Group, WenZhou Chenguang Group, Nansu Group, Shouguang Jianyuanchunand Inc. and Palmetto Industries.

Polyolefin woven sacks have an estimated market Rs. 17,950 Crores in 2019-20 which is estimated to grow with a CAGR of 4% to Rs. 21,838 Crores by 2024-25. The world market size is estimated by the industry at US$ 6,562 Million and is forecasted to grow at a CAGR of 3% to log sales of US$ 7,607.16 Million in 2024-25.

9.10.5 Soft Luggage

Soft luggage bags such as totes, duffle, uprights, and sky bags are made out of woven fabrics such as nylon and polyester that are light weight and durable. Woven textiles are tear-resistant, light weight, and offer high tensile strength. Technical textile component is approximately 18% of final price, so whatever is the soft luggage market, 18% of that will be the demand for TT element based on current technologies.

The India branded luggage bags market is dominated by three players, Samsonite, VIP Industries Limited and Safari. In future, the Indian market is likely to be more competitive, due to more foreign brands planning to expand their respective market shares. The leading global players in this product category are Tommy Hilfiger, Delsey, Briggs and Riley, Rimowa, VF Corporation (Eagle Creek and Eastpak), Travelpro, Victorinox, Olympia, Fox Luggage, Skyway, Traveler's Choice, ACE, Diplomat, Eminent etc.

The global consumption of technical textile component in soft luggage is assessed at US$ 1,476 Million in the year 2019-20. The growth in travel and tourism will result in growth at a CAGR of 4% which is likely to result in a global market of US$ 1,795.78 Million by the year 2024-25. The annual sale in India is estimated at Rs. 1,450 Crores that is expected to grow at 10% per annum and touch a sale of Rs. 2,335.24 Crores in 2024-25.

9.10.6 Tea Bag Filter Paper

Tea bag filter paper plays a key role in the packaging of single-use tea. Tea bags consist of a filter paper pouch with a thread, which holds the tea powder and a tag. This bag is dipped into hot water or milk and allowed to steep. Tea bag filter paper is made primarily from special natural fibres found in Philippines. They are further treated with heat sealable thermoplastics such as PVC or PP.

Tea filter paper is used to make tea bags to fulfil all consumer, household or business needs. Owing to the increased consumption of ready-to-drink tea, the demand for tea filter paper used for making tea bags is growing.

Asia Pacific is the largest consumer of tea bag paper, constituting more than 50% of consumption. Europe is the second largest consumer. The two major marketers of tea bags in India are Hindustan Unilever Ltd. (HUL) and Tata Tea Ltd. Glatfelter, Ahlstrom-Munksjö, Prico, Hebei Amusen Filter Paper, Pelipaper (Vezirkopru) are the top 5 players in the global tea bag paper market.

The market size of Tea Bag Filter Paper in India for the year 2019-20 is estimated at Rs. 1,641 Crores and the forecast for its growth rate is 8% so as to cause the annual sales to reach Rs. 2411.17 Crores in 2024-25. The corresponding size of world market is estimated at US$ 699 Million which is likely to grow at a CAGR of 2% and touch an annual sale of US$ 771.75 Million in 2024-25.

9.10.7 Treated/ Coated Wrapping Fabric

Treated / coated Wrapping fabric is made of unlaminated PP/HDPE, cotton canvas or woven fabric. It is mainly used for wrapping large paper rolls, paper bundles, steel coils, tyres, yarn cones etc. There is another type of wrapping fabric that is laminated which is used as lumber cloth. Lumber cloth is a wide width fabric used to cover big wooden logs. It can be laminated either on one side or on both sides and formed as rolls.

According to the figures mentioned in the industry market research reports, global market value is estimated at US$ 3,217 Million in 2019-20 and it is expected to progress at a CAGR of 4% over the next five years resulting in a likely market size of US$ 3,913.97 Million. Based on the estimates provided by Indian producers, the estimated consumption of Treated/ Coated Wrapping Fabric in India is valued at Rs. 4,190 Crores during 2019-20 and is expected to increase at a CAGR of 10% and reach Rs. 6,748.04 Crores by 2024-25.

9.10.8 Shopping Bags (Spun Bond, Non -Woven)

Shopping bags that are made from spun bond non-woven fabric are an important product of Packtech segment of technical textiles. Key manufacturers of India include Hari Om Polypacks , Jhilmil Nonwoven, Sidwin fabrics Pvt. Ltd.

India's market size for Shopping Bags (Non-Woven) in 2019-20 is estimated based on industry feedback at Rs. 1,736 Crores and is expected to grow at a CAGR of 10% to reach Rs. 2,795.85 Crores by 2024-25. The world market size is estimated by the industry at US$ 2,666 Million and is forecasted to grow at a CAGR of 5% to log sales of US$ 3,402.57 Million in 2024-25.

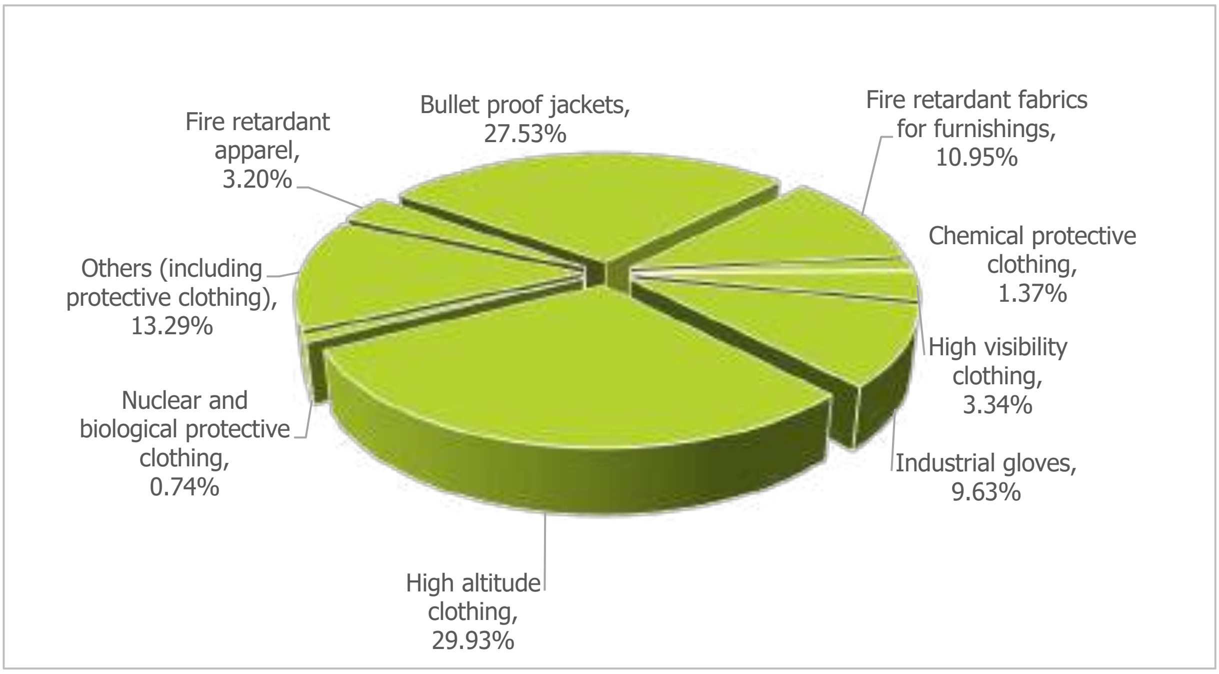
9.11 Protech

Protech are protective garments meant to protect the wearer from harsh external environmental effects at the workplace such as firefighters, paramedics, emergency medical technicians, personnel responding to toxic spills, workers in toxic environments, laboratory researchers and specialists cleaning up contaminated facilities etc.

Technical textile products under Protech segment are as follows:

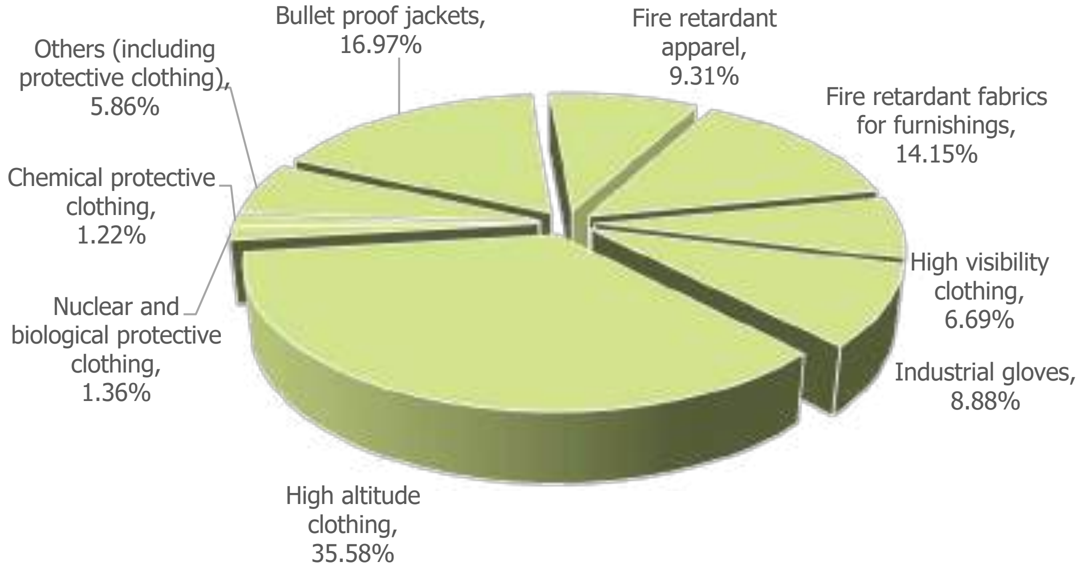
1. Bullet Proof Jackets
2. Fire Retardant Apparel
3. Fire Retardant Fabrics for Furnishings
4. High Altitude Clothing
5. High Visibility Clothing
6. Industrial Gloves (TT Component)
7. Nuclear & Biological Protective Clothing
8. Chemical Protective clothing
9. Others (including Outer Protective Clothing)

Figure 9.28: Percentage contribution of Protech products in the domestic market (2019-20)



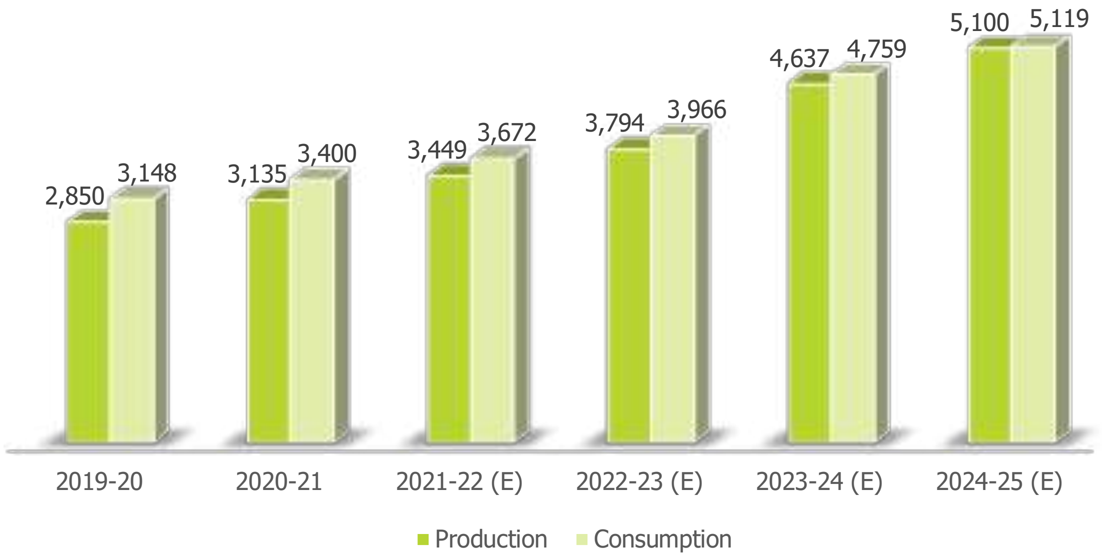
Domestically, High altitude clothing and Bullet proof jackets constitute the highest market share product categories at approximately 30% and 28% respectively.

Figure 9.29: Percentage contribution of Protech products in the international market (2019-20)



High altitude clothing comprises more than third of the global Protech market whereas Bullet proof jackets at approximately 17% of share of global market form the second highest slice of global Protech market.

Figure 9.30: Production Vs Consumption of Protech in the domestic market (Rs. Crores)



Current value of production (Rs. 2,850 Crores in 2019-20) of Protech products in India is lower than their consumption (Rs. 3,148 Crores in 2019-20). At present, India has to import its requirement of Protech items and even though India will reduce its trade gap significantly, it will continue to remain a net importer of Protech items till 2024-25.

Table 9.12: Protech - World and India Market Size 2019-20			
Product Name	**World (US$ Million)**	**India (Rs. Crores)**	**India's share**
Bullet Proof Jackets (TT Component)	1,898	867	7.01%
Fire Retardant Apparel	1,041	101	1.49%
Fire Retardant Fabrics for Furnishings	1,583	345	3.34%
High Altitude Clothing	3,980	942	3.64%
High Visibility Clothing	748	105	2.16%
Industrial Gloves (TT Component)	993	303	4.69%
Nuclear & Biological Protective Clothing	152	23	2.36%
Chemical Protective Clothing	137	43	4.84%
Others (including Outer Protective Clothing)	655	418	9.81%
Total	11,187	3,148	4.32%

9.11.1 Bullet Proof Jackets

A ballistic vest or bullet-resistant vest, often called a bullet proof vest, is an item of body armour that helps absorb the impact and reduce or stop penetration to the torso from firearm-fired projectiles and fragments from explosions. The vest may come in a soft form, as worn by many police officers, prison guards, security guards and some private citizens. Prison guards and police may also wear soft vests designed to resist stabbing attacks, using metallic or para-aramid components.

Europe accounts for the largest market size of bullet proof jackets market. It is due to governments' liberal funding programme and access to advanced technologies for the efficient production of bullet proof jackets.

The major manufacturers for bullet proof jackets in India are Tata Advanced Systems Ltd. (TASL), MKU Pvt. Ltd., SM Fabric Pvt. Ltd., SMPP Pvt. Ltd. and Anjani Technoplast Pvt. Ltd.

The key players of global bullet proof jackets are VestGuard, Point Black Body Armor, Canarmor and Black Hawk. Other prominent vendors are Wenzhou Start Co. Ltd., MKU Ltd., EnGarde, Infidel Body Armor, Point Blank Enterprises Inc., MARS Armor, Vestguard, Armourshield Ltd., BulletSafe and Compass International Corp. Ltd.

The estimated market size for technical textiles component of Bullet Proof Jackets in India for the year 2019-20 is Rs. 866.70 Crores and it is estimated to be growing at a CAGR of 17.4% and it is likely to reach Rs. 1,936.94 Crores by the year 2024-25. The size of world market is estimated at US$ 1,898 Million in 2019-20 and the forecast for its growth rate is 7.1% per annum that will cause it to reach US$ 2,664.62 Million by 2024-25.

9.11.2 Fire Retardant Apparel

Fire retardant (FR) apparel provides protection against environment with likely fire hazards and safeguard against splashes of welding, molten metal, electric arc flashes, and exposure to fire accidents in oil and gas industry. They are manufactured using two methods: using chemical FR coating on natural fibre and using inherent FR fibre. The former method has proven to be a medical hazard due to the toxic fumes emitting from chemical coating. Due to the toxicity of chemical coating, the apparel made from fire retardant fibre is becoming more common.

FR fibres have a special property wherein the molecules of such a fibre expand when these are subjected to heat/flame, providing sustained and better protection to the person. Apparel made from such a fibre does not lose its properties even after repeated washing and hence offers protection that is long lasting.

The construction industry is one of the main industries with a high demand for FR apparel to ensure protection for its workers. In many countries including India, the respective governments are insisting on implementation of guidelines to protect workers against fire hazards thus increasing the demand for FR apparel. Companies in countries such as the USA, UK, China and India are focusing on the R&D of FR apparel.

Leading Indian manufacturers of fire retardant apparel are Mallcom India Ltd., Tarasafe International and Chandramukhi Impex. Major global players in the flame retardant apparel market include 3M, Carhartt, Kimberly-Clark Bulwark, Honeywell International Inc., Ansell, National Safety Apparel, Lakeland Industries, Cintas and Williamson-Dickie Manufacturing.

The global market for FR Apparel stood at US$ 1,041 Million in 2019-20 and is expected to grow at a CAGR of 7.1% to US$ 1,461.47 Million by 2024-25. The Indian market for FR apparel was Rs. 100.80 Crores in 2019-20. It is expected to grow to Rs. 225.27 Crores by the year 2024-25 at a CAGR of 17.5%.

1.11.3 Fire Retardant Fabrics for Furnishings

Fire retardant fabrics are either synthetic fabric made of fibres that have inherent fire retardant properties or fabrics having a coating of fire resistant chemicals. These fabrics have properties that delay the spread of fire or provide insulation against heat and flame thereby providing crucial extra time to the person using it.

Fire retardant (FR) furnishing fabrics are textiles that are designed to provide superior resistance to fire compared to traditional materials. FR furnishing fabrics use either inherently resistant fibres or chemical treatment on natural fibres. When exposed to heat/flame, the FR fibres swell and become thick thus providing a protective barrier. Flame retardants in furnishings keep the public safe by preventing fires from spreading.

Defence, manufacturing, oil & gas, chemicals, and construction industries play an important role in the growth in demand for the fire-retardant furnishing material.

Asia Pacific, especially China and India are expected to perform well in the coming years owing to rising demand and production. Top producers in India are Seth Sons, AK Industrial Fabrics and Ginni Spectra Pvt.

Ltd. Some of the top performing companies in the world are Albemarle Corp, Israel Chemicals Ltd., Lanxess AG, Clariant International Ltd. and Nabaltec AG.

In 2019-20, the Indian market for fire retardant fabrics for furnishings was estimated to be worth Rs. 344.70 Crores as compared to the global market which was worth US$ 1,583 Million during 2019-20. The Indian market is expected to grow at a CAGR of 7.4% to reach Rs. 488.82 Crores by 2024-25 and the global market is estimated to increase to US$ 2,118.56 Million by 2024-25 at a CAGR of 6%.

9.11.4 High Altitude Clothing

High altitude clothing, also known as Extreme Cold Climate Clothing (ECCC), are used for protection against extremely low temperature, strong winds, falling snow etc. It is used by security forces as well as the mountaineering community. The clothing should be comfortable and yet fully protect the wearer from inclemental weather. The high altitude clothing consists of jacket and windcheater, waist coat, trousers, glacier cap, rappelling gloves and glacier gloves. The high altitude clothing needs to be waterproof and moisture resistant, breathable, abrasion resistant, maintain high integrity. The material used for these clothing is typically hydrophilic polyurethane coating or PTFE coating, Gore-Tex coating or Sympatex coating. The inner jacket is usually made of fleece and rest of the items are 100% polyester.

High altitude clothing is imported mainly from USA, Canada, Australia, Switzerland, Italy, UK and China since Kusumgar Corporates Pvt. Ltd. and Texplus Fibres Pvt Ltd. are the only Indian manufacturers for the same. Major global players are Black Diamond Equipment SP AG, Mountain Hard Wear and Westcomb Outerwear Inc.

In 2019-20, the Indian market for high altitude clothing was estimated to be worth Rs. 942.30 Crores as compared to the global market which was worth US$ 3,980 Million. The Indian market is expected to grow at a CAGR of 6.2% to reach Rs. 1,273.84 Crores by 2024-25 whereas the world market is estimated to grow to US$ 5,075.30 Million by 2024-25 at a CAGR of 4.9%.

9.11.5 High Visibility Clothing

High visibility clothing has a luminescent property that makes it discernible from any background. It is worn on the torso and arm area of the body by public safety personnel and workers working on road works and railway construction. These usually are of yellow or orange colour and follow ISO 20471 standards. High visibility clothing is classified into three types depending on its usage: type O (off road), type R (railways) and type P (public safety).

Asia Pacific is the dominant and fastest growing high visibility clothing market with Europe being the second largest market.

Leading manufacturers in India are V4you Group, Reflectosafe, Ramesh Trading Company, Rushabh Enterprises and NexG Apparels LLP. Top manufacturers globally are Ansell, Honeywell, Lakeland Industries, 3M, ASATEX, Bulwark, Ballyclare, Kermel, National Safety Apparel, Nasco Industries, OccuNomix and True North Gear.

The relevant market for technical textile component of high-visibility clothing in India is assessed to be worth Rs. 105.30 Crores as compared to the global market which is estimated to be worth US$ 748 Million. The

Indian market is expected to grow at a CAGR of 8.3% to reach Rs 156.57 Crores by 2024-25 whereas the world market is estimated to grow to US$ 1050.13 Million by 2024-25 at a CAGR of 7.1%.

9.11.6 Industrial Gloves

Industrial hand gloves are used as protective apparel for workers in factories. They are of two types, Cut-Slash Protection gloves and Thermal Protection gloves. Gloves offer protection against rough objects, sparks, heat, blows that are caused due to heavy-duty work. Hand gloves can be Nitrile gloves for dry grip, PVC impregnated textile gloves for dry, oily and wet grip, leather gloves with Kevlar and p-aramid layer for intense use in high heat or sharp edges environment. Industrial gloves are made of three base fabrics, cotton, nylon or polyester. The fabric is chosen according to the condition of use. The coating of either Nitrile or PVC is impregnated as required. Some of the gloves are meant for intense industrial use and these may have additional layer of special fabrics like Kevlar, Nomex, spectra or p-aramid to provide better temperature resistance, fire resistance and cut resistance.

Main manufacturers of industrial gloves in India are Mallcom India Ltd., Rajda Industries & Exports Pvt. Ltd. and Lumen India (Kolkata).

The global market for technical textiles component of Industrial Gloves is estimated at US$ 993 Million in 2019-20 and is expected to grow at a CAGR of 6% to US$ 1,328.95 Million by 2024-25. The corresponding value of Indian market is estimated Rs. 303.30 Crores in 2019-20. It is expected to grow to Rs. 430.11 Crores by the year 2024-25 at a CAGR of 7.5%.

9.11.7 Nuclear & Biological Protective Clothing

The threat posed by nuclear (radioactive fallout dust) and chemical warfare weapons can be countered by suits which are known as NBC (Nuclear Biological and Chemical) suits. The suits are designed to be worn for extended periods while continuing to operate in a hostile environment. The Nuclear Biological and Chemical protection suit comprises a trouser and jacket which are both made from permeable and breathable fabric.

In 2019-20, the Indian market for NBC (TT) was estimated to be worth Rs. 23.40 Crores as compared to the global market which was worth US$ 152 Million during 2019-20. The Indian market is expected to grow at a CAGR of 7.4% to reach Rs. 33.18 Crores by 2024-25 and the global market is estimated to increase to US$ 184.60 Million by 2024-25 at a CAGR of 3.9%.

9.11.8 Chemical Protective clothing

Chemical Protective Clothing (CPC) is used for protection against effect of exposure to toxic chemicals through inhalation or physical contact. The CPC suits are of two types, durable CPC is made from non-permeable textile fabrics (PVC/Rubber coated fabrics). However, because these fabrics do not permit air or moisture permeability, these lead to discomfort and loss of productivity. The disposable CPC is made of non woven fabric and can be repeatedly used for 3-4 times. The disposable CPC allows better air and moisture permeability and are breathable. It is for this reason that these are preferred over non-permeable type. The carbon-containing material developed so far includes carbon-coated non-woven fabric, carbon-impregnated polyurethane foam, hard carbon microsphere-adhered woven fabric and activated charcoal cloth. Overallas made from non-woven fabrics are also becoming popular in various industries. The CPC clothing also includes gas masks, hoods etc. to prevent against airborne toxic agents. The main manufacturer of Chemical protective clothing (CPC) in India are Sai Synergy LLP, Intech Safety Pvt. Ltd. and Venus Safety Equipments Ltd.

The annual consumption of technical textiles for Chemical Protective Clothing in India was estimated at Rs. 43.20 Crores in 2019-20, expected to grow at a CAGR of 7.5% to reach Rs. 61.26 Crores by 2024-25. The consumption at the global level for the same period is assessed to grow at 6% per annum from US$ 137 Million in 2019-20 to US$ 183.35 Million in 2024-25.

9.11.9 Others (including Outer Protective Clothing)

Outer protective clothing includes products like wind cheaters and rain coats which provide protection to the individuals from extreme weather, wind and water (rain) to keep the person comfortable and dry. The common products are rain jackets, wind cheaters (Breathable water proof rain coats, Breathable water resistant jackets commonly called wind cheaters, as the lamination of the fabric prevents strong winds to pass through the fabric) and Hybrid soft shell jackets. These products are mainly being made by small and medium enterprises in India.

The market size for technical textile requirement in outer protective clothing in India was Rs. 418.50 Crores in 2019-20, expected to grow at a CAGR of 4.2% to reach Rs. 513.14 Crores by 2024-25. The world market in the same period is assessed to grow at 3.9% per annum from US$ 655 Million in 2019-20 to US$ 795.49 Million in 2024-25.

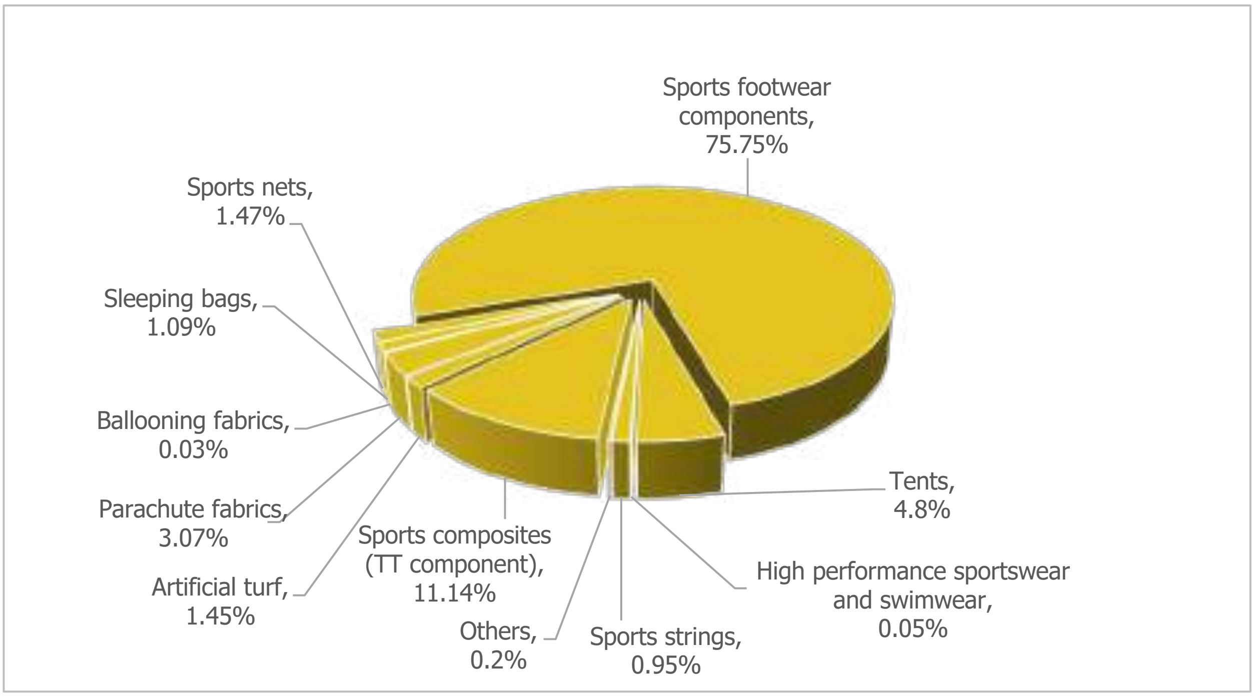
9.12 Sportech

Sports technical textiles or Sportech is the use of technical textiles for sports purposes. This includes all types of fabrics related to clothing as well as equipment.

Technical textile products under Sportech are as follows:

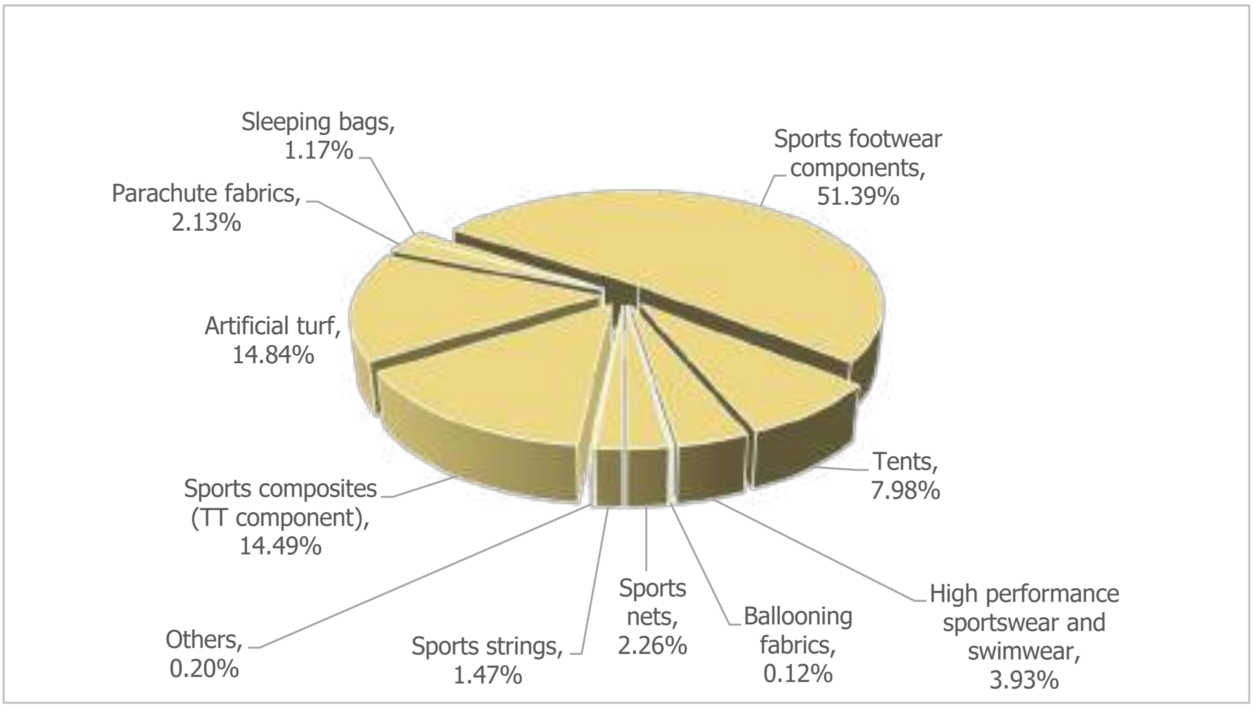
1. Artificial Turf
2. High performance swimwear and sportswear
3. Parachute Fabric
4. Sleeping Bags
5. Sports Composites (TT Component)
6. Sports Footwear Components
7. Tents
8. Ballooning Fabric
9. Sports Nets
10. Sports Strings

Figure 9.31: Percentage contribution of Sportech products in the domestic market (2019-20)



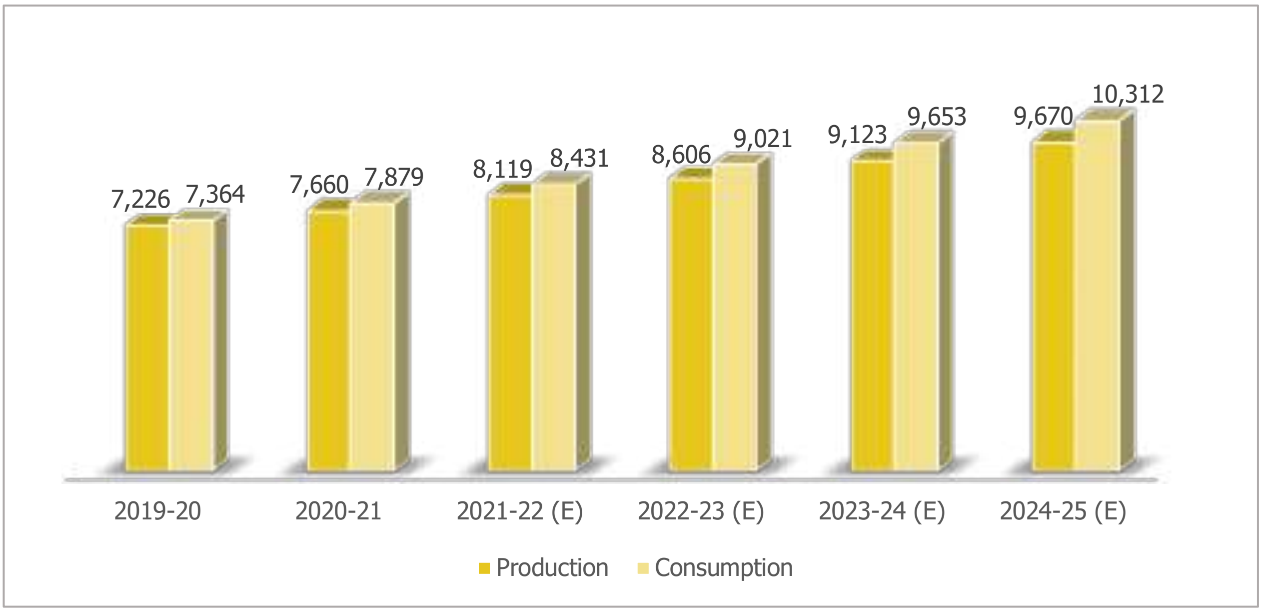
The domestic Sportech market is dominated by the Sports Footwear Components category which make up for more than three-fourths of the segment's share of market. Technical textiles elements in Sports Composites constitute the next large share of the market.

Figure 9.32: Percentage contribution of Sportech products in the international market (2019-20)



Similar to the domestic market, Sports Footwear Components dominate the international Sportech market as well, amounting to over half the market share of the entire segment. Artificial turf and Sports Composites (both having a share of nearly 15% each) also represent large slices of global Sportech market.

Figure 9.33: Production Vs Consumption of Sportech segment in the domestic market (Rs. Crores)



The value of domestic production of Sportech items in 2019-20 is estimated at Rs. 7,226 Crores which is a little lower than the value of domestic consumption. However, the deficit is likely to increase in the coming years due to increase in popularity of sports and games among the youth.

Table 9.13: Sportech - World and India Market Size 2019-20			
Product Name	**World (US$ Million)**	**India (Rs. Crores)**	**Share of India**
Artificial Turf	3,624	107	0.45%
High performance swimwear and sportswear	959	4	0.06%
Parachute Fabric	520	226	6.67%
Sleeping Bags	285	80	4.31%
Sports Composites (TT Component)	3,539	820	3.56%
Sports Footwear Components	12,548	5,578	6.83%
Tents	1,949	354	2.79%
Ballooning Fabric	30	2	1.02%
Sports Nets	553	108	3.00%
Sports Strings	359	70	2.99%
Others	50	15	4.61%
Total	24,416	7,364	4.63%

9.12.1 Artificial Turf

Artificial turf is a synthetic fibre surface that is used as a substitute for natural grass. The technology has evolved over time and the latest generation of artificial grass is mainly made from three different types of plastic: polypropylene, polyethylene (most widely used) and nylon (polyamide) (most durable). Turf can be used to replicate a lawn in any setting but is most widely used in arenas where sports are played on grass (such as football, lawn tennis etc).

The artificial turf structure consists of different layers; the pile fibres, backing cloth, shock absorbing layer and the supporting base.

The advantage this product has over natural grass is that it requires little maintenance, less frequent watering, and less exposure to sunlight. The international world market is dominated by Germany due to high levels of customer awareness about the benefits of replacing natural grass with artificial turf, however it is the Asia-Pacific region where the market is expected to grow at the fastest rate in the coming years both in terms of volume and value. The major global players are Sport Group, Tarkett Group, Tencate Grass and SiS Pitches. The entire market of artificial turf in India is catered via imports. There are no manufacturers of artificial turf in India.

The global market for artificial turf was US$ 3,624 Million whereas the Indian market stood at Rs. 107 Crores in 2019-20. The global market is expected to grow at a CAGR of 8% and is expected to touch US$ 5,324.85 Million in 2024-25, whereas the Indian market is expected to grow at a CAGR of 17% to log in annual sales of Rs. 234.59 Crores.

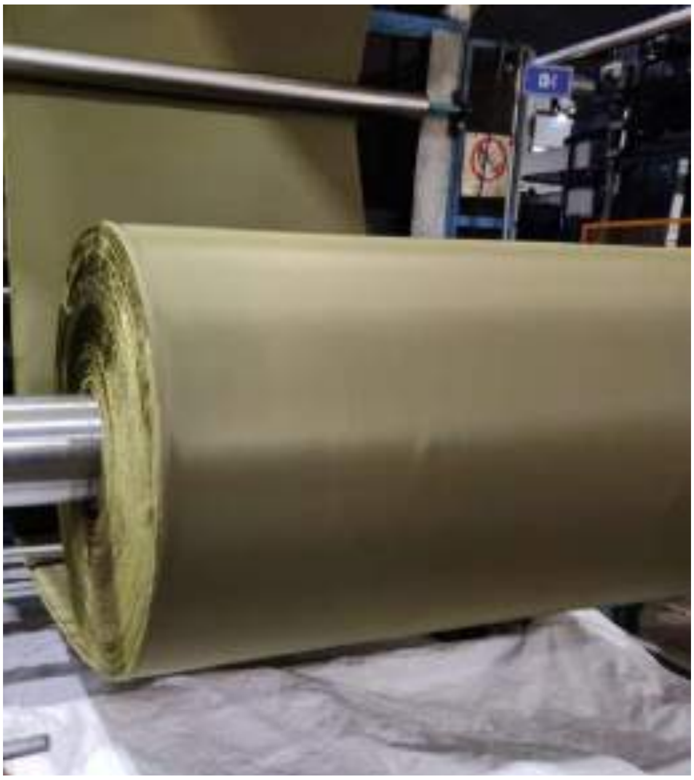
9.12.2 High Performance Sportswear and Swimwear

High performance sportswear and swimwear is a category of specialised clothing worn by athletes to boost their performance while playing sports or engaging in fitness activities by maximising movement of the body and minimising resistance provided by the clothing. The material used is often breathable, quick drying, thermal and chemical resistant. Different types of high-performance sportswear include ready to wear; fashion outer, pants and t-shirt; rash guard, wet suit and swimwear and shoes (sports shoes, aqua shoes and aqua socks). Different fabrics used to make these are polyester, nylon, neoprene, polypropylene, spandex, cotton, and others (rayon and lyocell).

North America dominates the global market and is seeing a rising trend of athleisure wear. This is followed by Europe which is seeing a high demand for fashionable activewear. In India, so far, the sportswear industry seems to be emerging as an extension of mainstream apparel industry instead of a separate entity. Breathable fabrics, water-repellent, soil-proof clothing, body temperature control, and quick-dry clothing are all being introduced into the Indian apparel market for daily wear. Nike, Puma, Adidas, and Lululemon are the top global brands. Page industries Ltd. is a key player in India and has dealerships for Speedo, Adidas India Ltd. and Reebok India Ltd. India imports specialised, high performance sportswear.

In 2019-20, the Indian market for high performance sportswear and swimwear was worth Rs. 4 Crores and the global market was worth US$ 959 Million. The Indian market is expected to grow at a slow pace of 5% per annum due to affordability issues over the next five years and reach sales of Rs. 5.11 Crores in 2024-25. The global market is likely to grow at 7% per annum and expected to have a market size of US$ 1,345.05 Million.

9.12.3 Parachute Fabrics



A parachute is meant to slow the movement of a person or object as it falls or moves through the air by creating a drag. They can be of two types as according to the pattern: a dome canopy and rectangular parafoil. These are generally used for tourism, sports and military purposes. Parachutes are often made up of lightweight and strong cloth like silk, canvas or nylon. Kevlar and terylene are two new types of technical textile fabrics which are being increasingly used for making parachutes, as these fabrics are heat resistant and very strong. North America accounted for the major share of the parachute fabric market, followed by Europe and Asia Pacific.

Key manufacturers of parachute fabrics in India are Kusumgar Corporates and Entremonde Polycoaters. Parachute Systems, Airborne Systems, Ruby Mills Ltd., Shahlon Group and FXC Corporation are leading companies at global level.

The market size for parachute fabrics in India is worth Rs. 226 Crores in 2019-20 and is likely to grow at a CAGR of 14% to reach Rs. 435.14 Crores by 2024-25. The corresponding figure for the world market for parachute fabrics is estimated at US$ 520 Million and is expected to grow at a CAGR of 5% and reach US$ 663.67 Million by the year 2024-25.

9.12.4 Sleeping Bags

Sleeping bags are blanket-like bags that allow individuals to sleep inside them. They are a great substitute for a bed wherever and whenever the latter is not available especially when doing camping, trekking, mountaineering, nature exploration, adventure travel etc. Sleeping bags also provide protection against harsh weather when used in an outdoor setting. Sleeping bags can be categorised based either on shape as square sleeping bags, mummy sleeping bags and sleeping pods or based on the fill used to make them: down fill and synthetic fill. Manufacturers based in North America and Europe are leading players in this market. This can be attributed to many professional rock climbers, mountaineers and adventure enthusiasts. A large number of online advertisements, especially on social media also influence the market towards greater consumption. As teenagers and young adults increasingly prefer adventure activities, it is expected to drive up the demand for sleeping bags in the Asia Pacific region in the next few years.

K C International, Standard Newar Mills, Tirupati Texco Pvt. Ltd., Naveen Textile Agencies and Industrial Enterprisers are the major Indian players. Jarden, Vaude, Johnson Outdoors, Oase Outdoors, Big Agnes, V F Corp., Snugpak, AMG Group, Jack Wolfskin, Columbia Sportswear, Exxel Outdoors and Gelert are major competitors in the global sleeping bags market.

In 2019-20, India's market size for technical textile component in Sleeping Bags was estimated at Rs. 80 Crores and expected to grow at a CAGR of 12% to touch annual sales of Rs. 140.99 Crores. The size of the world market for TT elements of sleeping bags is US$ 285 Million and it is likely to grow at a CAGR of 5% and expected to reach a market size of US$ 363.74 Million in 2024-25.

9.12.5 Sports Composites (TT Component)

The use of Sports composites in India is mainly in boxing equipment, inflatable balls and protective equipment for cricket. The items included as Boxing equipment are Boxing Gloves, Punching Gloves, Head Guards, Punching Pads, Abdominal Guard, Speed Ball, Punching Bag etc. Inflatable balls consist of football, volleyball, basketball, handball etc. Footballs account for 50% of the market of inflatable balls. Protective equipment for cricket has a range that includes leg-guards, batting gloves, wicket keeping gloves, thigh pads, helmets, caps & hats, cricket kit bags etc. It also includes sports helmets, in which the use of cricket helmet in India predominates.

The market size for the technical textile elements of sports composites at the world level is US$ 3,539 Million in 2019-20, which is expected to grow at 8% to increase value of annual consumption to US$ 5,199.95 Million. The Indian market for sports composites is estimated to be worth Rs. 820 Crores in 2019-20. It is estimated to grow at a CAGR of 11% to be able to expand to Rs. 1,382 Crores by 2024-25.

9.12.6 Sports Footwear Components

Shoe lining and Shoe upper fabrics are the major Sports footwear components. These components keep the shoes well-ventilated and moisture-free which provides comfort to the feet of the individual wearing the shoes. The technical textile component used in sports shoes is PU/PVC coated/laminated fabrics that are used in shoe uppers, linings on the counters and below the shoe uppers, non-woven insoles, laces, tapes, labels, elastics, sandwiched meshes etc. The shoe uppers and linings account for 90-95 % of the technical textile components used.

The production of technical textile component of sports shoes is mainly done by small units in unorganised sector of India. There are a few large players like Action shoes, Bata and Liberty which manufacture their own footwear components.

The global market size for the technical textile elements of sports footwear is US$ 12,548 Million in 2019-20, which is expected to grow at 3% to increase value of annual consumption to US$ 14,546.57 Million. The Indian market for technical textile elements of sports footwear is estimated to be worth Rs. 5,578 Crores in 2019-20. It is estimated to grow at a CAGR of 5% to be able to expand to Rs. 7,119.10 Crores by 2024-25.

9.12.7 Tents

Tents are portable shelters made of cloth or other cloth-like materials and are supported by poles. Tents are stretched tight by chords or loops attached to pegs that have been inserted into the ground. There are three main types of tents; arctic tents are designed to protect against the cold and wind, extendable tents are tents that are larger and can accommodate up to four people and swiss cottage tents which are luxury tents and much bigger than the other two.

Europe is the largest market for tents, and it is expected to further expand in the next five years because of rapid growth in outdoor adventure tourism and camping. The Asia Pacific region is expected to grow at the fastest rate. A V Enterprise, Standard Newar Mills, Tirupati Texco Pvt. Ltd. and K C International are major players of the Indian tent industry. At the global level, AMG Group, Hilleberg, Johnson Outdoors, The North Face, Newell Brands, Oase Outdoors, Simex Outdoor International, The Coleman Company, Big Agnes, Exxel Outdoors and Kampa are the major producers of tents. In India, more than 80% of the tenting fabric manufacturers operate in and around Kanpur, most of them being small and medium-sized enterprises (SMEs) or micro, small and medium sized (MSMEs).

The global market for tent fabrics is US$ 1,949 Million in 2019-20, which is expected to grow at 5% to US$ 2,487.47 Million. The Indian market for tent fabrics is worth Rs. 354 Crores. It is estimated to grow at a CAGR of 11% to be able to expand to Rs. 596.51 Crores by 2024-25.

9.12.8 Ballooning Fabrics

Hot air balloons are nonporous envelopes of thin material filled with a lifting gas that is capable of lifting a suspended payload into the atmosphere. They consist of two main parts, the envelope (or gas bag) and the basket. These are generally made up of urethane-coated nylon, polyethylene or polyester. These balloons were used in wars earlier, but nowadays these are generally used for military, scientific and recreational purposes. Major types of balloons are meteorological balloon, zero pressure balloon, super pressure balloon (a constant level balloon), military tethered balloon and powered balloon.

There are two major manufacturers of ballooning fabric in India - Bandhu Aerospace Pvt. Ltd. and Unique Inflatables. Some of the global players are Cameron Balloons, Aerosaurus Balloons Ltd., Firefly Balloons, Lindstrand Technologies Ltd., Kubicek Balloons and Ultramagic Balloons.

The Indian market for ballooning fabrics was Rs. 2 Crores in 2019-20 and is expected to have growth of 2% CAGR to Rs. 2.21 Crores by 2024-25 in the immediate future. The world market for ballooning fabrics is estimated at US$ 30 Million in 2019-20 and it is likely to grow at 3% for the next five years to US$ 34.78 Million in 2024-25.

9.12.9 Sports Nets

Sports nets are used in various sports viz. Badminton, Football, Basketball, Volleyball, Tennis, Table Tennis, Handball etc. Cricket practice nets are also used widely. The nets are bought and used by educational institutions, sports clubs, regional centres of Sports Authority of India for use in various tournaments, sports institutes and hostels. Most of the sports nets being manufactured in India are being exported. Main manufacturers of sport-nets in India are Garware Technical Fibres Ltd. and Kwality Nets Manufacturing Company Ltd.

The global market for sports nets was US$ 553 Million whereas the Indian market stood at Rs. 108 Crores in 2019-20. The global market is expected to grow at a CAGR of 6% and is expected to touch US$ 740.04 Million in 2024-25, whereas the Indian market is expected to grow at a CAGR of 20% to log in annual sales of Rs. 268.74 Crores in 2024-25.

9.12.10 Sports Strings

Sports strings are made from nylon and polyester and are used for stringing of badminton, lawn tennis and squash racquets. The textile based sports strings comprise over 95% of sports strings usage natural gut strings make up a small share. The sports strings are of six types: Monofilament strings, Multifilament strings, Solid core with single wrap, Single core double winding, Multi-core with wraps and Natural Gut strings.

China, Japan and Taiwan are the main countries where manufacturing of sports strings takes place at a large scale. Imported strings comprise 90% of the sports strings consumed in India. There are very few Indian manufacturers and those too are of small to moderate size. Some of the prominent enterprises in this industry are Sunrise Sports India Pvt. Ltd., the distributor for Yonex brand of sports racquets and Sportiff India Pvt. Ltd. which is the distributor for Babolat tennis racquets and strings in India.

The market size for the textile based sports strings at the world level is estimated to be worth US$ 359 Million in 2019-20, which is expected to grow at 6% per annum to US$ 480.42 Million. The estimated value of Indian market for sports strings is Rs. 70 Crores in 2019-20. It is expected to grow at a CAGR of 10% to be able to expand to Rs. 112.74 Crores by 2024-25.

10. Leading Countries in Technical Textiles:

A Comparison

10.1 Identification of leading countries in technical textiles

Secondary research was conducted to identify countries where technical textiles industry is thriving. Various parameters pertaining to technical textiles industry were compared across several nations. The final list of countries is as follows:

1. China
2. United States of America (USA)
3. Germany

These countries have been termed as 'leading countries' for the purpose of the present study. A comparison has been drawn between India and the leading countries across various metrics. The metrics which have been documented include annual output, CAGR, exports, major product innovations, largest companies, academic institutions, and, research and development institutes.

10.2 Output and CAGR of Technical Textiles

Table 10.1: Annual output and CAGR of Technical Textile in India and the leading countries (2018)

S. No.	Particulars	China	USA	Germany	India	World
1	Total annual output of TT (Kilo tons)	5211.5	6692.7	2622.4	2887.4	38112.9
2	Total value of annual output of TT ($ Billion)	57.7	47.8	13.3	13.4	192.57
3	Share of value of global annual output	30%	24.8%	6.9%	7%	-
4	CAGR of TT	5.6%	3.5%	4.1%	7%	4.3%

In terms of volume and output, China had the largest share in the annual output during 2018. USA also has a large share in terms of volume and output. While India is expected to grow at a CAGR of 7 percent which is the highest among the countries under study, China too is expected to grow at a fast pace with a CAGR of 5.6 percent.

10.3 Exports of Technical Textiles

Table 10.2: Exports of Technical Textiles by leading countries and India (2019)						
S. No.	Particulars	China	USA	Germany	India	World
1	Total value of exports of TT ($ Billion)	27.30	8.60	9.00	1.98	107.10
2	Percentage share of value of exports	25.5%	8%	8.4%	1.85%	100%

In terms of exports of technical textiles products, China occupies the first position in the world, exporting products worth $ 27.3 Billion. Indian exports have a very small share (1.85 percent) of the world exports, indicating a high potential for growth.

10.4 Technical textiles: Its share and major products

Table 10.3: Share of technical textiles in textiles and its major products (2019)						
S. No.	Particulars	China	USA	Germany	India	World
1	Value of technical textile output as a percentage of value of total textile output	20%	42%	N.A.	13%	27%
2	Major products/innovations in the field of technical textiles	Plastic coated fabrics, Bags, Fibreglass	Yarns, Nonwovens, Protective apparel	Tyre cord fabric, Coated or impregnated textiles, Textile wicks, conveyor belts or belting	Geosynthetics, Tarpaulins, Fire Retardant Clothing	-

Technical textiles accounted for 27 percent of the total textile industry of the world in 2019. USA has the highest share of value of technical textiles as a percentage of value of total textiles. The technical textile industry in India is still at a nascent stage as compared to the high potential that exists in India.

10.5 Large enterprises producing technical textiles

Table 10.4: Large enterprises producing technical textiles in each country					
S. No.	Particulars	China	USA	Germany	India
1	Three large enterprises that produce technical textiles	1. Jiangsu Hengli Group Co. Ltd. 2. Shangtex Holding Co. Ltd. 3. Lu Thai Textile Co. Ltd.	1. Berry Global Inc. 2. Dupont De Nemours Inc. 3. GSE Environmental LLC	1. KAP AG 2. UTT Technische Textilien GmbH & Co. KG 3. Setex-Textil-GmbH	1. SRF Limited 2. Kusumgar Corporates Private Limited 3. Garware Technical Fibres Limited

The table presented above mentions the names of a few large firms in technical textiles industry of respective countries.

10.6 Premier academic institutions for technical textiles

Table 10.5: Premier academic institution(s) for education in technical textiles in India and in leading countries

S. No.	Particulars	China	USA	Germany	India
1	Premier academic institution(s) for Technical Textiles	1. Donghua University 2. Wuhan Textile University 3. Zhejiang University	1. NC State University 2. Auburn University 3. Clemson University	1. RWTH Aachen University 2. Dresden University of Technology 3. University of Stuttgart	1. Indian Institute of Technology, Delhi 2. Institute of Chemical Technology, Mumbai 3. Dr B R Ambedkar National Institute of Technology, Jalandhar

The three premier institutions at national level that impart education in technical textiles in each of the leading countries and in India have been mentioned in the table shown above.

10.7 Prominent R&D facilities/institutions for technical textiles

Table 10.6: Prominent R&D facilities/institutions for technical textiles in India and in leading countries

S. No.	Particulars	China	USA	Germany	India
1	Prominent R&D facility/institution for Technical Textiles	1. Teijin Product Development China Co., Ltd. 2. China Chemical Fibres Association 3. Advanced Textile Innovation Center (ATIC)	1. Advanced Functional Fabrics of America Institute (AFFOA) 2. Erez Thermoplastic Products Agriculture Cooperative Association Ltd. 3. Textiles and Nonwovens Development Center, University of Tennessee	1. Deutsche Institute für Textil- und Faserforschung Denkendorf (DITF) 2. DWI – Leibniz-Institut für Interaktive Materialien 3. Hochschule Niederrhein	1. Northern India Textile Research Association, Ghaziabad 2. South India Textile Research Association, Coimbatore 3. Ahmedabad Textile Industry's Research Association, Ahmedabad

10.8 Major initiatives taken by Governments of leading countries for supporting technical textiles industry

10.8.1 China

1. Currently, a significantly large part of annual production of technical textiles in China is being sold within the country. The Government is giving high priority to augmenting exports and making large investments to facilitate acceleration of R&D activities in the technical textiles industry so as to make Chinese industry more competitive at a global level.
2. The Chinese government is placing a strong emphasis on especially increasing exports of fabrics that are used in production of medical textiles and products.
3. The Chinese government is supporting manufacturers targeting some of the emerging countries in Africa, particularly Zambia and Tanzania.

10.8.2 USA

1. In 2016, Advanced Functional Fabrics of America (AFFOA) was selected by the federal government to serve as the Revolutionary Fibers and Textiles Manufacturing Innovation Institute. It received more than US $75 million in government funding and nearly US $250 million in private investments to support US-based, high-volume production of new technologies. Since then, AFFOA has helped facilitate pilot production of sophisticated textiles and fabrics so companies can engage consumers with small batches of advanced fabric products, or prototypes, in a manner similar to how software companies roll out minimally viable products to quickly gather feedback from customers and consumers.
2. US trade policy in technical textiles is moving more towards bilateral rather than multilateral agreements which tend to allow more focus on protecting domestic sourcing.

10.8.3 Germany

1. A project of the future, 'Perspectives 2025', was presented to an international professional audience for the first time at a press conference of TECHTEXTIL 2019. It outlined the challenges for technical textiles in terms of 10 areas of growth. Over the following one year, workshops and seminars were organised in which more than 80 scientists, business people and students participated. This resulted in an evaluation of over 250 ideas and potential solutions for the use of technical textiles.

10.8.4 India

1. Under Union Budget 2020-21, a National Technical Textiles Mission was proposed for a period from 2020-21 to 2023-24 at an estimated outlay of Rs. 1,480 Crores. In the same budget, the Government of India allocated around Rs. 3,515 Crores to the Ministry of Textiles and Rs. 80 Crores for the Integrated Textile Parks scheme.
2. The Government has launched production linked incentive scheme to provide incentives for manufacture and exports of specific textile products made from man-made fibre. Under this scheme, the government has approved Rs. 10,683 Crores for manufacture of manmade fibres and technical textiles.

10.9 Data sources

- Grand View Research (GVR) Industry Analysis, Technical Textiles Market, 2020
- Allied Market Research Report, Technical Textiles Market, 2020
- ATI, Top 10 Textile Companies in China, 2018
- IBIS World, Technical Textiles Manufacturing in Germany, Industry Trends 2015-2020
- Invest India, Technical Textiles: The Future of Textiles, 2019
- Textilegence, Global Technical Textiles Market, 2020
- The Textile Magazine, 'China and India to Remain lucrative markets for Technical Textiles Globally', 2015
- Massachusetts Institute of Technology (MIT) – Fabrics poised to become new software, 2019

11. Future demand and trade expectations in Technical Textiles

11.1 Introduction to supply sources and demand destinations for technical textiles

Technical textiles is rapidly emerging as an industry which is revealing new applications and opportunities driven by technology-led innovations. Countries and enterprises that are investing in developing new technologies, fostering innovation, encouraging entrepreneurship and upgrading their system of teaching and training human resources have taken a lead over others in establishing themselves as major sources of supply of technical textiles machines and products. The experience so far suggests that such countries and enterprises also form collaborations and leverage networks to share knowledge and introduce innovations. Entities that are significant sources of supply, are also main consumers of technical textiles.

China, USA and Germany, are not only leading countries for production and exports of technical textile but also are its three leading consumers. These three countries put together account for more than 60 percent of the value of global annual output of technical textiles. China is the largest producer, accounting for nearly one-third of global production; USA accounts for one-fourth of the global production. These two countries also happen to be the two largest consumers of technical textiles. The exports from Chinese technical textile industry comprise a significant part of international trade in all segments of technical textiles. The value and share of world exports of different countries is presented in the following table:

Table 11.1: Exports of Technical Textiles by leading countries and India (2019)

S. No.	Particulars	China	USA	Germany	India	World
1	Total value of exports of TT (US $ Billion)	27.30	8.60	9.00	1.98	107.10
2	Percentage share of value of exports	25.5%	8%	8.4%	1.85%	100%

11.2 Demand and trade characteristics of Indian technical textiles

India's annual rate of growth of technical textile industry is around 7 percent – faster than China's nearly 6 percent annual growth in the technical textiles industry. In terms of exports of technical textiles products, China occupies the first position in the world, exporting products worth US $ 27.3 Billion that make up for over 25 percent of world exports. Indian exports have a small share (1.85 percent) of the world exports market. This indicates a high potential for growth of India's exports. This magnitude of gap is partly explained by the share of technical textiles output as a percentage of country's textile industry's output in value terms. The value of annual output of technical textiles accounted for 27 percent of the output of total global textile industry in 2019. The value of output of technical textile industry comprises nearly 20 percent of the output of the textile industry as a whole in China whereas in India, the corresponding figure is between 10-15 percent according to different estimates.

A study of the data of India's trade in technical textiles (as specified through 449 ITC HS codes that IIT Delhi is suggesting for adoption) over the last eight years from 2012-13 to 2019-20 reveals that exports have grown for ten out of eleven segments in the eight-year period from 2012-13 to 2019-20. Exports have grown at a CAGR of around 7% and the trade surplus in technical textiles has increased from Rs. 15,210 Crores in 2012-13 to Rs. 20,644 Crores in 2019-20.

India's technical textiles exports are mainly to USA, Germany and UK with India's exports to USA comprising nearly one-fourth of India's technical textile exports. There has been a continuous increase in exports to USA over last few years. India's imports of technical textiles are mainly from China. South Korea and Germany are also significant supply sources, catering to India's demand for technical textiles. Eight Technical Textiles segments – Packtech, Clothtech, Hometech, Mobiltech, Protech, Agrotech, Sportech, and Buildtech have witnessed trade surplus during 2019-20. Indutech, Meditech, and Geotech segments have witnessed deficit during 2019-20. The overall rate of growth in imports is higher than that in exports. This makes it imperative to take steps to boost technical textile exports and create avenues for higher domestic production to achieve import substitution and move towards an *Atmanirbhar Bharat* (Self-reliant India).

11.3 Segment-wise features of demand and trade of technical textiles in India

1. Agrotech

Agrotech has experienced a decline in exports in the last 8 years (2012-13 to 2019-20) and comprised 0.7-1.8 percent of India's technical textiles exports. The annual exports have seen a decline in the past eight years from Rs. 791 Crores to Rs. 665 Crores. The local consumption has been growing with increasing modernisation of agriculture in the last few years. Main products which are exported from India are fishing nets and shade nets and these have grown in exports in the last few years. India is able to meet its domestic demand without imports and the future outlook suggests that there is a good possibility of increasing exports of other items like mulch mats and crop covers too.

Major item of India’s Agrotech exports is Made Up Fishing Nets - other than Nylon (ITC HS Code 56081190). It has the largest share with 38% of the value of exports of this segment in 2019-20. It also has had the highest export value over the last four years. Made Up Fishing Nets and woven fabrics have had a total export share of more than 60% in each of the past eight years. Fishing net manufacturing industries in India are mostly in the MSME sector. With comparatively low wages, our labour-intensive fishing net industry can be developed to overtake those in China, Thailand, Indonesia, etc., in the world market. This is besides feeding our domestic market which is equally significant. There was evidence of dumping of fishing nets in India by Chinese and Bangladeshi exporters after which Anti Dumping Duty (ADD) has been imposed to bring the artificially deflated prices of imported fish nets at par with that of domestic fish nets.

2. Buildtech

Exports of those Buildtech products which are covered by suggested ITC HS Codes have been rising at relatively faster rates (higher than CAGR of 10%) compared to other segments of technical textiles. The annual exports have seen a growth from Rs. 105 Crores to Rs. 367 Crores at a CAGR of 19% in the last eight years. In the same period, imports have grown from Rs. 102 Crores to Rs. 224 Crores, at a CAGR of 12%. Due to higher growth in exports than imports, the trade surplus has increased from Rs. 4 Crores in 2012-13 to Rs. 142 Crores in 2019-20. The contribution of exports of Buildtech to the overall exports of technical textiles during the eight-year study period rose from 0.2% to 0.8% and products share in imports increased from 0.3% to 0.4%.

Wallpaper and similar wall coverings (ITC HS Code 48142000) have largest export value in 2019-20 with a share of 68% in Buildtech exports. It is followed by trade advertising material, commercial catalogues, (ITC HS Code 49111090) at 23%. UAE is the largest importer of Indian Buildtech products in 2019-20 with a 44% share in India’s Buildtech exports. Its share has increased from approximately 4% in 2012-13 to more than 40% in recent years.

Despite experiencing rapid growth in construction activity, India continues to be largely self-sufficient in terms of Buildtech products and is at present a marginal player in global trade. This situation is unlikely to change and despite the demand for Buildtech products increasing due to continually increasing construction activity, the requirements for buildtech products will continue to be met by domestic supplies. Exports from this category is unlikely to be significant in the coming years.

3. Clothtech

Clothtech exports for items (covered under ITC HS Codes as suggested by IIT Delhi) have grown from Rs. 6,380 Crores to Rs. 9,340 Crores at a CAGR of 6% and imports have grown from Rs. 1,778 Crores to Rs. 2,491 Crores, at a CAGR of 5% during the period 2012-13 to 2019-20. Over the last eight years, India has reported trade surplus in Clothtech for each year. Due to higher growth in exports than imports, the surplus has increased over the last eight years from Rs. 4,602 Crores in 2012-13 to Rs. 6,849 Crores in 2019-20. Between 2013 and 2020, the year-to-year contribution of exports of Clothtech segment to overall exports of technical textiles ranged from 13% to 14% and for imports, the contribution of Clothtech to total imports was between 4% and 6%.

Synthetic Filament Yarn (54023300) with a share of 54% has the largest contribution to exports of Clothtech for the year 2019-20. Turkey is the largest importer of Indian Clothtech goods in 2019-20. The share of Turkey has been around 14-15% during this period. Bangladesh, Brazil, USA, and UAE are the other countries where India exports its Clothtech products significantly.

India is a significant exporter of industrial and sewing threads made of natural and synthetic yarn. There is huge potential for increasing exports in this area because of world class large facilities created in India for yarns and threads. However, India has to rely on imports especially for meeting a part of its demand for interlining, elastic tapes and zip fasteners. With increasing consumer prosperity and adoption of contemporary trends in apparel, there is a likelihood of increasing demand for Clothtech products in India.

4. Hometech

Over the last eight years, India has reported a trade surplus in Hometech segment (as defined by the ITC HS Codes suggested by IIT Delhi for inclusion in technical textiles) for all the years. India's exports and imports for 2019-20, for this segment were Rs. 9,497 Crores and Rs. 2,914 Crores respectively. Total exports have seen a growth from Rs. 5,525 Crores to Rs. 9,497 Crores at a CAGR of 8% in the study period. During the same period, imports have grown from Rs. 1,292 Crores to Rs. 2,914 Crores at a CAGR of 12%. Even as imports are growing at a faster pace than exports, India has had a trade surplus for Hometech in each of the eight years that are being considered.

Woven fabrics (ITC HS Code 54072090) and carpets have had the largest share of 13% in the exports for 2019-20. USA is the largest importer of Indian Hometech goods in 2019-20 with a share of 39% in terms of value of India's exports for this segment. Germany, China, Afghanistan, and UK are the other important importers of Indian Hometech products.

India is largely self-sufficient with respect to meeting its domestic demand for Hometech products. After meeting its domestic requirements, it is able to export coated fabrics, carpet backing cloth and Polyester Staple Fibre (PSF). The scenario is unlikely to change in the coming years.

5. Mobiltech

Mobiltech is the technical textile segment with largest exports in value terms but the rise of India's exports in this segment is steady at a CAGR of 3.7% in the last 8 years. It formed 29% of India's technical textiles exports, down from 34% in 2012-13. The local consumption has grown at a brisk rate in the last few years due to expansion of automobile market as well as increase in use of technical textiles as a replacement for other materials in automobiles. The main products which are exported from India are airbags, tyre cords, seat belts, seat covers, felts and carpets. These have grown in exports in the last 10 years. India is able to meet most of its domestic demand without imports and the future outlook suggests that the situation is going to remain the same.

There has been a trade surplus for Mobiltech segment in all of the last eight years. During 2019-20, India's exports and imports for this segment were Rs. 21,095 Crores and Rs. 18,122 Crores respectively. Due to higher growth in exports than imports, the annual surplus has increased over the last eight years from Rs. 1,779 Crores in 2012-13 to Rs. 2,973 Crores in 2019-20. Mobiltech is the largest segment in technical textile industry of India in terms of both imports and exports, based on the 449 ITC HS codes considered for analysis. In terms of countries, USA was the largest importer of Indian Mobiltech goods in 2019-20 with a share of 22.7% in India's Mobiltech exports.

6. Packtech

Packtech has been a major contributor towards India's trade surplus as the trade surplus of Packtech has consistently increased and has nearly doubled from Rs. 6,845 Crores in 2012-13 to Rs. 12,971 Crores in 2019-20. Yearly exports have grown at a CAGR of 10%. Packtech segment has second largest value of exports in 2019-20 with a share of 24%. India's Packtech exports and imports for the year 2019-20 were Rs. 17,185 Crores and Rs. 4,215 Crores respectively. The yearly percentage contribution of exports of Packtech products to the overall exports of technical textile has ranged from 19.1% to 24% and that of imports from 6.3% to 8.2% over the eight-year period.

Sacks and Bags of Man-made textile material (ITC HS Codes 63053200) have largest share of 28% of Packtech export value in 2019-20. This has also been the most exported product for the past eight years. USA was the largest importer of Indian Packtech products in 2019-20 and exports to USA constituted 25.5% of exports of Packtech products.

India is able to meet its domestic demand to a large extent through local production. Indian FIBC or Jumbo Bags exports have been a major success in the exports markets. It is going to remain so in the coming years with no apparent competition in sight.

7. Protech

Exports of Protech products have been rising at relatively faster rate (higher than CAGR of 10%) when compared to most other segments. The imports for Protech items have also been increasing at relatively faster rates as compared to those of many other segments. Yearly exports have grown from Rs. 382 Crores in 2021-13 to Rs. 882 Crores in 2019-20 at a CAGR of 13%. During the same period, imports have also grown significantly from Rs. 97 Crores to Rs. 322 Crores at a CAGR of 19%. India has experienced trade surplus for Protech segment for last eight years. The percentage share of yearly exports of Protech products to overall exports of technical textile ranges from 0.8% to 1.2% and for imports, it ranges from 0.3% to 0.6%.

India imports most of the specialised hazard resistant /hazard proof fabric and garments such as life jackets, bullet and blast proof jackets, fire resistant suits, chemical proof suits, etc., and exports winterproof clothing. Protech forms a small part of india's technical textile trade. As self-reliance is being emphasised by the Government of India, there appear to be new opportunities opening up for enterprises who intend to take up production of Protech products.

8. Sportech

India's annual exports for Sportech segment have risen from Rs. 698 Crores in 2012-13 to Rs. 861 Crores in 2019-20 at a CAGR of 3%. India has reported trade surplus for Sportech for all the years except in one year of the eight-year period under study. India's exports and imports in 2019-20 for this segment were Rs. 861 Crores and Rs. 445 Crores respectively. Due to higher absolute growth in exports than imports, the surplus has increased from Rs. 338 Crores in 2012-13 to Rs. 416 Crores in 2019-20.

Sportech goods contribute only 1-2% to the overall exports of technical textiles industry in each year. USA is the main destination for India's Sportech exports. Australia, Germany, and South Africa are also among the leading importers of Indian Sportech products. India is able to meet its domestic demand of most of the Sportech items except for Artificial Turfs and Sports equipment such as raquets, hockey sticks, etc. made of Sports composites. India also happens to be a large exporter of Sportech items such as protective pads, nets, and balls. There is likely to be an increasing emphasis on import substitution and Indian firms are likely to start producing Artificial turfs and composites-based sports equipment.

9. Indutech

India has had a trade deficit in Indutech segment in each of the years of the period under study. Although the value of Indutech exports has seen a growth from Rs. 6,160 Crores to Rs. 9,924 Crores over the last eight years at a CAGR of 7%, imports have grown from Rs. 9,188 Crores to Rs. 19,142 Crores, at a CAGR of 11% in the same period. The trade deficit has increased over the last eight years from Rs. 3,028 Crores in 2012-13 to Rs. 9,218 Crores in 2019-20. Indutech is the second largest segment in terms of India's imports and exports of technical textiles. The yearly share of exports of Indutech to the overall exports of technical textile industry in the eight years ranged 13% to 14% and for imports it was 30% to 36%.

Synthetic Staple Fibres (ITC HS Code 55032000) has the largest share (21%) of the value of exports in 2019-20. Printed circuits (ITC HS Code 85340000) had the largest import value among Indutech items in 2019-20 and had a share of 23% in India's Indutech imports.

10. Meditech

India's exports of Meditech products have been rising at relatively faster rates (higher than CAGR of 10%) when compared to other segments. However, the imports of Meditech have risen at a faster rate than the exports thus causing an increase in trade deficit from year-to-year. Value of annual exports has seen a growth in last eight years from Rs. 868 Crores to Rs. 2,178 Crores at a CAGR of 14%. In the same period, yearly imports have grown from Rs. 1,298 Crores to Rs. 3,090 Crores at a CAGR of 13%. The annual trade deficit has increased over last eight years from Rs. 430 Crores in 2012-13 to Rs. 912 Crores in 2019-20. The contribution of exports of Meditech products as a percentage of overall exports of technical textile has been 2% to 3% whereas the imports of Meditech comprise 4% to 6% of imports of technical textiles during the eight year period. USA is the largest importer of Indian Meditech products.

In this segment, while India is importing a significant range and quantity of products such as artificial organs, Extra Corporeal Devices, vascular grafts, artificial implants to meet its domestic demand is increasing at a fast pace, India also exports, surgical dressings, disposables, PPE Kits, masks, diapers and sanitary napkins. The usage of technical textiles for health, hygiene and surgical applications is going to increase in the coming years. There is a huge opportunity for India to leverage its existing capabilities to play an important role in the global market for Meditech products.

11. Geotech

Geotech segment has experienced a rapid growth in exports in the recent years and despite the prevailing trade deficit, this segment appears to be filled with promise for India. Geotech exports were Rs. 67 Crores in 2012-13 but these have risen to Rs. 247 Crores in 2019-20 due to a CAGR of 20%. During the same period, imports have grown from Rs. 213 Crores to Rs. 493 Crores at a CAGR of 13% and there has been a trade deficit in each of the years of the eight-year period. The year-wise contribution of exports of Geotech to overall exports of technical textiles during these eight years has ranged from 0.1% - 0.3% and for imports it has been 0.7% - 1.1%.

Even though the current level of domestic demand as well as exports from India are at a low level, Geotech segment has experienced a very rapid increase in its acceptance by domestic consumers as well as entrepreneurs. In the years to come, Geotech will play a very important role in the domestic market as well as India’s export basket.

12. Attractiveness of Different States for Technical Textile Manufacturers

12.1 Need for comparing attractiveness of states

Technical Textiles is a fast emerging area of business that is characterised by rapid changes in all parts of its value chain. This is leading to growth of several opportunities that business enterprises can take advantage of. The industry also requires enterprises to be creative in making business and technology related decisions so that they can maintain their competitiveness. One of the major decisions facing enterprises is that of choosing the state(s) for locating their technical textiles manufacturing units. Different states of India vie with each other to attract industrial investments and some of them have policy provisions that offer special incentives for technical textiles units. It is important for the entrepreneurs/promoters to examine the policies of different states and assess their suitability for the proposed enterprise (new or under expansion/diversification). Carrying out such an assessment will help the entrepreneurs/promoters to determine the relative 'attractiveness' of the states in terms of estimating the overall costs (ease of doing business, concessions, incentives, facilitating environment, benefits of reimbursements and subsidies) of doing technical textile business and enable them to be more competitive in the technical textile market (domestic and international).

12.2 Method followed for comparing attractiveness of states

Industrial and Business related policies of all the States and UTs were listed and then studied by the team of researchers from IIT Delhi. Based on this study, 17 states were identified which, in the recent years, had announced such policies having provisions related to textiles that could be of use to technical textile enterprises. The 17 states so identified are listed as follows:

1. Andhra Pradesh
2. Bihar
3. Gujarat
4. Haryana
5. Jharkhand
6. Karnataka
7. Kerala
8. Madhya Pradesh
9. Maharashtra
10. Odisha
11. Punjab
12. Rajasthan
13. Tamilnadu
14. Telangana
15. Uttar Pradesh
16. Uttarakhand
17. West Bengal

The relevant policies and packages of the states have been studied and their provisions have been classified into certain 'areas of importance' for the enterprises. For brevity and ease of use, such areas of importance are referred as 'heads' in the subsequent content in this section. The provisions of benefits and incentives that each of the state policy is offering to the entrepreneurs have been categorised and recorded as per the 'heads'. The state-wise policy provisions under different heads have been presented in the following tables:

Table 12.1: Comparison of support offered by States to textile/technical textile industry (States covered: Andhra Pradesh, Bihar, Gujarat, Haryana and Jharkhand)

Heads	Andhra Pradesh	Bihar	Gujarat	Haryana	Jharkhand
Main Operative Policy	Revised Policy for Textiles and Apparel (2018-2023)	The Industrial Investment Promotion Policy (2016)	'Gujarat Textile Policy 2012-17' which was later extended with its extended tenure ending in 2018. Implemented 'Scheme for Assistance to Strengthen Specific Sectors in the Textile Value Chain (2018-23)	Haryana Textile Policy (2019)	Jharkhand Textile, Apparel and Footwear Policy (2016)
Land and infrastructure support	50 percent of land cost or 5 percent of project cost, whichever is lower. For standalone projects not allotted land in industrial park, 25 percent of external infrastructure cost	A jute park involving an investment outlay of Rs. 42.36 Crores is being setup at Maranga, Purnea	25 percent of capital expenditure. Maximum limit- Rs.15 Crores	Financial assistance of 50 percent of total project cost with a maximum cap of Rs. 10 Crores to establish infrastructure facilities	50 percent rebate on land cost that will be paid over 5 years in 10 equal instalments Creation of textile parks of more than 75 acres in size to be supported by Jharkhand government
Capital subsidy	Dependent upon the fixed capital investment, subsidy is 10 percent -20 percent with upper cap of Rs. 15-50 Crores	50 percent of the approved project bill with upper limit being Rs. 20 Crores	20 percent of cost of machinery and equipment. Maximum limit- Rs. 30 Lakhs. 50 percent of the fee paid towards Energy audit/Water Audit subject to a maximum of Rs. 1 Lakh	To attract Anchor unit, capital subsidy @25 percent, maximum up to Rs. 50 Crores, 15 percent with a maximum of Rs. 25 Lakhs for technical textile projects Capital subsidy @ 15 percent of Gross FCI for textile machine manufacturers	20 percent of investments made in fixed capital with an upper cap of Rs. 50 Crores
Interest subsidy	8 percent p.a. for 7 years with a moratorium of 2	10 percent return on interest guarantees	6 percent for MSMEs and 4-6 percent for Non-MSMEs (depending on	Interest subsidy @ 3 percent per annum for textile machine	7 percent p.a. or 50 percent of interest per annum with Max.

	years Capped at 12.5% per annum after taking into account assistance from all sources.	or real interest rates on term loans, whichever is lower.	employment generated) Maximum limit- Rs. 20 Crores p.a. Maximum duration- 5 years	manufacturers	cap of Rs. 1 Crore for 7 years
Power cost support	Power cost reimbursement @ Rs.2/- per unit for a period of 5 years from the date of commencement of commercial production	-	Rs. 3 (for LT power connection) and Rs. 2 (for HT power connection and non-weaving activities). Energy Audit. Maximum limit- Rs. 1 Lakh separately for each audit	-	50 percent for 7 year on power tariff and 100 percent exemption on Electricity duty for 7 years
Technology upgradation related support	Upto 50% financial assistance for investment in technology, limited to Rs. 25 Lakhs per process/product	-	Up to 50 percent of the investment for technology acquisition/upgradation. Maximum limit- Rs. 25 Lakhs for operative period of scheme	25 percent of cost (with a cap of Rs. 15 Lakhs/product) for new product development	Proposed creation of incubation centre
Stamp duty exemption	Reimbursement of 100% of stamp duty and transfer duty paid for purchase/mortgages/lease/hypothecation of land meant for industrial use	-	Reimbursement of 100 percent of stamp duty paid on purchase of land required for the new Park for developer of park as well as for individual enterprise setup in new park	Reimbursement @100 percent of stamp duty paid for units set up in certain specified locations	100 percent exemption
Skill support	One time grant of 50 percent of training cost with an upper limit of Rs. 7500-10000 per trainee 75 percent financial assistance for Project cost (maximum Rs. 4 Crores) to training institutions for setting up new training facilities in the state	Lower of skill development subsidy of Rs. 20,000 per employee or prevalent Bihar Skill Development Mission (BSDM) rates	The state Government shall provide assistance for setting up a training institution of up to 85 percent of project cost subject to a cap of Rs. 3 Crores	Financial assistance of 25 percent of investment in machinery and equipment with a maximum of Rs. 20 Lakhs for training purposes. Reservation of 20 seats per quarter for entrepreneurs from Haryana for skill training workshops at the Focus Incubation Centre (additional 50 percent sponsorship)	Rs. 13000 one time (per worker) for training/skill development
Quality development and R&D support	-	-	-	-	50 percent of the cost incurred on BIS / ISO / SAS / LEED / certification subject to a limit of Rs. 10 Lakhs

					50 percent of the cost incurred on patent registration, subject to a limit of Rs. 10 Lakhs [of this, up to Rs. 4 Lakhs is on cost of patent filing etc.; the balance is payable on final registration of the patent] Proposed creation of Centre of Excellence (CoE) in the state
Employment and employee related support	Monthly employment subsidy for the employees ranging from Rs. 1,000- Rs. 3,750 on the roles, for a period of 5 years for all activities in textile value chain (except ginning, spinning)		Textile Park will be provided financial assistance @ 25 percent of the cost of Hostel/ Dormitory Housing within the Park for a minimum of 100 workers domiciled in Gujarat The state Government shall provide 50 percent of the wages @ Rs. 4,000/- for female employee and Rs. 3200/- for male employee per month for a period of 5 years as payroll assistance to new enterprise Gujarat Amendment: Provision of Ramp-up period of 6 months available to applicants to ensure industry gets maximum benefit of payroll assistance under the Policy	Provision of financial assistance @50 percent of project cost of Hostel/ Dormitory Housing for domicile workers maximum up to Rs. 2 Crores to park Employment Generation Subsidy: Upto Rs. 36,000 per year per employee for 5 years or 20 percent of the SGST deposited, whichever is less to all category of Textile enterprises	Assistance for Construction of Dormitories: Assist ance of 50 percent land cost with upper cap of 50 Lakhs

Source: IIT Delhi Research

Table 12.2: Comparison of support offered by States to textile/technical textile industry (States covered: Karnataka, Kerala, Madhya Pradesh and Maharashtra)

Heads	Karnataka	Kerala	Madhya Pradesh	Maharashtra
Main Operative Policy	'Textile policy 2004-09' which was followed by a new 'Textile Policy 2008-13 (Suvarna Vastra Neethi 2008-2013)'. 'Textile Policy-Nuthana Javali Neethi 2013-2018' was re-introduced, with technical textile sector elaborately mentioned and supported in the policy. After 2018, the policy again got improvised and State government brought out a new textile and garment policy 2019-24	Provisions related to garment sector of textile covered in the State's 'Industrial & Commercial Policy 2015', improvised into 'Kerala Industrial & Commercial Policy 2018'	Special provisions for textile & apparel industry as a part of the Industrial Promotion Policy 2014	Declared its 'Textile Policy 2011-17' in January 2012, later declared 'Textile Strategy of the State for 2018-23' with special emphasis on emerging technical textiles market
Land and infrastructure support	One time grant support for development of common infrastructure for Greenfield Parks with individual promoters up to 25 percent of the project cost or Rs. 25 Crores per Park project, whichever is less (in all zones). One time grant support for the development of common infrastructure for Greenfield Parks of up to 40 percent of the project cost or Rs. 40.00 Crores per Park project, whichever is less (for SPV). One time grant support for the development of common infrastructure for Brownfield Parks of up to 40 percent of the project cost or Rs. 12.00 Crores per Park project, whichever is less (for SPV)	Proposed construction of industrial parks, which also have textile units	50-75 percent rebate on land premium (on land size) for MPIDC developed industrial areas, 50 percent rebate offered if undeveloped land parcel is leased from MPIDC. Maximum area admissible for rebate- up to 40 Hectare. Infrastructure development @50 percent, Maximum limit-Rs. 1.00 Crores each for developing water, power and roads infrastructure for private or undeveloped Govt. land Development Fee related subsidy for Apparel/Garment Sector 50 percent discount offered for taking lease land in the industrial area Infrastructure development subsidy @50 percent with a maximum limit of INR 1.00 Cr each for developing Water, Power and Roads infrastructure for Private or Undeveloped Govt. Land	9 percent of project cost up to Rs. 25 Lakhs is provided to technical textile parks set up under Scheme for Integrated Textile Parks (SITP)
Capital subsidy	30 percent, 25 percent and 20 percent are	Fixed Capital rebate of Rs. 20-30 Lakhs	Investment Promotion Assistance (IPA) offered	10 percent Capital subsidy for textile

	allowed for MSME Enterprise of zone 1, 2 and 3. 25 percent, 20 percent and 15 percent are allowed for Large Enterprise of zone 1, 2 and 3. 50 percent capital subsidy or Rs. 5 Crores whichever is less for establishment of Effluent Treatment Plants (ETPs)	depending on category of unit for investment in Land, Building, Plant & machinery, Electrification, Essential Office Equipment, Pollution Control Devices and other fixed assets	to large scale industries from 40 percent-10 percent of investment in plant and machinery Minimum investment- Rs. 10 Crores. SGST reimbursement with maximum ceiling of 100 percent investment in plant and machinery approved under TUFS scheme. Tax-delinked SGST reimbursement under customised package for Mega projects	units located in Vidharbha, Marathwada and North Maharashtra General category- 40 percent, SC/ST/Minority category- 45 percent, Production of yarn, cloth, and other non-conventional yarn products- 10 percent, Additional capital- 20 percent, Units having Forward/Backward integration- 5 percent
Interest subsidy	5 percent p.a. on term loans for the first 5 years for units in zone 1, 2 and 3	-	@2 percent for 5 years on term loan taken for TUFS approved P&M, Maximum limit- Rs. 5 Crores for units having investment up to Rs. 25 Crores. @ 5 percent for 5 years on term loan for existing stand-alone textile units with an investment > Rs. 25 Crores. @ 7 percent for 5 years on term loan for Composite textile unit with an investment > Rs. 25 Crores	State will provide interest subsidy so that the effective rate of interest payable by eligible units will be 0-2 percent
Power cost support	Reimbursement of cost of power paid at Rs. 1.00 per unit for a period of 5 years for both Large and MSME Enterprise located in zone 1,2 and 3	-	Power tariff rebate as well as electricity duty rebate under customized package for Mega projects	Power subsidy of Rs. 2.00 to Rs. 3.77 per unit depending on the category of enterprise All eligible new Units in Group C, D, and D+ areas and No-Industry District(s) and Naxalism affected Area will be exempted from payment of Electricity Duty during eligibility period not exceeding 15 years
Technology upgradation related support	-	Current efforts to promote the use of coir as Geotextiles for better conservation of water and soil, intends to invest efforts towards market development of coir fibres for Geotextile application	Available as per different categories of upgradation	Proposed latest technological centres established with the help of institutions such as IIT, SASMIRA and WRA, which are actively involved in R&D 5 percent subsidy on capital equipment for Technology Up-gradation, subject to

				a maximum of Rs. 25 Lakhs 25 percent subsidy on capital equipment for cleaner production measures limited to Rs. 5 Lakhs
Stamp duty exemption	Stamp Duty Exemption and concessional registration charges rate of Rs. 1.00 per Rs. 1000	-	Stamp Duty Exemption under customized package for Mega projects	50 percent, 75 percent and 100 percent exemption available to units depending on their category/classification
Skill support	-	Proposed set up of skill learning centres	Skill development/training incentive under customised package for Mega projects	State Textile University will be set up in Vidarbha providing specialised courses in the focussed sectors
Quality development and R&D support	Grant of Rs. 10 Crores for setting up of Centre of Excellence for textile to be funded by the State Government Assistance up to 50 percent, Max Rs. 50,000 for Energy Audit/WaterAudit/Environmental Compliance which will be applicable in each case separately	-	Reimbursement of patent charges @100 percent up to Rs. 5 Lakhs per patent	75 percent subsidy on expenses incurred on quality certification limited to Rs. 1 Lakh 75 percent subsidy on the expenses incurred on patent registration limited to Rs. 10 Lakhs for the National patents and Rs. 20 Lakhs for the International patents
Employment and employee related support	75 percent reimbursement of employer's contribution of wage rate per employee per month for all the new units for 5 years for MSMEs located in zone 1, 2 and 3	-		

Table 12.3: Comparison of support offered by States to textile/technical textile industry (States covered: Odisha, Punjab, Rajasthan and Tamilnadu)

Head	Odisha	Punjab	Rajasthan	Tamilnadu
Operative Policy	Odisha Industrial Policy Resolution, 2015	Punjab Industrial and Business Development Policy, 2017	Rajasthan Investment Promotion Scheme 2019	Tamil Nadu Integrated Textile Policy, 2019
Land and Infrastructure Support	Land available at subsidised rates for all industries including textile industry. 25 percent subsidy on cost of land:	Land Cost Rebate: Land cost is considered under Fixed Capital Investment for incentives under	50 percent exemption from payment of stamp duty and land tax for 7 years	

	Applicable for Anchor Industrial Units of a technology park Exemption from payment of premium due to change of land-use charges): 100 percent up to 100 acres and 50 percent for balance area	Punjab's Industrial & Business Development Policy 2017 100 percent exemption from Change of Land Use Charges and External Development Charges		
Capital Subsidy	10 percent of investment with a maximum of Rs. 10 Crores, Rs. 20 Crores and Rs. 30 Crores for the locations A1/B1, A2/B2 and A3/B3 respectively 50 percent of the infrastructure cost with a ceiling of Rs. 10 Crores per green field industrial park/cluster 50 percent of total cost with a ceiling of Rs. 5 crores for up gradation of brown field clusters For MSME: Subsidy @25 percent for General and @30 percent for SC/ST	-	-	Credit Linked Capital Investment Subsidy of 15 percent for investments on eligible machinery in Technical Textiles under ATUFS 5 percent Additional Capital Subsidy for new / expansion of textile units set up in southern districts
Interest Subsidy	5 percent per annum on term loan for a period of five years, to a maximum of Rs. 1 Crore	5 percent interest grant to MSMEs for new/expansion/diversification in addition to ATUF benefits for a period of three years with an annual limit of Rs. 10 Lakhs	5 percent on term loans for 5 years for existing units. Additional 1 percent interest subsidy if additional investment in eligible plant & machinery is more than Rs. 25 Crores, 7 percent per annum for new enterprises	6 percent interest subsidy in addition to any other incentives available from the Government of India
Power cost support	Reimbursement of Rs. 0.25 - 1.25 per unit for a period of 5 years, based on employment and investment levels as defined in the policy 100 percent Exemption from Electricity duty for a contract demand of 5 MVA for 5 years One-time reimbursement of Energy audit cost for MSMEs with maximum cap of Rs. 3 Lakhs	Electricity (variable tariff) @ Rs. 5 per unit to all industrial units 100 percent exemption from payment of Electricity Duty for 15 years	50 percent exemption from payment of electricity for 7 years	Electricity Tax exemption for 2 years to 5 years on power purchased from TANGEDCO or generated or consumed from captive sources

Plant & Machinery/ Technology upgradation related support	Environmental Protection Infrastructure Subsidy of Rs. 20 Lakhs or 20 percent of capital cost of setting ETP for MSMEs Assistance for 100 percent of cost of purchase of technical know- how up to Rs. 1 Lakh in case of indigenous technology and up to Rs. 5 Lakhs in case of imported technology	-	-	Concessional Custom Duty of 5 percent for specific technical textile machinery Financial support of 9 percent of project cost (max Rs 9 Crores) to Technical Textile Park
Stamp duty exemption	100 percent Exemption with respect to land allotted by the Government to IDCO or Govt/IDCO to Private Industrial Estate Developers or when transfer of land/shed by Govt, IDCO and Private Industrial Estate developer to industrial units On Loan agreements, credit deeds, mortgages and hypothecation deeds executed by the Industrial Units in favour of Banks or Financial Institutions	100 percent exemption or reimbursement of stamp duty on purchase or lease of land and building	50 percent exemption from Stamp duty of purchase or lease of land	100 percent Stamp Duty Exemption will be given for technical textile projects
Skill support	Entrepreneurship Development Subsidy: Reimburseme nt of 75 percent of course fee limited to Rs. 50,000 per course Reimbursement of training cost up to Rs. 1750 – 4000 per person: For every person newly trained or undergoing skill upgradation for a period of three years, based on employment and investment levels. 50 percent of skill upgradation or training for local manpower: For MSMEs: Up to Rs. 3000 per person for	-	-	25 percent subsidy will be provided for setting up of new training centres for Apparel and Textiles linked with ITIs, towards machinery purchased, subject to a maximum ceiling of Rs. 20 Lakhs per centre. Subsidy will be given through Tamilnadu Skill Development Agency

	maximum 10 persons in micro and 20 persons in Small and Medium enterprises. Additional Rs. 1000 per women trainee			
Quality development and R&D support	100 percent of the registration for Patent Registration cost up to maximum of Rs. 10 Lakhs Quality Certification: Renewal for consecutive two years i.e. for a period of 3 years @ 100 percent to a total maximum limit of Rs. 3 Lakhs	To set up Technology Centre for Advanced Textiles which will serve as a research and demonstration centre for the latest tools	-	Subsidy upto Rs.2 Crores per CFC is provided for setting up of design centre / studio, testing facilities, training centre, information cum trade centre and common raw material / yarn / sales depot, water treatment plant, dormitory, worker's residential space, pre-weaving and post-weaving facilities etc
Employment and Employee related support	For Workers' Hostel: Land rate at 50 percent of the prevailing market rates of IDCO for 1-3 acres of land, based on employment and investment levels. Employment generation incentive: Rs. 1500 per worker per month for 36 months if 90 percent of workers are domicile of Odisha with minimum 200 employees @ 100 percent Reimbursement of Employment Cost Subsidy (ESI/ESF): For 3 years for displaced employees and for 5 years for disabled employees @ 75 percent for male; 100 percent for female: For Micro & small units for 5 years @ 50 percent for male; 100 percent for female: For Medium units for 3 years	Employment Generation subsidy with no domicile restriction is offered upto Rs. 36,000 per employee per year upto 5 years Upto Rs. 48,000 per employee per year for Women & SC/BC/OBC upto 5 years	-	Soft loan to be provided to companies employing more than 1500 people and located in certain notified districts of Tamilnadu

Table 12.4: Comparison of support offered by States to textile/technical textile industry (States covered: Telangana, Uttar Pradesh, Uttarakhand and West Bengal)				
Head	**Telangana**	**Uttar Pradesh**	**Uttarakhand**	**West Bengal**
Operative Policy	Telangana Textile and Apparel Policy, 2017-18	Uttar Pradesh Handloom, Power loom, Silk, Textile & Garmenting Policy 2017	Mega Textile Policy 2014	West Bengal textile Policy 2013-18
Land and Infrastructure Support	Extended rebate of 50 percent of the cost in any new Textile Park, with an upper limit of rebate of Rs. 20 lakhs per acre to the anchor customer(s) and first movers In the case of technical textile units, an additional 25 percent rebate will be extended with a limit of Rs. 10 Lakhs per acre	50 percent of land cost (30 percent in GB Nagar district) on land purchase from State Agencies	50 percent rebate on the prevailing land prices of the State Infrastructure and Industrial Development Company of Uttarakhand (SIDCUL)	
Capital Subsidy	35 percent capital subsidy with capping as per categories for technical textiles For SC/ST and additional 5% of capital subsidy is offered	25 percent for plant and machinery based on investment	15 percent to the maximum limit of Rs. 50 Lakhs for MSMEs and 15 percent to the maximum limit of Rs. 30 Lakhs for heavy industry	10 percent-40 percent capital subsidy is offered depending on category of unit and its location zone. Subject to a ceiling of Rs. 50 Lakhs for small enterprise 20 percent additional subsidy is offered on admissible subsidy for all enterprises wholly owned by women, SC/ST and minority community entrepreneurs This incentive would be in addition to what the unit gets under any scheme of GoI
Interest Subsidy	75 percent of the interest rate of the loans availed by a unit, subject to a cap of 8 percent per annum, for technical textile related projects for 8 years	7 percent up to Rs. 1.50 Crores (up to Rs. 75 Lakhs for GB Nagar) for 7 years for procurement under TUFS 50 percent on purchase of land for 7 years up to Rs. 50 Crores and @60 percent for 7 years for construction of staff-quarters, hostel/dormitory Infrastructure interest subsidy: 5 percent up to Rs.1 Crore for 5 years per unit for developing infrastructural amenities	Interest subsidy of 7 percent for 7 years up to a maximum limit of Rs. 50 Lakhs to be paid annually	For micro and small units subsidy offered by state is 6 percent for all units and 7.5 percent to units set up in the C and D Zone districts for 5 years For Medium Enterprise in Zone B & C – 25 percent of total Term Loan Interest subject to ceiling of Rs. 175.00 Lakhs per year for 5 years For Medium enterprise in Zone D – 25 percent of total Term Loan Interest subject to ceiling of Rs. 175.00 Lakhs per year for 7 years

Power cost support	Power subsidy of Rs. 1.50 to 2.50 per unit for Technical Textiles units of different categories	100 percent subsidy to new units for 10 years	Reimbursement of 1- per unit on the energy bill and 100 percent electricity tax refund for 5 years	Micro & Small Enterprise- 100 percent waiver for 4 years for Zone A & B and for 6 years for Zone C & D Medium Enterprise- Zone B & C - 100 percent waiver of electricity on the electricity consumption for 5 years subject to maximum of Rs. 25.00 Lakhs per year or Rs. 1.25 Crores for 5 years. Medium Enterprise in Zone D – 100 percent waiver of electricity duty on the electricity consumption for 5years and 75 percent waiver from the sixth year upto tenth year subject to maximum of Rs. 50.00 Lakhs per year or Rs. 2.50 Crores in 5 years
Plant & Machinery/ Technology upgradation related support	Financial assistance of up to 50 percent of the investment in technology development, subject to a maximum amount of Rs. 10 Lakhs per process/product will be offered to eligible units			Rebate of 25 percent of the project expense subject to a cap of Rs 5 Lakhs to help business growth, branding and design
Stamp duty exemption	100 percent reimbursement of the stamp duty/transfer duty paid during purchase of land	100 percent (75 percent in GB Nagar district) to developer and @50 percent to first buyer of plot/unit	100 percent exemption from stamp duty	
Skill support	Training subsidy of Rs. 3000 per employee to the companies to reimburse the cost incurred in skill upgradation and training the local manpower. The subsidy shall be Rs. 5000 per employee for units employing more than 1000 persons			
Quality development and R&D support	20 percent subsidy will be offered by state government for the annual expenditure of the firm on design and product development expenditure limited to a maximum subsidy of Rs. 2 Lakhs per year	Reimbursement of 50 percent of cost up to a limit of a maximum of Rs. 5 Lakhs for expenses incurred in securing registration of patent Reimbursement for expenditure incurred in Quality Certification:	5 percent up to Rs. 1 Crore for 5 years per laboratory for research and quality improvement	

		Micro & Small Enterprise- 50 percent of cost subject to a ceiling of Rs. 5 Lakhs for obtaining certification /accreditation like ISO-9000, ISO-14000, ISO-18000, Social Accountability Standards, OEKO-TEX etc.		
Employment and Employee related support			EPF reimbursement for 5 years to new unit @50 percent with minimum 100 workers & @ 60 percent with minimum of 200 workers	

12.3 Findings regarding attractiveness of states

The information regarding provisions of policies of various identified states which have been presented in the tables above have been analysed under different heads as follows:

1. **Existence of a separate Textile Policy:** Presence or absence of a policy that is specially dedicated to textiles is an important indicator of the relative emphasis placed by any state government on growth and development of textile industry within the state. A study of the policies of 17 states revealed that Bihar, Kerala, Madhya Pradesh, Odisha, Punjab and Rajasthan do not have a separate, exclusive textile policy. Even if these states have provisions of benefits and incentives for textile industry, these have been mentioned as part of their respective industrial policies.
2. **Mention of and special provisions for 'Technical Textiles' in state policies**: The mention of 'technical textiles' in the state's policy document is one of the pointers towards a state's ability to recognise the need for focusing distinctive actions and attention towards technical textiles. It is observed that except for three states – Kerala, Madhya Pradesh and Uttar Pradesh, all other states have made a mention of 'technical textiles' as a distinct area of attention and focus. Some like Telangana, Tamilnadu, Gujarat and Andhra Pradesh have made special provisions for technical textiles.
3. **Support for Land and Infrastructure cost:** Land and infrastructure cost is a major expenditure for the enterprise. The level of support extended by the state government contributes significantly towards determining the level of attractiveness of the state for setting up the enterprise. Despite this, it is observed that out of 17 identified states, there is no land and infrastructure support offered by the five state governments – Bihar, Kerala, Rajasthan, Tamilnadu and West Bengal. Maharashtra provides only 9% upto Rs. 25 Lakhs and Punjab too offers relatively lesser benefit in the form of land cost being considered under Fixed Capital Investment for incentives as well as 100% exemption from Change of Land Use Charges and External Development Charges, which anyways is offered by many

other states. Andhra Pradesh, Telangana and Uttar Pradesh are the states offering the best package at 50 percent of the land cost plus other related benefits. Gujarat, Karnataka and Odisha at 25% also have a reasonably attractive package. Haryana too offers 50% of the project cost as rebate but only upto a limit of Rs. 10 Crores making it more suitable for relatively smaller units. Telangana offers additional sops, over and above attractive benefits, especially to technical textile units.

4. **Provision for Capital Subsidy:** In addition to the support for cost of land and infrastructure, the benefit given by the state to enterprise in the form of Capital Subsidy is an important, relatively high value incentive which is extremely crucial for determination of state's degree of attractiveness for the enterprises. Punjab and Rajasthan do not offer any subsidy under this head. Kerala, with its Fixed Capital rebate of Rs. 20-30 Lakhs depending on category of unit amounts to relatively little support. West Bengal too offers minor benefit under this head. Gujarat, Haryana, Maharashtra and Uttarakhand offer relatively low levels of support as Capital Subsidy. Andhra Pradesh, Bihar, Madhya Pradesh, Jharkhand, Odisha, Tamilnadu, Telangana and Uttar Pradesh offer significant support by providing substantial Capital Subsidy benefits.

5. **Interest Subsidy:** The enterprises often borrow money as term loans from RBI recognised institutions. Indian economy has a high interest regime relative to the world. This adds extra costs to the enterprise's offerings and the products have to be priced higher to cover the additional costs, making them unaffordable and non-competitive in the domestic and international markets. Many states offer interest subsidy and subvention to act as an incentive for enterprises to locate themselves in the state and restore competitiveness of enterprises' products. Andhra Pradesh (8%), Jharkhand (7%), Karnataka (5%), Maharashtra (so that maximum interest payable is 0-2%), Telangana (~6-8%), Uttar Pradesh (7%) and Uttarakhand (7%) offer high interest subsidy. The states other than these offer interest subsidy in the range of 3-6% with relatively shorter tenures which makes the benefit relatively minor for the enterprises in such states.

6. **Assistance for technology upgradation:** Technical textile is a new, rapidly changing field where new product development and innovation are the key. The states are perceived as attractive if the governments incentivise enterprises by providing either immediate cost reimbursement/cost sharing or facilitating a benefit with a long gestation period by financing the establishment of R&D facilities. It is reasonable to assume that the immediate benefits will be factored in by enterprises while evaluating their choices of locations and assessing the attractiveness of the state. It is noticed that Bihar, Gujarat, Jharkhand, Karnataka, Kerala, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand do not offer any assistance for technology upgradation. Andhra Pradesh, MP, Maharashtra, Odisha, Telangana and Tamilnadu do provide good support whereas Haryana provides moderate support. Tamilnadu recognises the importance of technical textile units and provides additional support for technology upgradation to technical textiles units located in the state.

7. **Quality improvement and R&D assistance:** The types of support that state governments offer to enterprises to promote quality improvement, testing and R&D is of two types. Firstly, the short gestation period incentive in the form of reimbursements of costs incurred in certification from leading quality certification agencies as well as for filing and obtaining patents (national and international). The long gestation period support in this regard consists of financing the establishment of Centres of Excellence and other testing/validation facilities. A study of the state policies shows that Andhra

Pradesh, Bihar, Gujarat, Haryana, Kerala, Rajasthan and West Bengal do not provide any assistance. Jharkhand, Maharashtra, Madhya Pradesh, Uttar Pradesh and Uttarakhand offer good assistance in the form of reimbursement of patent and quality certification costs. Odisha and Telangana offer best assistance as they provide short term as well as long term assistance. Karnataka offers very nominal assistance and Tamilnadu offers support that is long term in nature by helping to set up facilities.

8. **Power Cost support:** The subsidy on cost of power, concessional rates charged for power supply, waiver of electricity charges and electricity duty are the types of benefits that are offered by state governments under this head. An examination of the policies of state governments disclosed that Bihar, Haryana, Kerala do not provide any power subsidy or concession on electricity duty to industrial units. Uttar Pradesh offers the most attractive incentive in the form of 100% power cost waiver to units (for 10 years) while West Bengal gives power cost waiver for 5-6 years only for MSME units. Jharkhand, Punjab and Rajasthan offer substantial support in the form of ~50% rebate for 7 years. Maharashtra at a maximum subsidy of Rs. 3.77 per unit and Andhra Pradesh and Gujarat at Rs. 2 per unit also offer significant support to eligible manufacturing units. Madhya Pradesh (variable support provide unit is classified as mega project) and Karnataka (subsidy of Rs. 1 per unit) also offer some concession on power bills which benefits enterprises established in the respective states. Telangana offers power subsidy of Rs. 1.50 to 2.50 per unit for technical textiles units of different categories.

9. **Stamp Duty exemption/reimbursement:** The 100% exemption or partial concession on payment of stamp duty on land transactions in the state is one of the common incentives provided by state governments to attract industry to their respective states. It is observed that Bihar, Kerala and West Bengal do not offer any exemption on payment of stamp duty and Madhya Pradesh (for only Mega Projects) and Maharashtra (percentage of exemption dependent on and classification of units' size and location) offer it selectively. Haryana offers 50% exemption. All other states offer 100% exemption albeit some of them with a few conditions.

10. **Support for Skill building:** The improvement in quality of human resources associated with technical textiles is an important determinant for business success of enterprises in this industry. It impacts all stages of the value chain and any support from state governments regarding this aspect may act as an incentive for technical textile enterprises. Karnataka, Punjab, Rajasthan, Uttar Pradesh, Uttarakhand, West Bengal do not offer any support for skill building. Gujarat, Haryana, Kerala, Maharashtra and Tamilnadu offer long term support for setting up of training institutions. Odisha and Jharkhand (reimbursement of training expenses upto Rs. 13,000 per trainee employee), AP (reimbursement of training expenses upto 7500-10,000 per trainee employee plus assistance for institution), Telangana (offers reimbursement of Rs. 3000-5000 per employee) are proactive in providing direct support in the form of reimbursement of training cost to the manufacturing firms and becoming attractive states or companies who wish to invest significantly in upgrading the skills of their employees. Government of Madhya Pradesh also offers support for such activity but it is available only to those units that are classified as mega projects by the state government.

11. **Employment and employee related support:** One of the main reasons why different states compete for attracting industrial investment is the positive impact such investments can have on generation of employment within the state. The types of support that states offer for employment can either be in terms of part or full funding of facility creation like worker dormitories/hostels/other

common facilities or direct cash assistance /employers' EPF contribution reimbursement on a per employee basis. While some states insist that the support will be available only if the employees are domiciled in that particular state, there are other states which do not have any such condition. A study of policies of 17 states reveals that Bihar, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Uttarakhand and West Bengal do not provide any specific support to the enterprises for expenses incurred on employees or employment generation. Andhra Pradesh, Karnataka and Punjab offer straightforward incentive /reimbursement on a per employee basis. Gujarat, Haryana, Odisha and Telangana (50% of EPF reimbursement) offer blend of both short term (direct reimbursement) and long-term (assistance for creating accommodation and common facilities for worker community). Jharkhand offers support only for long-term asset creation. Tamilnadu offers soft loan for companies employing more than 1500 people and located in certain notified districts of Tamilnadu.

12.4 Inferences and conclusions regarding attractiveness of states

A careful examination of the findings that have been elucidated in the preceding passages lead to following step-wise approach to identify attractive states based on inferences and conclusions:

1. Exclude relatively less attractive states: There are certain states which offer very low levels of support, incentives and benefits. These states may be excluded from consideration as among attractive states for technical textiles. As per the information available, these states are Bihar, Kerala, Punjab and West Bengal.
2. Eliminate states with low level support in high value heads: States which do not offer 'substantial benefits and incentives' in high value heads such as support for land and infrastructure, support for capital subsidy, interest subsidy and support for technology upgradation may be taken out of consideration. These states are Maharashtra and Uttarakhand.
3. Remove the states that impose stiff conditions: Remove the states that place limitations for availing of high value incentives as described earlier. Based on this criteria, Madhya Pradesh will be removed from the list of attractive states.
4. Exclude states having poor industrial infrastructure: Based on this criteria Jharkhand will get eliminated.
5. Determination of relatively attractive states: The states that remain after the above mentioned considerations, are relatively more attractive for investments in technical textiles. These can be arranged based on the level of incentives on low value heads. Based on that criteria, Andhra Pradesh, Telangana, Tamilnadu, Gujarat, Uttar Pradesh, Karnataka and Odisha are more attractive and Rajasthan and Haryana are relatively less attractive states.

13. Analysis of Technical Textiles Trade of India

Vibrant international trade is important for the growth and development of any industry. This section presents an analysis of India's exports and imports of technical textile products for the period 2012-13 to 2019-20. The data has been sourced from official website of Department of Commerce, Government of India for this purpose. As per the present practice, India's trade data for technical textile is compiled and analysed on the basis of 207 ITC HS codes notified by Government of India. It is suggested that a comprehensive list of 449 ITC HS codes (including 207 HSN codes notified by the Government of India) as presented in Annexure 1 and Annexure 2 of this report be adopted as an improvement over the current list of 207 ITC HS codes. The analysis of India's trade has been presented in the following sections on the basis of 449 ITC HS Codes.

13.1 Overview

In the eight-year period (2013-2020), average exports of technical textile items on the basis of 207 HSN codes were Rs. 10,542.63 Crores and average imports were Rs. 11,600.49 Crores. The total exports have grown at a CAGR of 12.14% whereas the total imports have grown at a CAGR of 9.50% over this time period.

Based on the proposed 449 ITC HS code classification, in the eight-year period (2013-2020), average exports of technical textiles were Rs. 61,142 Crores whereas average imports were Rs. 41,410 Crores. Total exports have seen a growth from Rs. 46,215 Crores to Rs. 72,241 Crores at a CAGR of 7%. During the same period, imports have grown from Rs. 31,005 Crores to Rs. 51,597 Crores, at a CAGR of 8%.

13.2 Balance of Trade

Over the last eight years, India has reported a trade surplus for all the years. For 2019-20, India's exports and imports were Rs. 72,241 Crores and Rs. 51,597 Crores respectively. Due to higher absolute growth in exports than imports, the surplus has increased over the last eight years from Rs. 15,210 Crores in 2012-13 to Rs. 20,644 Crores in 2019-20.

Figure 13.1: Value of Exports and Imports of Technical Textiles (2012-13 to 2019-20) (Rs. Crores)

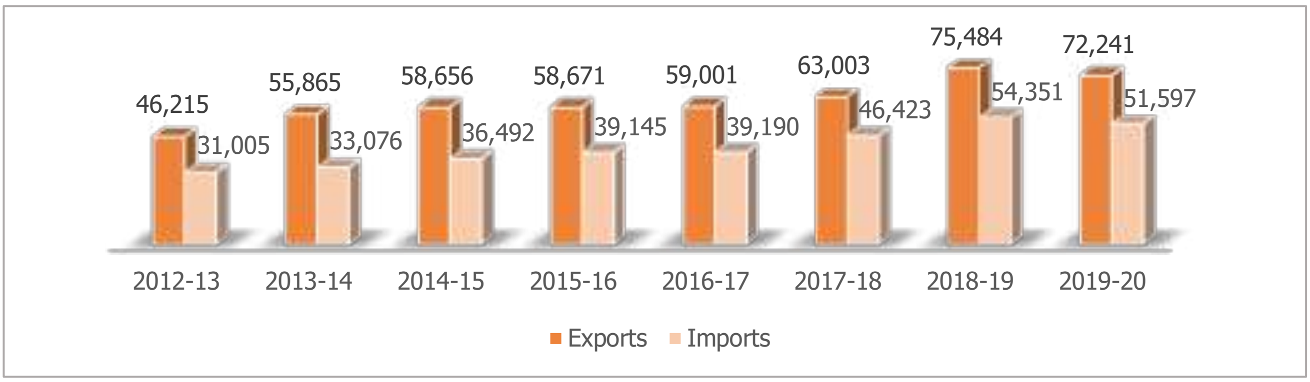


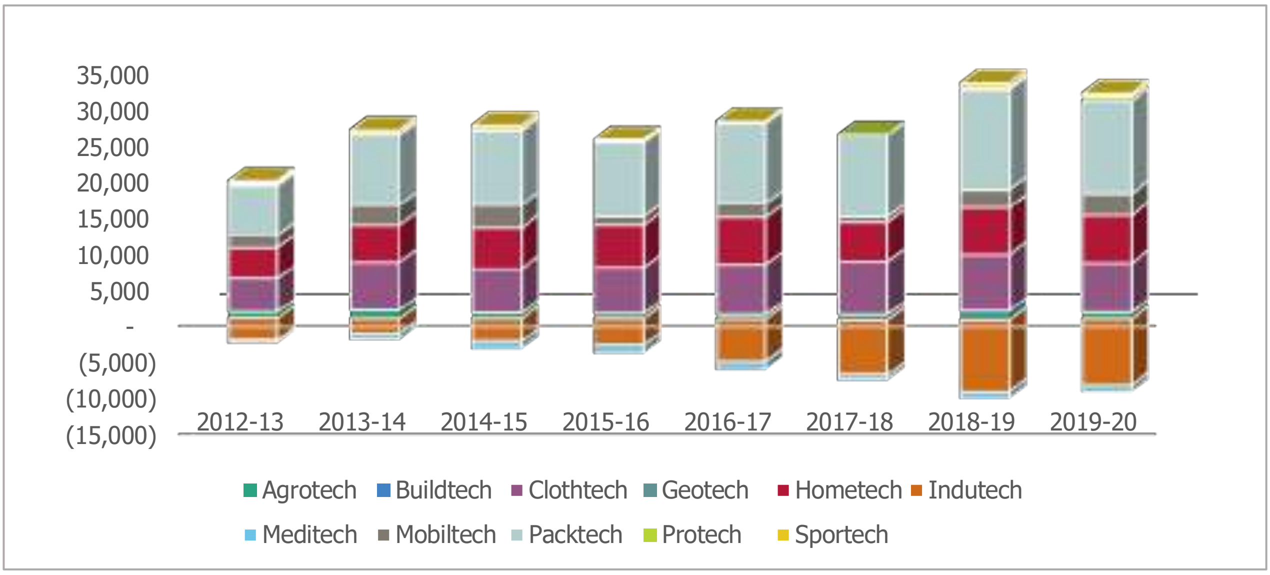
Table 13.1: Comparison of Export and Import Data of Technical Textiles (Rs. Crores)									
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**Aggregate**
Based on existing 207 HSN Code Classification									
Exports	6,338	8,809	10,343	10,107	9,413	11,193	13,987	14,152	84,341
y-o-y growth		39%	17%	-2%	-7%	19%	25%	1%	12%
Imports	7,666	8,987	10,111	10,963	11,342	13,705	15,645	14,385	92,804
y-o-y growth		17%	13%	8%	3%	21%	14%	-8%	9.5%
Trade Status	-1,328	-178	232	-856	-1,930	-2,512	-1,658	-234	-8,463
	Deficit	Deficit	Surplus	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit
Based on proposed 449 HSN Code Classification									
Exports	46,215	55,865	58,656	58,671	59,001	63,003	75,484	72,241	4,89,136
y-o-y growth		21%	5%	-	1%	7%	20%	-4%	7%
Imports	31,005	33,076	36,492	39,145	39,190	46,423	54,351	51,597	3,31,279
y-o-y growth		7%	10%	7%	0%	18%	17%	-5%	8%
Trade Status	15,210	22,789	22,164	19,526	19,811	16,580	21,133	20,644	1,57,857
	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.3 Segment-wise analysis of Exports and Imports in India

The 449 ITC HS codes have been segregated into various application segments to gauge how individual segments have contributed to the overall trade trends. This will also help in understanding the products/ segments where policy interventions may be required. Technical textile products are segregated into twelve application segments. International trade analysis has been done for all segments except Oekotech because of non-availability of appropriate data.

Figure 13.2: Trade Surplus (Deficit) across application segments from 2012-13 to 2019-20 (Rs. Crores)



The figure above indicates that most of the segments have shown a trade surplus over the study period except for Indutech, Meditech and Geotech.

13.3.1 Export distribution across segments and countries

Mobiltech segment, with a share of 29%, is the largest contributor to exports in terms of value in 2019-20. Packtech segment has second largest value of exports in 2019-20 with a share of 24%.

Share of Packtech segment in total exports has increased from 19% in 2012-13 to 24% in 2019-20. On the contrary, the share of Mobiltech segment has decreased from 35% in 2012-13 to 29% in 2019-20.

The top five segments contributing to the exports are Mobiltech, Packtech, Indutech, Hometech, and Clothtech**.** These have a combined share of 93% in 2019-20.

Figure 13.3: Distribution of exports across segments (2019-20)

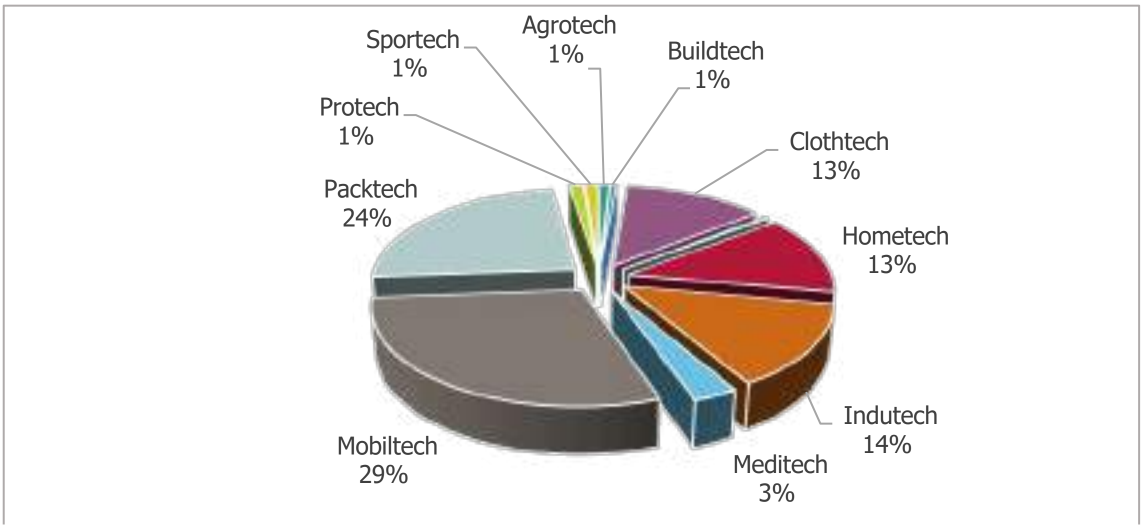
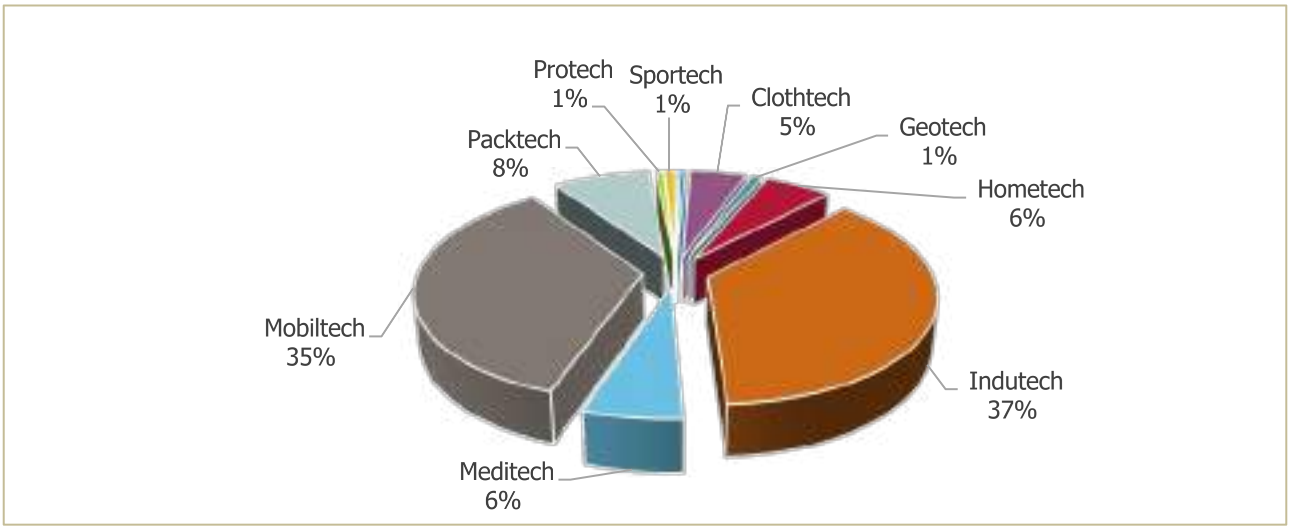


Table 13.2: Five countries with largest imports of Indian technical textiles items (2019-20)		
Country	**Total Value of imports (Rs. Crores)**	**Share in total exports (%)**
USA	16,380	22.7
Germany	4,102	5.7
UK	3,330	4.6
Turkey	3,040	4.2
UAE	2,423	3.4
Total	29,274	40.5

The table given above reveals that USA is the largest importer of Indian Technical Textiles products in 2019-20 with a share of 23% of India's exports. The share of USA has increased from 17% in 2012-13 to 23% in 2019-20. Germany is the second largest importer of Indian Technical Textiles products with a share of about 6%. The total share of exports to five top export destinations is 40.5%. Exports of technical textiles products from India is relatively dispersed and therefore India's technical textiles industry is relatively less sensitive to country risks.

13.3.2 Distribution of Imports across segments and countries

Figure 13.4: Import distribution across segments (2019-20)



Indutech segment had the largest share in value of imports in 2019-20 at 37%. The share of Indutech segment in total imports increased from 30% in 2012-13 to 37% in 2019-20. Mobiltech segment has the second largest share in value of imports in 2019-20 at 35%. Its share in imports decreased from 47% in 2012-13 to 35% in 2019-20. The top five product segments comprising India's imports are Indutech, Mobiltech, Packtech, Meditech and Hometech. All put together, these five segments have a combined share of 92% (2019-20).

Table 13.3: Five largest exporters of Technical Textiles items to India (2019-20)

Country	Total Value of Exports (Rs. Crores)	Share in total imports (%)
China P RP	19,289	37.4
Korea RP	5,632	10.9
Germany	3,636	7.0
USA	2,576	5.0
Hong Kong	2,569	5.0
Total	33,702	65.3

In terms of countries, China is the biggest exporter of technical textiles goods to India in 2019-20. Its share in India's import basket increased from 31% in 2012-13 to 37% in 2019-20.

Korea is the second largest exporter of Technical Textiles goods to India in 2019-20 making up almost 11% share. China, Korea, Germany, USA, and Hong Kong are the five largest exporters of technical textiles goods to India in 2019-20. Imports from these top five countries constitute 65% of the total imports of technical textiles. Imports of technical textiles items are concentrated and therefore, there is a high dependence on a handful of countries. This tends to increase the country risks for India.

13.3.3 Conclusion

Based on the calculation using the proposed 449 code classification, India has been generating trade surplus in technical textiles for the last eight years – from 2012-13 to 2019-20. Packtech has been a major contributor towards this surplus. Its contribution towards total trade surplus has consistently increased from Rs. 6,845 Crores in 2012-13 to Rs. 12,971 Crores in 2019-20.

Eight segments – Packtech, Clothtech, Hometech, Mobiltech, Protech, Agrotech, Sportech, and Buildtech – are surplus segments in technical textiles for 2019-20. Indutech, Meditech, and Geotech are deficit segments in technical textiles for 2019-20.

USA is the largest importer of technical textiles from India. China is the largest exporter of technical textiles to India.

In terms of segments, Mobiltech occupies the largest share in total exports whereas Indutech tops the segments for largest share in imports.

13.4 Segment-wise analysis of Exports and Imports of Technical Textiles products in India

The preceding paragraphs throw light on the overall trade trend of the 449 ITC HS codes undertaken for the analysis. The 449 codes have been further analysed based on their categorisation into eleven application segments (based on information it was not possible to categorise any of the 449 ITC HS codes as belonging to Oekotech segment).

13.4.1 Agrotech

The following section presents international trade analysis of four ITC HS codes corresponding to Agrotech segment in India.

Figure 13.5: Value of Exports and Imports of Agrotech Segment (2012-13 to 2019-20) (Rs. Crores)

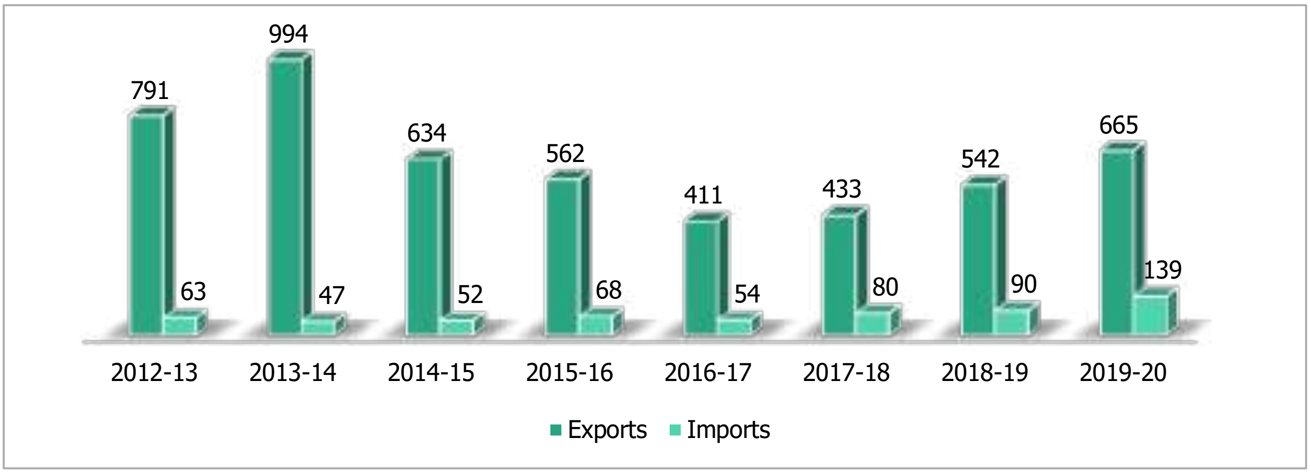


Table 13.4: Comparison of India's Exports and Imports of Agrotech segment (Rs. Crores)									
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**Aggregate for eight years**
Exports	791	994	634	562	411	433	542	665	5,033
y-o-y growth		26%	-36%	-11%	-27%	5%	25%	23%	-2%
Contribution in total exports of TT	1.7%	1.8%	1.1%	1.0%	0.7%	0.7%	0.7%	0.9%	1.0%
Imports	63	47	52	68	54	80	90	139	593
y-o-y growth		-25%	10%	31%	-20%	49%	12%	55%	12%
Contribution in total imports of TT	0.2%	0.1%	0.1%	0.2%	0.1%	0.2%	0.2%	0.3%	0.2%
Trade Status	728	946	582	494	358	353	453	526	4,440
	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.1.1 Overview

During the eight-year period under consideration, exports in the Agrotech segment totalled Rs. 5,033 Crores as compared to total imports of Rs. 593 Crores. The exports have seen a decline in the past eight years from Rs. 791 Crores to Rs. 665 Crores. This corresponds to a CAGR of -2%. During the same period, imports have grown significantly from Rs. 63 Crores to Rs. 139 Crores at a CAGR of 12%.

13.4.1.2 Balance of Trade

India has been reporting a trade surplus in each of the eight years for Agrotech segment. For the year 2019-20, India's exports and imports for this segment were Rs. 665 Crores and Rs. 139 Crores respectively. For all the eight years, the value of exports is 5 times or higher than the value of imports. However, due to declining exports and increasing imports, the surplus has shrunk over the last eight years from Rs. 728 Crores in 2012-13 to Rs. 526 Crores in 2019-20.

The contribution of Agrotech to overall exports of technical textiles during the period, ranges from 0.7% to 1.8% and for imports, it ranges from 0.1% to 0.3%.

13.4.1.3 Export distribution across items and countries

Table 13.5: Export share of top four Agrotech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
56081190	Made Up Fishing Nets: Other Than Nylon	38
54071019	Woven fabrics obtained from high tenacity yarn of nylon or other polyamides or of polyesters: Unbleached: Other polyester fabrics	32
56081110	Made Up Fishing Nets: of Nylon	29
56075010	Nylon Fish Net Twine	1
Share of top four items		100

Made Up Fishing Nets - other than Nylon (56081190) has the largest share with 38% of the value of exports of this segment in 2019-20. It has had the highest export value over the last four years.

In exports, out of the four products, made up fishing nets and woven fabrics have had a total export share of more than 60% in each of the past eight years.

Table 13.6: Five countries with largest imports of Indian Agrotech items (2019-20)		
Country	**Total Value of Imports (Rs. Crores)**	**Share in total exports (%)**
Afghanistan	97	14.6
Chile	77	11.6
Norway	61	9.2
UK	50	7.5
UAE	46	6.9
Total	332	49.9

In terms of countries, Afghanistan was the biggest importer of Indian Agrotech goods in 2019-20 with a share of 14.6% in India's exports of Agrotech products. This share has increased from about 3% in 2012-13.

In 2012-13, UAE and Pakistan were the two largest importers of Indian Agrotech goods with about 22% and 20% share of India's exports of Agrotech products. However, their combined import value has fallen to less being than 8% of India's Agrotech exports in 2019-20. Afghanistan, Chile, Norway, UK and UAE are other countries that are large importers of Indian Agrotech goods.

Exports to top five countries constitute approximately 50% of the Agrotech exports. It shows that exports of Agrotech products are concentrated to few countries and therefore the exports in this segment are relatively more sensitive to country risks.

13.4.1.4 Import distribution across items and countries

Table 13.7: Import share of top three Agrotech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
56081110	Made Up Fishing Nets: of Nylon	39
56081190	Made Up Fishing Nets: Other Than Nylon	36
54071019	Woven fabrics obtained from high tenacity yarn of nylon or other polyamides or of polyesters: Unbleached: Other polyester fabrics	25
Share of top three items		100

Made Up Fishing Nets of Nylon (56081110) has the largest import value in 2019-20 with a share of 39% of Agrotech imports. Its share has increased from 24% in 2012-13 to 39% in 2019-20. It has been the most imported product in Agrotech segment in the last seven years with a share as high as 65% in 2016-17. The import share of Woven fabrics obtained from high tenacity yarn of nylon (54071019) reduced from a high of 59% in 2012-13, when it also was the most imported Agrotech product, to 25% in 2019-20.

Table 13.8: Five largest exporters of Agrotech items to India (2019-20)		
Country	**Total Value of Exports (Rs. Crores)**	**Share in total imports (%)**
Bangladesh	45	32.5
Malaysia	40	28.9
China P RP	24	17.2
Thailand	16	11.5
USA	5	3.6
Total	131	93.7

The largest share in imports of Agrotech items in 2019-20 is from Bangladesh. The share has increased from <0.1% in 2012-13 to ~32% in 2019-20. It was imports from China that had the largest share (more than 60%) in India's imports of Agrotech goods in 2012-13. However, share of imports from China has declined to less than 20% in 2019-20. Second largest share in India's imports of Agrotech items is that from Malaysia at approximately 29%. China, Thailand, and USA are the other large sources of imports of Agrotech goods for India. Imports from top five countries are approximately 94%, highlighting India's high dependence for Agrotech imports on very few countries thus heightening supply risks.

13.4.2 Buildtech

The following section presents the international trade analysis of ten ITC HS codes corresponding to Buildtech segment in India.

Figure 13.6: Value of Exports and Imports of Buildtech Segment (2012-13 to 2019-20) (Rs. Crores)

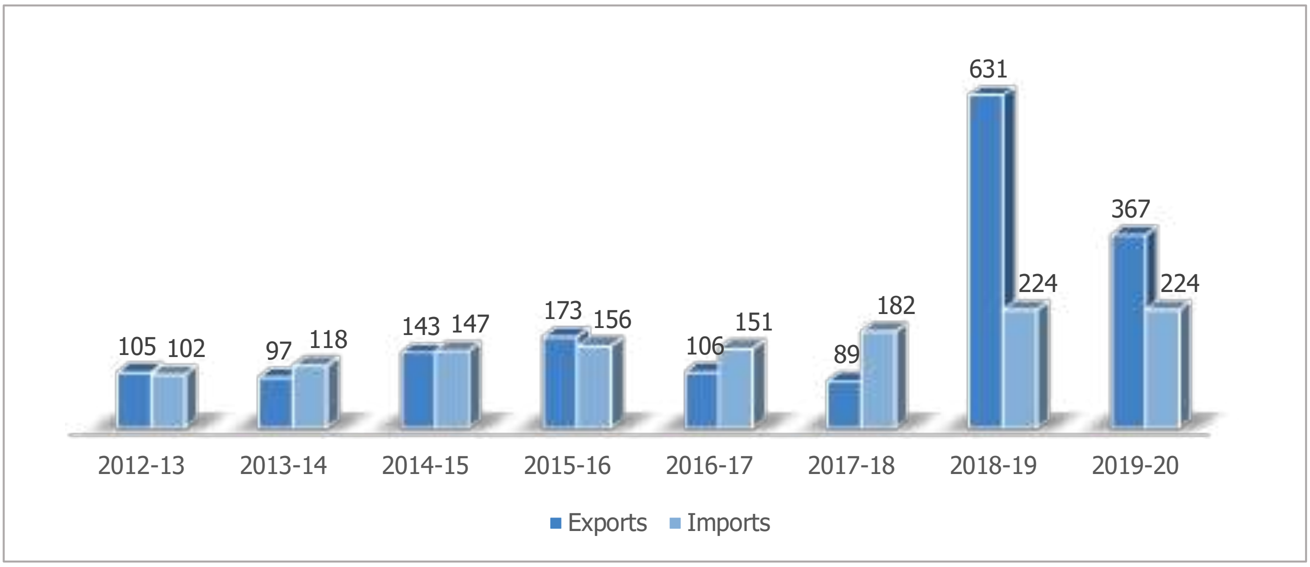


Table 13.9: Comparison of Exports and Imports of Buildtech segment (Rs. Crores)									
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**Aggregate for eight years**
Exports	105	97	143	173	106	89	631	367	1,710
y-o-y growth		-8%	48%	21%	-39%	-16%	608%	-42%	19%
Contribution in total exports of TT	0.2%	0.2%	0.2%	0.3%	0.2%	0.1%	0.8%	0.5%	0.3%
Imports	102	118	147	156	151	182	224	224	1,303
y-o-y growth		16%	25%	6%	-3%	21%	23%	0%	12%
Contribution in total imports of TT	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Trade Status	4	(21)	(4)	17	(45)	(93)	407	142	407
	Surplus	Deficit	Deficit	Surplus	Deficit	Deficit	Surplus	Surplus	Surplus

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.2.1 Overview

In the eight-year period, Buildtech segment had total exports of Rs. 1,710 Crores whereas total imports in last eight years were around Rs. 1,303 Crores. Total exports have seen a growth from Rs. 105 Crores to Rs. 367 Crores at a CAGR of 19% in the last eight years. In the same period, imports have grown from Rs. 102 Crores to Rs. 224 Crores, at a CAGR of 12%.

13.4.2.2 Balance of Trade

In the last eight-year period, India has reported a trade deficit and surplus for four years each in the Buildtech segments. India’s exports and imports for this segment were Rs. 367 Crores and Rs. 224 Crores respectively in 2019-20. Due to higher growth in exports than imports, the surplus has increased over the last eight years from Rs. 4 Crores in 2012-13 to Rs. 142 Crores in 2019-20.

The contribution of exports of Buildtech to the overall exports of technical textiles during the eight-year study period rose from 0.2% to 0.8% and products share in imports increased from 0.3% to 0.4%.

13.4.2.3 Export distribution across items and countries

Table 13.10: Export share of top five Buildtech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
48142000	Wallpaper and similar wall coverings, consisting of paper coated or covered, on the face side, with a grained, embossed, coloured, design-printed or otherwise decorated layer of plastics	68
49111090	Trade advertising material, commercial catalogues, and the like: Other	23
63061200	Tarpaulins, Awnings and Sunblind etc.: of Synthetic Fibres	5
49111010	Trade Advertising Material, Commercial Catalogues and The Like: Posters, Printed	2
63061910	Jute Tarpaulins (Incl. DW tarpaulin)	1
Share of top five items		99

Wallpaper and similar wall coverings (48142000) have largest export value in 2019-20 with a share of 68% in Buildtech exports. The share of top five exported Buildtech products adds up to 99% in total Buildtech exports. This indicates very high concentration of India's exports in terms of items which have high export value contribution in this segment.

Table 13.11: Five countries with largest imports of Indian Buildtech items (2019-20)		
Country	**Total Value of Imports (Rs. Crores)**	**Share in total exports (%)**
UAE	161	44.0
Malaysia	83	22.6
USA	58	15.7
Canada	7	1.8
Ethiopia	7	1.8
Total	315	86.0

UAE is the largest importer of Indian Buildtech products in 2019-20 with a 44% share in India's Buildtech exports. Its share has increased from approximately 4% in 2012-13 to more than 40% in recent years.

Malaysia, USA, Canada and Ethiopia are the other large importers of Indian Buildtech products. The combined share of Exports to top five countries is 86% and this indicates that the exports in this segment have high dependence on a few countries thereby they face high country risks.

13.4.2.4 Import distribution across items and countries

Table 13.12: Import share of top five Buildtech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
48142000	Wallpaper and similar wall coverings, consisting of paper coated or covered, on the face side, with a grained, embossed, coloured, design-printed or otherwise decorated layer of plastics	57
49111090	Trade advertising material, commercial catalogues and the like: Other	26
63062200	Tents: of Synthetic Fibres	6
49111010	Trade Advertising Material, Commercial Catalogues and The Like: Posters, Printed	4
59050090	Textile Wall Coverings: Other	3
Share of top five items		96

Wallpaper and similar wall coverings (48142000) have the largest import value in 2019-20 with a share of 57%in Buildtech imports. Import share of top five Buildtech products is 96%. This shows that almost entire value of imports is spent on only a few products.

Table 13.13: Five largest exporters of Buildtech items to India (2019-20)		
Country	**Total Value of Exports (Rs. Crores)**	**Share in total imports (%)**
China P RP	128	57.1
Korea RP	20	8.9
Germany	13	5.7
USA	10	4.3
Belgium	9	4.2
Total	180	80.2

India imported its largest share of Buildtech products from China in 2019-20 and share of Chinese imports has increased from 27% to 57% over the last eight years. Share of Buildtech products imported from South Korea has increased from 2% in 2012-13 to 9% in 2019-20. Germany, USA, and Belgium are the other large exporters of Buildtech products to India. The share of imports from top five countries is around 80%, and it highlights India's high dependence on a very few countries regarding imports of Buildtech products.

13.4.3 Clothtech

The following section presents the international trade analysis of fifty-eight ITC HS codes corresponding to Clothtech segment in India.

Figure 13.7: Value of Exports and Imports of Clothtech Segment (2012-13 to 2019-20) (Rs. Crores)

Table 13.14: Comparison of Exports and Imports of Clothtech segment (Rs. Crores)									
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**Aggregate for eight years**
Exports	6,380	8,410	7,915	8,207	8,623	9,222	10,028	9,340	68,127
y-o-y growth		32%	-6%	4%	5%	7%	9%	-7%	6%
Contribution in total exports of TT	13.8%	15.1%	13.5%	14.0%	14.6%	14.6%	13.3%	12.9%	13.9%

Imports	1,778	1,754	1,791	1,823	1,695	1,901	2,253	2,491	15,485
y-o-y growth		-1%	2%	2%	-7%	12%	18%	11%	5%
Contribution in total imports of TT	5.7%	5.3%	4.9%	4.7%	4.3%	4.1%	4.1%	4.8%	4.7%
Trade Status	4,602	6,656	6,125	6,384	6,928	7,321	7,776	6,849	52,642
	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.3.1 Overview

Clothtech segment has total exports worth Rs. 68,127 Crores and total imports of Rs. 15,485 Crores in the eight-year period. In this period, Clothtech exports have grown from Rs. 6,380 Crores to Rs. 9,340 Crores at a CAGR of 6% and imports have grown from Rs. 1,778 Crores to Rs. 2,491 Crores, at a CAGR of 5%.

13.4.3.2 Balance of Trade

Over the last eight years, India has reported trade surplus for all periods. For 2019-20, India's exports and imports for this segment were Rs. 9,340 Crores and Rs. 2,491 Crores respectively. Due to higher growth in exports than imports, the surplus has increased over the last eight years from Rs. 4,602 Crores in 2012-13 to Rs. 6,849 Crores in 2019-20.

Between 2013 and 2020, the year-to-year contribution of exports of Clothtech segment to overall exports of technical textiles ranged from 13% to 14% and for imports, the contribution of Clothtech to total imports was between 4% and 6%.

13.4.3.3 Export distribution across items and countries

Table 13.15: Export share of top five Clothtech products in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
54023300	Synthetic Filament Yarn (Other Than Sewing Thread), Not Put Up for Retail Sale, Including Synthetic Monofilament of Less Than 67 Dacite: Textured Yarn: of Polyesters	54
63079090	Other made-up articles, including dress patterns: Other (Excluding Floorcloths, Dishcloths, Dusters and Similar Cleaning Cloths and Life Jackets and Lifebelt): Other	11
54077200	Other woven fabrics, containing 85% or more by weight of synthetic filaments: Dyed	10
54077400	Other woven fabrics, containing 85% or more by weight of synthetic filaments: Printed	4
54075290	Other woven fabrics, containing 85% or more by weight of textured polyester filaments: Dyed: Other	3
Share of top five items		83

Synthetic Filament Yarn (54023300) with a share of 54% has the largest contribution to exports of Clothtech for the year 2019-20. Top five Clothtech products that are exported comprise share of 83% of Clothtech exports.

Table 13.16: Five countries with largest imports of Indian Clothtech items (2019-20)

Country	Total Value of Imports (Rs. Crores)	Share in total exports (%)
Turkey	1,518	16.3
Bangladesh PR	1,264	13.5
Brazil	918	9.8
USA	462	5.0
UAE	445	4.8
Total	4,607	49.3

Turkey is the largest importer of Indian Clothtech goods in 2019-20. The share of Turkey has increased from around 14% in 2012-13 to more than 15% in 2019-20.

Bangladesh, Brazil, USA, and UAE are the other countries with large shares in exports of Indian Clothtech goods. Exports to the top five importing countries are at approximately 49%. This implies that the exports of Clothtech items are not concentrated too much on a few countries and so India's exports of Clothtech items are reasonably hedged against country risks.

13.4.3.4 Import distribution across items and countries

Table 13.17: Import share of top five Clothtech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
54075290	Other woven fabrics, containing 85% or more by weight of textured polyester filaments: Dyed: Other	18
63079090	Other made-up articles, including dress patterns: Other (Excluding Floorcloths, Dishcloths, Dusters and Similar Cleaning Cloths and Life Jackets and Life-Belt): Other	11
58062000	Other Narrow Woven Fabrics Containing by Weight 5% or More of Elastomeric Yarn/ Rubber Thread	9
96072000	Slide Fasteners and Parts Thereof: Parts	8
54023300	Synthetic Filament Yarn (Other Than Sewing Thread), Not Put Up for Retail Sale, Including Synthetic Monofilament of Less Than 67 Dacite: Textured Yarn: of Polyesters	6
Share of top five items		53

Other woven fabrics (54075290) has largest import value in 2019-20 with a share of 18%. Import share of top five Clothtech products is more than 53%. This shows that the value of India's import basket comprises of a few products.

Table 13.18: Five largest exporters of Clothtech items to India (2019-20)		
Country	**Total Value of Exports (Rs. Crores)**	**Share in total imports (%)**
China P RP	1,211	48.6
Hong Kong	406	16.3
Korea RP	113	4.5
Indonesia	85	3.4
Taiwan	82	3.3
Total	1,897	76.2

India's Clothtech imports sourced from China have the largest share in 2019-20. Its share in India's import basket for Clothtech goods has increased from 46% to 49% over the last eight years. Hong Kong's share in total imports of India has increased from less than 10% in 2012-13 to more than 16% in 2019-20.

Indonesia, and Taiwan are the other significant exporters of Clothtech goods to India. Imports from top five countries comprise approximately 76% of total value of imports of Clothtech items into India.

13.4.4 Geotech

The following section presents the international trade analysis of five ITC HS codes that comprise Geotech segment in India.

Figure 13.8: Value of Exports and Imports of Geotech Segment (2012-13 to 2019-20) (Rs. Crores)

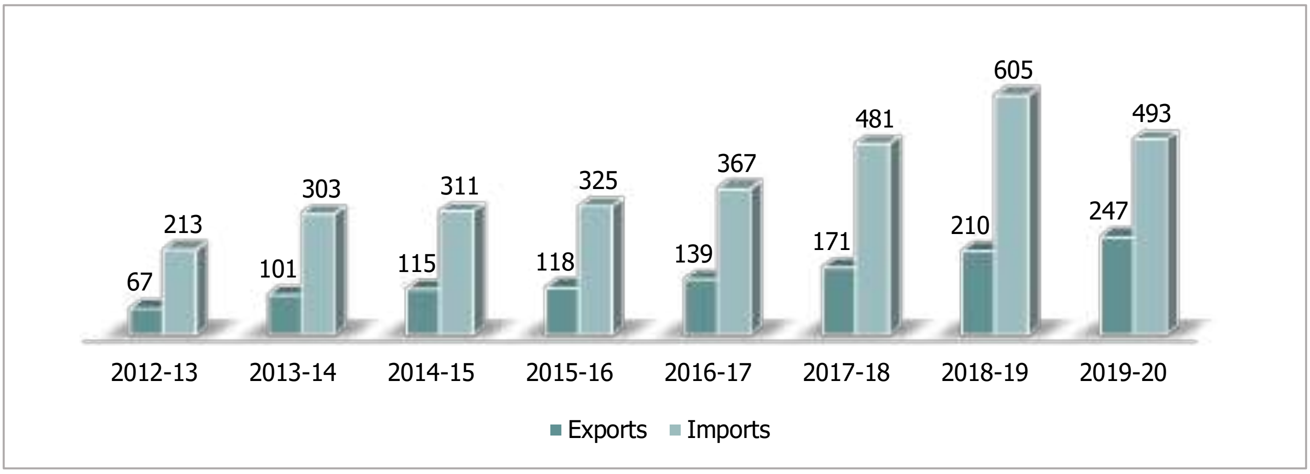


Table 13.19: Comparison of Exports and Imports of Geotech segment (Rs. Crores)									
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**Aggregate for eight years**
Exports	67	101	115	118	139	171	210	247	1,168
y-o-y growth		50%	14%	3%	18%	22%	23%	18%	20%
Contribution in total exports of TT	0.1%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.2%

Imports	213	303	311	325	367	481	605	493	3,099
y-o-y growth		42%	3%	4%	13%	31%	26%	-18%	13%
Contribution in total imports of TT	0.7%	0.9%	0.9%	0.8%	0.9%	1.0%	1.1%	1.0%	0.9%
Trade Status	(146)	(203)	(196)	(207)	(228)	(310)	(394)	(246)	(1,931)
	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.4.1 Overview

Geotech segment has achieved a exports of Rs. 1,168 Crores as compared to imports of Rs. 3,099 Crores over the entire period. Exports have seen a growth from Rs. 67 Crores to Rs. 247 Crores at a CAGR of 20% in the past eight years. In the same period, imports have grown from Rs. 213 Crores to Rs. 493 Crores at a CAGR of 13%.

13.4.4.2 Balance of Trade

Over the last eight-year period, India has reported a trade deficit for all the years. For the year 2019-20, India's exports and imports for this segment were Rs. 247 Crores and Rs. 493 Crores respectively. Due to lower absolute growth in exports than imports, the deficit has increased over last eight years from Rs. 146 Crores in 2012-13 to Rs. 246 Crores in 2019-20.

The year-wise contribution of exports of Geotech to overall exports of technical textiles during these eight years has ranged from 0.1% - 0.3% and for imports it has been 0.7% - 1.1%.

13.4.4.3 Export distribution across items and countries

Table 13.20: Export share of top three Geotech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
38244090	Prepared binders for foundry moulds or cores; chemical products and preparations of the chemical or allied industries (including those consisting of mixtures of natural products), not elsewhere specified, or included: Prepared additives for cements, mortars, or concretes: Other	73
53110015	Woven fabrics of other vegetable textile fibres; Woven fabrics of paper yarn: of coir including log form and geotextiles	26
53109099	Woven Fabrics of Jute or of Other Textile Base Fibres of Heading 5303: Other: Other (Excluding Product of Bleached, Dyed and Printed)	1
Share of top 3 items		100

Prepared binders for foundry moulds (54023300) have the largest export value in 2019-20 with a share of 73%.

Table 13.21: Five countries with largest imports of Indian Geotech items (2019-20)		
Country	**Total Value of Imports (Rs. Crores)**	**Share in total exports (%)**
Bangladesh PR	54	22.0
USA	33	13.4
Nepal	32	13.1
UAE	17	6.7
Australia	12	5.0
Total	149	60.3

Bangladesh is the largest importer of Indian Geotech goods in 2019-20 with a share of 22% of India's Geotech exports. Its share has increased from approximately 19% in 2012-13 to more than 22% in 2019-20.

Nepal, Bangladesh, Australia, USA, and UAE are the other significant importers of Indian Geotech goods accounting for around 60% of India's total exports in this segment.

13.4.4.4 Import distribution across items and countries

Table 13.22: Import share of top 2 Geotech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
38244090	Prepared binders for foundry moulds or cores; chemical products and preparations of the chemical or allied industries (including those consisting of mixtures of natural products), not elsewhere specified, or included: Prepared additives for cements, mortars or concretes: Other	95
53110029	Woven Fabrics of paper yarn: Other (Excluding Product of Unbleached, Bleached, Dyed and Printed)	4
Share of top 2 items		100

Prepared binders for foundry moulds (38244090) have the largest share of 95% of the import value of Geotech in 2019-20.

Table 13.23: Five largest exporters of Geotech items to India (2019-20)		
Country	**Total Value of Exports (Rs. Crores)**	**Share in total imports (%)**
Korea RP	190	38.5
USA	78	15.8
China P RP	49	10.0
Germany	45	9.1
Switzerland	23	4.7
Total	385	78.1

Exports from Korea RP (South Korea) had the largest share of imports of Geotech goods to India in 2019-20 and its share in India's imports has increased from 12% to 38% over the last eight years. China ranks second but its annual share has decreased from more than 30% in 2012-13 to around 10% in 2019-20. USA, Germany, and Switzerland are the other significant exporters of Geotech goods to India. Imports from top five countries are approximately 78%.

13.4.5 Hometech

The following section presents international trade analysis of sixty two ITC HS codes corresponding to Hometech segment in India.

Figure 13.9: Value of Exports and Imports of Hometech Segment (2012-13 to 2019-20) (Rs. Crores)

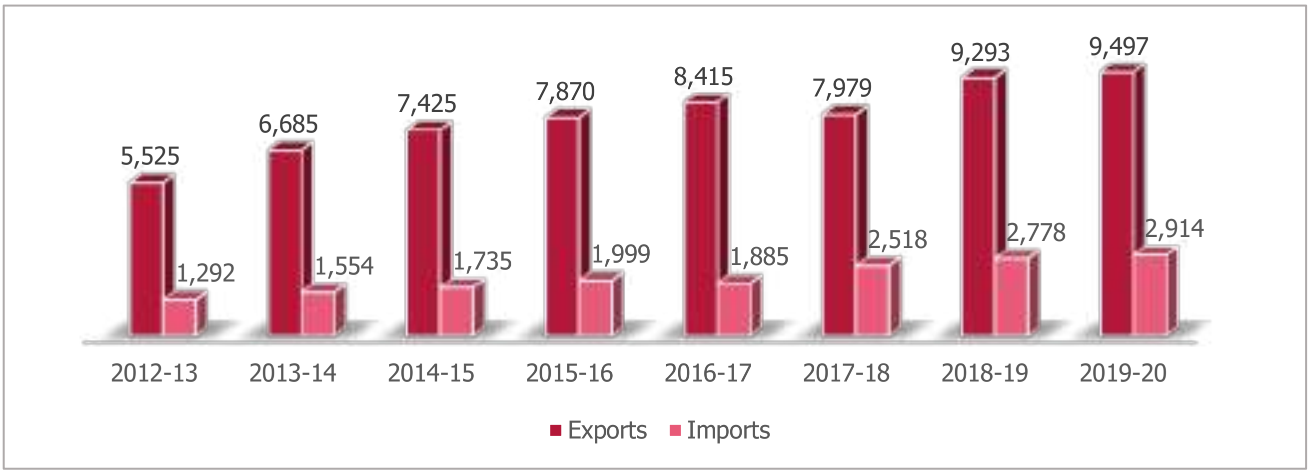


Table 13.24: Comparison of Exports and Imports of Hometech segment (Rs. Crores)

Period	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Aggregate for eight years
Exports	5,525	6,685	7,425	7,870	8,415	7,979	9,293	9,497	62,689
y-o-y growth		21%	11%	6%	7%	-5%	16%	2%	8%
Contribution in total exports of TT	12.0%	12.0%	12.7%	13.4%	14.3%	12.7%	12.3%	13.1%	12.8%
Imports	1,292	1,554	1,735	1,999	1,885	2,518	2,778	2,914	16,673
y-o-y growth		20%	12%	15%	-6%	34%	10%	5%	12%
Contribution in total imports of TT	4.2%	4.7%	4.8%	5.1%	4.8%	5.4%	5.1%	5.6%	5.0%
Trade Status	4,233	5,132	5,691	5,871	6,530	5,462	6,515	6,583	46,016
	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.5.1 Overview

Over the last eight years, total exports of products in Hometech segment has been Rs. 62,689 Crores and total imports have been Rs. 16,673 Crores. Total exports have seen a growth from Rs. 5,525 Crores to Rs. 9,497 Crores at a CAGR of 8% in the study period. During the same period, imports have grown from Rs. 1,292 Crores to Rs. 2,914 Crores at a CAGR of 12%.

13.4.5.2 Balance of Trade

Over the last eight years, India has reported a trade surplus in Hometech segment for all the years. India's exports and imports for 2019-20, for this segment were Rs. 9,497 Crores and Rs. 2,914 Crores respectively. Due to the higher absolute growth in exports than imports, the surplus has increased over last eight years from Rs. 4,233 Crores in 2012-13 to Rs. 6,583 Crores in 2019-20.

The contribution of exports of Hometech segment to the overall exports of technical textile ranges from 12% to 13% and 4% to 6% for imports for the eight-year period under consideration.

13.4.5.3 Export distribution across items and countries

Table 13.25: Export share of top five Hometech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
54072090	Woven fabrics obtained from strip or the like: Other	13
57011000	Carpets and Other Textile Floor Coverings, Knotted, Whether Made Up: of Wool or Fine Animal Hair	13
57019090	Carpets and Other Textile Floor Coverings, Knotted, Whether Made Up: of Other Textile Materials: Other than cotton and coir	9
57023110	Other, of Pile Construction, Not Made Up: of Wool or Fine Animal Hair: Carpets	8
57023210	Other, of Pile Construction, Not Made Up: of Man-Made Textile Material: Carpets, Carpeting and Rugs and The Like	7
Share of top five items		50

Woven fabrics (54072090) and carpets have had the largest share of 13% in the exports for 2019-20. Top five exporting products have had a share of 50% in the value. This suggests that in Hometech segment, the export product range is quite diverse.

Table 13.26: Five countries with largest imports of Indian Hometech items (2019-20)

Country	Total Value of Imports (Rs. Crores)	Share in total exports (%)
USA	3,713	39.1
Germany	620	6.5
China P RP	596	6.3
Afghanistan TIS	566	6.0
UK	460	4.8
Total	5,955	62.7

USA emerges as the largest importer of Indian Hometech goods in 2019-20 with a share of 39% in terms of value of India's exports for this segment. The share of USA has increased from approximately 33% in 2012-13 to 39%. Germany, China, Afghanistan, and UK are the other important importers of Indian Hometech products.

Exports to top five importing countries are approximately 63% implying that exports of Hometech products are moderately dependent on a few countries and therefore these are vulnerable to country risks.

13.4.5.4 Import distribution across items and countries

Table 13.27: Import share of top five Hometech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
59032090	Other Fabrics Impregnated Laminated Plated and Coated with Polyurethane	32
48114100	Gummed or adhesive paper and paperboard: Self-adhesive	16
57032090	Carpets and other textile floor coverings, tufted, whether made up: of nylon or other polyamides: Other	13
57033090	Carpets and Other Textile Floor Coverings, Tufted, Whether Made Up: of other man-made textile materials: Other	9
48182000	Handkerchiefs, cleaning or facial tissues and towels	3
Share of top five items		72

Other Fabrics Impregnated Laminated Plated and Coated with Polyurethane (59032090) has largest import value in 2019-20 with a share of 32% of Hometech imports. Import share of top five Hometech products is 72% of the value. This shows India's high dependence on imports of only few products.

Table 13.28: Five largest exporters of Hometech items to India (2019-20)		
Country	**Total Value of Exports (Rs. Crores)**	**Share in total imports (%)**
China P RP	1,308	44.9
USA	219	7.5
Vietnam REP	197	6.8
Thailand	197	6.8
Korea RP	132	4.5
Total	2,053	70.5

China is the biggest exporter of Hometech goods to India in 2019-20; however, its annual share in India's Hometech imports has decreased from more than 50% in earlier years to around 45% in year 2019-20.

Other significant exporters of Hometech goods to India are USA, Vietnam, Thailand, and Korea. Value of imports from top five countries is approximately 70%, highlighting India's high import dependence on a few countries.

13.4.6 Indutech

The following section presents the international trade analysis of 132 ITC HS codes corresponding to Indutech segment in India.

Figure 13.10: Value of Exports and Imports of Indutech Segment (2012-13 to 2019-20) (Rs. Crores)

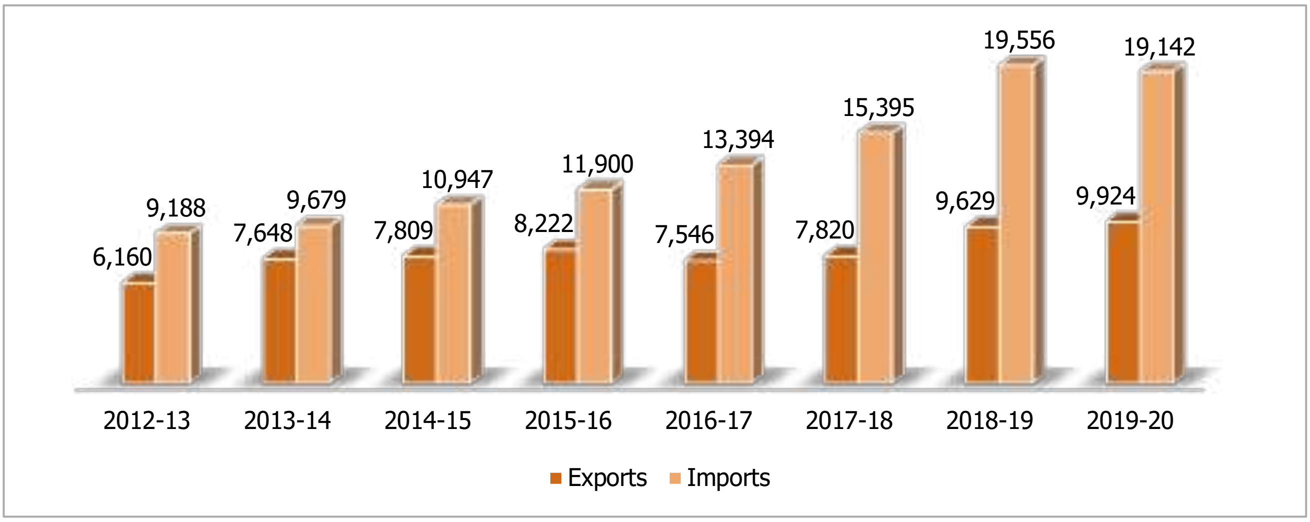


Table 13.29: Comparison of Exports and Imports of Indutech segment (Rs. Crores)

Period	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Aggregate for eight years
Exports	6,160	7,648	7,809	8,222	7,546	7,820	9,629	9,924	64,758
y-o-y growth		24%	2%	5%	-8%	4%	23%	3%	7%
Contribution in total exports of TT	13.3%	13.7%	13.3%	14.0%	12.8%	12.4%	12.8%	13.7%	13.2%
Imports	9,188	9,679	10,947	11,900	13,394	15,395	19,556	19,142	109,202
y-o-y growth		5%	13%	9%	13%	15%	27%	-2%	11%
Contribution in total imports of TT	29.6%	29.3%	30.0%	30.4%	34.2%	33.2%	36.0%	37.1%	33.0%
Trade Status	(3,028)	(2,032)	(3,138)	(3,678)	(5,848)	(7,575)	(9,927)	(9,218)	(44,444)
	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.6.1 Overview

The aggregate exports of Indutech segment is Rs. 64,758 Crores and total imports is Rs. 109,202 Crores for the eight-year period under consideration.

The value of Indutech exports has seen a growth from Rs. 6,160 Crores to Rs. 9,924 Crores over the last eight years at a CAGR of 7%. In the same period, imports have grown from Rs. 9,188 Crores to Rs. 19,142 Crores, at a CAGR of 11%.

13.4.6.2 Balance of Trade

There has been a trade deficit in Indutech segment in each of the last eight years. For 2019-20, India's exports and imports for this segment were Rs. 9,924 Crores and Rs. 19,142 Crores respectively. Due to lower growth in exports than imports, the deficit has increased over the last eight years from Rs. 3,028 Crores in 2012-13 to Rs. 9,218 Crores in 2019-20. The yearly share of exports of Indutech to the overall exports of technical textile industry in the eight years ranged 13% to 14% and for imports it was 30% to 36%. Indutech is the second largest segment in terms of India's imports and exports of Technical Textiles.

13.4.6.3 Export distribution across items and countries

Table 13.30: Export share of top five Indutech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
55032000	Synthetic Staple Fibres, Not Carded, Combed or Otherwise Processed for Spinning: of Polyesters	21
84219900	Filtering or Purifying Machinery and Apparatus, For Liquids or Gases: Parts	11
85340000	Printed circuits	9
56074900	Other cordage etc.: of polyethylene/ polypropylene	6
59031090	Other Fabrics Impregnated, Laminated Plated and Coated with PVC	5
Share of top five items		52

Synthetic Staple Fibres (55032000) has the largest share (21%) of the value of exports in 2019-20. Top five among the exported Indutech products have a value share of 52%. It shows low to moderate product diversity in terms of export value contribution and therefore moderate product risk.

Table 13.31: Five countries with largest imports of Indian Indutech items (2019-20)

Country	Total Value of Imports (Rs. Crores)	Share in total exports (%)
USA	2,257	22.7
Bangladesh PR	437	4.4
UAE	436	4.4
Germany	359	3.6
Nepal	339	3.4
Total	3,829	38.6

USA is the largest importer of Indian Indutech products in 2019-20 with a share of 22.7% in India's Indutech exports. The annual share of USA has increased from approximately 15% in 2012-13 to more than 20% for the period being studied. Bangladesh, UAE, Nepal, and Germany are the other destination countries for India's Indutech exports. Exports to top five countries is less than 40%, implying that the export of Indutech products in terms of countries is well diversified and therefore the segment is relatively less dependent on demand from a select few countries.

13.4.6.4 Import distribution across items and countries

Table 13.32: Import share of top five Indutech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
85340000	Printed circuits	23
84219900	Filtering or Purifying Machinery and Apparatus, For Liquids or Gases: Parts	14
85079090	Electric Accumulators, Including Separators Therefor, Whether Rectangular (Including Square): Parts: Other	9
55032000	Synthetic Staple Fibres, Not Carded, Combed or Otherwise Processed for Spinning: of Polyesters	5
59039090	Other Fabric Plated Laminated Coated Impregnated with Other Plastics	5
Share of top five items		56

Printed circuits (85340000) had the largest import value among Indutech items in 2019-20 and had a share of 23% in India's Indutech imports. The share of top five Indutech products in India's imports of this segment is 56%, showing that only a few products comprise considerable share in terms of value. This has an effect of increasing India's product related buying risks.

Table 13.33: Five largest exporters of Indutech items to India (2019-20)		
Country	**Total Value of Exports (Rs. Crores)**	**Share in total imports (%)**
China P RP	9,002	47.0
Hong Kong	1,764	9.2
Korea RP	1,410	7.4
USA	919	4.8
Thailand	773	4.0
Total	13,867	72.4

China is the largest exporter of Indutech goods to India in 2019-20. Its share has remained stable at approximately 47% of India's imports in this segment for the last eight years. The share of India's imports from Hong Kong has increased from 2% in 2012-13 to 9% in 2019-20. Korea, USA, and Thailand are the other big exporters of Indutech goods to India. The value of imports from top five countries is approximately 72% of India's import basket of Indutech goods. This highlights India's high dependence for Indutech imports on a few countries and enhancing India's buying risks associated with source countries.

13.4.7 Meditech

The following section presents the international trade analysis of twenty-seven ITC HS codes corresponding to Meditech segment in India.

Figure 13.11: Value of Exports and Imports of Meditech Segment (2012-13 to 2019-20) (Rs. Crores)

Table 13.34: Comparison of Export and Import Data of Meditech segment (Rs. Crores)									
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**Aggregate for eight years**
Exports	868	958	1,002	1,068	1,269	1,761	2,107	2,178	11,210
y-o-y growth		10%	5%	7%	19%	39%	20%	3%	14%
Contribution in total exports of TT	1.9%	1.7%	1.7%	1.8%	2.2%	2.8%	2.8%	3.0%	2.3%
Imports	1,298	1,834	2,081	2,212	2,410	2,491	3,066	3,090	18,483
y-o-y growth		41%	13%	6%	9%	3%	23%	1%	13%
Contribution in total imports of TT	4.2%	5.5%	5.7%	5.7%	6.2%	5.4%	5.6%	6.0%	5.6%
Trade Status	(430)	(876)	(1,079)	(1,144)	(1,142)	(730)	(959)	(912)	(7,273)
	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit	Deficit

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.7.1 Overview

In the eight-year period, India's Meditech segment has had total exports of Rs. 11,210 Crores and total imports valued at Rs. 18,483 Crores.

Value of annual exports has seen a growth in last eight years from Rs. 868 Crores to Rs. 2,178 Crores at a CAGR of 14%. In the same period, yearly imports have grown from Rs. 1,298 Crores to Rs. 3,090 Crores at a CAGR of 13%.

13.4.7.2 Balance of Trade

The Meditech segment has reported a trade deficit for all the years in the eight-year period that has been studied. India's exports and imports in 2019-20, for this segment were Rs. 2,178 Crores and Rs. 3,090 Crores respectively. Due to lower absolute growth in exports than imports, the annual trade deficit has increased over last eight years from Rs. 430 Crores in 2012-13 to Rs. 912 Crores in 2019-20.

On an yearly basis, the contribution of exports of Meditech products to overall exports of technical textile was 2% to 3% and 4% to 6% for imports during the eight year period.

13.4.7.3 Export distribution across items and countries

Table 13.35: Export share of top five Meditech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
61152990	Panty hose, tights, stockings, socks, and other hosiery, including graduated compression hosiery (for example, stockings for varicose veins) and footwear without applied soles, knitted or crocheted: of other textile materials: Panty Hose and tights of Other Fibres	14
90213900	Other artificial parts of the body: Other	14
40151100	Articles of Apparel and Clothing Accessories (Including Gloves, Mittens and Mitts) for All Purposes, or Vulcanised Rubber Other Than Hard Rubber: Surgical Gloves, Mittens & Mitts	13
56012110	Textile Materials and Articles Thereof; Textile Fibres, Not Exceeding 5 Mm in Length (Flock), Textile Dust and Mill Naps: Wadding; Other Articles of Cotton Wadding: Absorbent Cotton Wool	12
30059040	Bandages Without Adhesive Layer	8
Share of top five items		61

Panty hose, tights, stockings, socks, and other hosiery (61152990) has the largest share of 14% in Meditech exports from India in 2019-20.

Top five among the exported products have a total share of 61%. This suggests that there is a moderate concentration in terms of exported goods in value terms and diversification may be needed to reduce risks.

Table 13.36: Five countries with largest imports of Indian Meditech items (2019-20)

Country	Total Value of Imports (Rs. Crores)	Share in total exports (%)
USA	198	9.1
Nepal	172	7.9
Spain	144	6.6
Germany	135	6.2
Poland	113	5.2
Total	761	35.0

USA is the largest importer of Indian Meditech products in 2019-20 with a share of 9.1% in India's Meditech exports. Its annual share in India's exports has remained stable at 9% to 10% over the last eight years. Nepal, Spain, Germany, and Poland are the other large importers from India in this segment. Exports to top five countries are around 35%. This implies that the exports of Meditech items are well diversified in terms of countries.

13.4.7.4 Import distribution across items and countries

Table 13.37: Import share of top five Meditech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
90213900	Other artificial parts of the body: Other	34
90213100	Artificial Joints	28
40151100	Articles of Apparel and Clothing Accessories (Including Gloves, Mittens and Mitts) For All Purposes, or Vulcanised Rubber Other Than Hard Rubber: Surgical Gloves, Mittens & Mitts	8
96190090	Sanitary towels (pads) and tampons, napkins and napkin liners for babies and similar articles, of any material: Other	6
96190040	Clinical Diapers	4
Share of top five items		80

Items classified under Other artificial parts of the body (90213900) have largest import value in 2019-20 with a share of 34% of Meditech imports of India.

Import share of top five Meditech products is 80%. It shows a considerable part of India's import bill of the Meditech product is spent on a relatively few items in terms of value.

Table 13.38: Five largest exporters of Meditech items to India (2019-20)

Country	Total Value of Exports (Rs. Crores)	Share in total imports (%)
USA	474	15.3
Belgium	408	13.2
China P RP	362	11.7
Switzerland	276	8.9
The Netherlands	259	8.4
Total	1,779	57.6

USA was the largest exporter of Meditech goods to India in 2019-20. However, its share has decreased from more than 45% in 2012-13 to 15% in 2019-20. Belgium, China, Switzerland, and The Netherlands are the other countries from where India sources its imports of Meditech items. The share of imports from top five countries is approximately 58% of the total in this category. It underscores India's dependence on only a few countries for Meditech imports.

13.4.8 Mobiltech

The following section presents the international trade analysis of nineteen ITC HS codes corresponding to Mobiltech segment in India.

Figure 13.12: Value of Exports and Imports of Mobiltech Segment (2012-13 to 2019-20) (Rs. Crores)

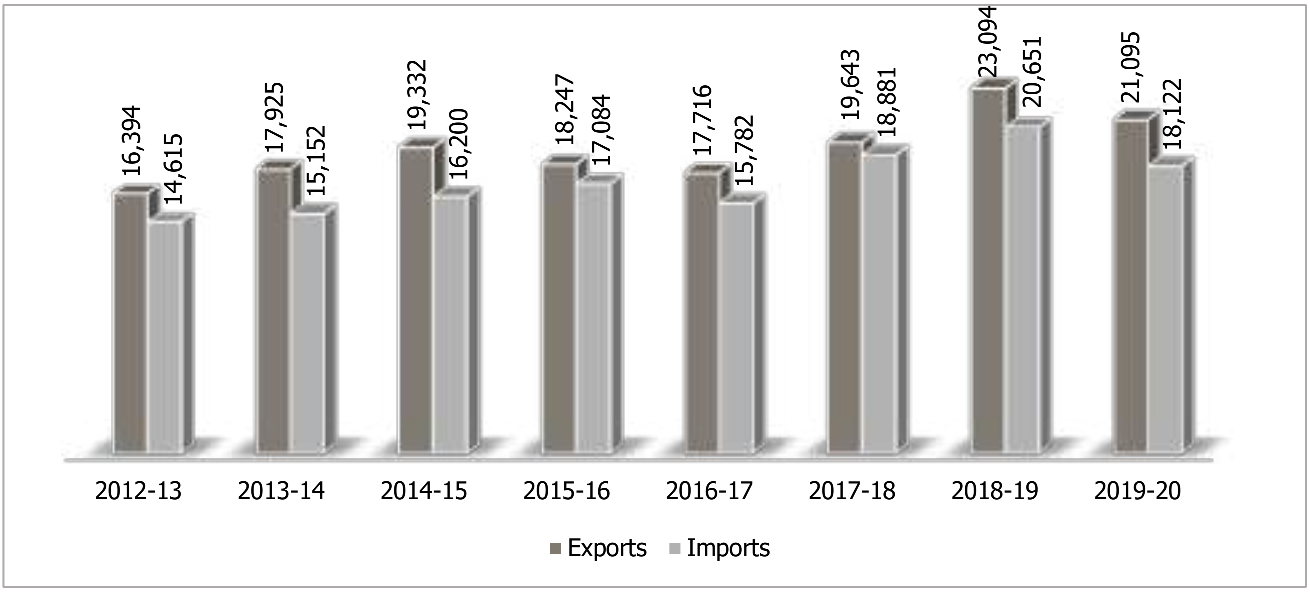


Table 13.39: Comparison of Exports and Imports Data of Mobiltech segment (Rs. Crores)

Period	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Aggregate for eight years
Exports	16,394	17,925	19,332	18,247	17,716	19,643	23,094	21,095	153,447
y-o-y growth		9%	8%	-6%	-3%	11%	18%	-9%	4%
Contribution in total exports of TT	35.5%	32.1%	33.0%	31.1%	30.0%	31.2%	30.6%	29.2%	31.4%
Imports	14,615	15,152	16,200	17,084	15,782	18,881	20,651	18,122	136,487
y-o-y growth		4%	7%	5%	-8%	20%	9%	-12%	3%
Contribution in total imports of TT	47.1%	45.8%	44.4%	43.6%	40.3%	40.7%	38.0%	35.1%	41.2%
Trade Status	1,779	2,773	3,132	1,163	1,934	762	2,443	2,973	16,959
	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.8.1 Overview

The Indian products of Mobiltech segment have an aggregate value of exports as Rs. 153,447 Crores and of imports as Rs. 136,487 Crores for the eight-year period. Annual value of exports has seen a growth in last eight years from Rs. 16,394 Crores to Rs. 21,095 Crores at a CAGR of 4%. During the same period, imports have grown from a value of Rs. 14,615 Crores to Rs. 18,122 Crores, at a CAGR of 3%.

13.4.8.2 Balance of Trade

There has been a trade surplus for Mobiltech segment in all of the last eight years. During 2019-20, India's exports and imports for this segment were Rs. 21,095 Crores and Rs. 18,122 Crores respectively. Due to higher growth in exports than imports, the annual surplus has increased over the last eight years from Rs. 1,779 Crores in 2012-13 to Rs. 2,973 Crores in 2019-20. The annual percentage contribution of exports of Mobiltech products to overall exports of technical textiles during eight years has ranged from 29% to 36% and it has been between 35% and 47% for the imports. Mobiltech is the largest segment in Technical Textiles industry of India in terms of both imports and exports based on the 449 ITC HS codes considered for analysis.

13.4.8.3 Export distribution across items and countries

Table 13.40: Export share of top five Mobiltech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
87089900	Parts and Accessories of The Motor Vehicles of Headings 8701 To 8705: Other parts and accessories: Other	83
87082900	Parts and Accessories of The Motor Vehicles of Headings 8701 To 8705: Other Parts and Accessories of Bodies (Including Cabs): Other	6
94019000	Seats (Other Than Those of Heading 9402), Whether or Not Convertible Into Beds, and Parts Thereof: Parts	2
54071039	Woven fabrics obtained from high tenacity yarn of nylon or other polyamides or of polyesters: Dyed: Other	2
87082100	Parts and accessories of the motor vehicles of headings 8701 to 8705 : Other parts and accessories of bodies (including cabs) : Safety seat belts	2
Share of top five items		95

Parts and Accessories of the Motor Vehicles (56081190) at a share of 83% comprise the largest export value in 2019-20 in this segment. Top five among the exported products have a share of 95%. This shows high concentration of products in terms of their contribution to value of exports.

Table 13.41: Five countries with largest imports of Indian Mobiltech items (2019-20)

Country	Total Value of Imports (Rs. Crores)	Share in total exports (%)
USA	4,785	22.7
Turkey	1,249	5.9
Brazil	1,174	5.6
Mexico	1,154	5.5
Germany	1,118	5.3
Total	9,480	44.9

In terms of countries, USA was the largest importer of Indian Mobiltech goods in 2019-20 with a share of 22.7% in India's Mobiltech exports. This share has increased from approximately 18% in 2012-13 to more than 20% during 2019-20. Turkey, Brazil, Mexico, and Germany import a significantly large value of Indian Mobiltech goods. Value of exports to top five countries is approximately 50% which indicates a moderate degree of concentration in terms of countries to which Indian Mobiltech products are exported.

13.4.8.4 Import distribution across items and countries

Table 13.42: Import share of top five Mobiltech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
87089900	Parts and Accessories of The Motor Vehicles of Headings 8701 To 8705: Other parts and accessories: Other	57
87082900	Parts and Accessories of The Motor Vehicles of Headings 8701 To 8705: Other Parts and Accessories of Bodies (Including Cabs): Other	17
94019000	Seats (Other Than Those of Heading 9402), Whether Convertible into Beds, and Parts Thereof: Parts	7
87089500	Parts and accessories of the motor vehicles of headings 8701 to 8705: Other parts and accessories: Safety airbags with inflater system; parts thereof	6
59021090	Tyre cord fabric of nylon or other polyamides: Others	4
Share of top five items		91

Parts and Accessories of Motor Vehicles (87089900) has had the largest import value in 2019-20 as it had a share of 57%. Share of top five imported Mobiltech products is more than 90%. This shows high import dependence of India on only a few Mobiltech products.

Table 13.43: Five largest exporters of Mobiltech items to India (2019-20)		
Country	**Total Value of Exports (Rs. Crores)**	**Share in total imports (%)**
China P RP	4,483	24.7
Korea RP	3,726	20.6
Germany	2,445	13.5
Thailand	1,441	8.0
Japan	1,214	6.7
Total	13,309	73.4

China was the biggest exporter of Mobiltech goods to India in 2019-20 and its share has increased from 15% in 2012-13 to approximately 25%. South Korea was the largest exporter of Mobiltech goods to India in 2012-13 and it had a share of more than 21% in India’s imports of Mobiltech items. However, share of Korean exports to India has marginally declined to approximately 20%. The other countries whose exports of Mobiltech items to India are significant are Germany, Thailand, and Japan. The value of imports from top five countries is approximately 73%, which underlines India’s high dependence on a few countries for Mobiltech imports.

13.4.9 Packtech

The following section presents the international trade analysis of 59 ITC HS codes corresponding to Packtech segment in India.

Figure 13.13: Value of Exports and Imports of Packtech Segment (2012-13 to 2019-20) (Rs. Crores)

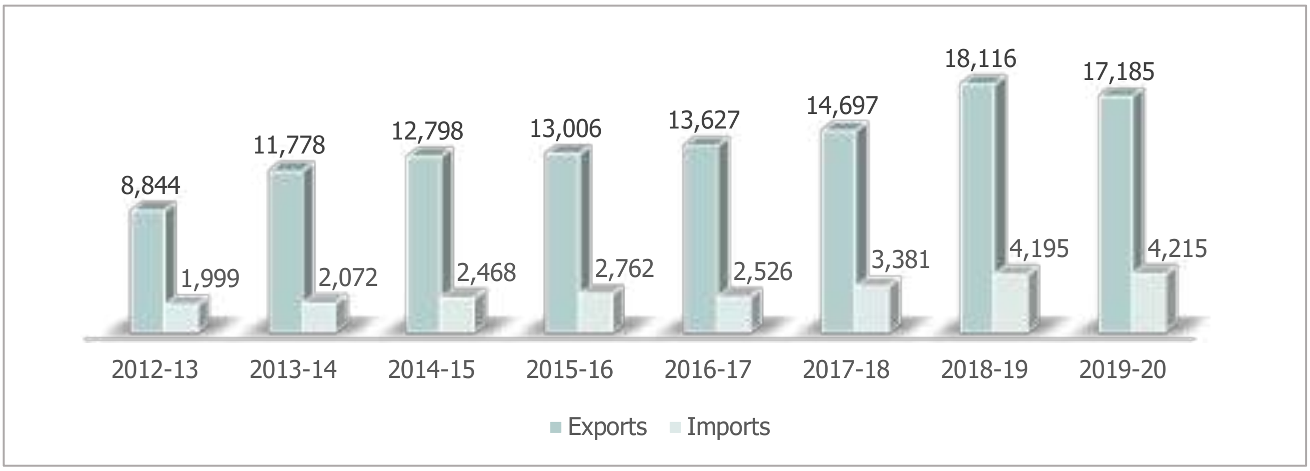


Table 13.44: Comparison of Exports and Imports of Packtech segment (Rs. Crores)

Period	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Aggregate for eight years
Exports	8,844	11,778	12,798	13,006	13,627	14,697	18,116	17,185	110,051
y-o-y growth		33%	9%	2%	5%	8%	23%	-5%	10%
Contribution in total exports of TT	19.1%	21.1%	21.8%	22.2%	23.1%	23.3%	24.0%	23.8%	22.5%
Imports	1,999	2,072	2,468	2,762	2,526	3,381	4,195	4,215	23,617
y-o-y growth		4%	19%	12%	-9%	34%	24%	0%	11%
Contribution in total imports of TT	6.4%	6.3%	6.8%	7.1%	6.4%	7.3%	7.7%	8.2%	7.1%
Trade Status	6,845	9,706	10,330	10,244	11,100	11,316	13,922	12,971	86,434
	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.9.1 Overview

The exports from Packtech segment are Rs. 110,051 Crores and imports are Rs. 23,617 Crores in the eight-year period being observed.

Yearly exports have seen a consistent and healthy growth from Rs. 8,844 Crores to Rs. 17,185 Crores at a CAGR of 10%. During the same period, imports have also grown significantly from Rs. 1,999 Crores to Rs. 4,215 Crores, at a CAGR of 11%.

13.4.9.2 Balance of Trade

India has been reporting a trade surplus in all the products under Packtech segment over the last eight years. India's Packtech exports and imports for the year 2019-20 were Rs. 17,185 Crores and Rs. 4,215 Crores respectively. For all the eight years, the value of exports is more than four times of the value of imports and the trade surplus has almost doubled from Rs. 6,845 Crores in 2012-13 to Rs. 12,971 Crores in 2019-20.

The yearly percentage contribution of exports of Packtech products to the overall exports of technical textile has ranged from 19.1% to 24% and that of imports from 6.3% to 8.2% over the last eight-year period.

13.4.9.3 Export distribution across items and countries

Table 13.45: Export share of top five Packtech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
63053200	Sacks and Bags, Flexible Intermediate Bulk Containers: of Man Made Textile Materials	28
42023120	Articles of A Kind Normally Carried In The Pocket or In The Handbag: With Outer Surface of Leather or of Composition Leather: Wallets and Purses, of Leather	13
42022190	With outer surface of leather or of composition leather: or of patent leather: other	9
42022220	With Outer Surface of Sheeting of Plastics or of Textile Materials: Handbags and Shopping Bags, of Cotton	8
42022110	With Outer Surface of Leather or of Composition Leather: or of Patent Leather: Hand-Bags For Ladies	8
Share of top five items		66

Sacks and Bags of Man-made textile material (63053200) have largest share of 28% of Packtech export value in 2019-20. This has also been the most exported product for the past eight years.

The top five Packtech products have a total export share between 65% and 70% in each of the last eight years. The list of top exported products is consistent i.e. the same five products have featured in top five exported products list over these eight years.

Table 13.46: Five countries with largest imports of Indian Packtech items (2019-20)

Country	Total Value of Imports (Rs. Crores)	Share in total exports (%)
USA	4,376	25.5
Germany	1,724	10.0
UK	1,618	9.4
The Netherlands	995	5.8
Spain	957	5.6
Total	9,671	56.3

USA was the largest importer of Indian Packtech products in 2019-20 and exports to USA constituted 25.5% of exports of Packtech products. The share of USA has increased from approximately 20% in 2012-13 to more than 25% in 2019-20.

In 2012-13, UK was the second largest importer of Indian Packtech products comprising of 14% share. However, its share of imports has fallen to less than 10% in 2019-20. Germany, The Netherlands and Spain are the other significant export destinations for Indian Packtech products.

India's exports to top five countries are at more than 55%. Exports of Packtech products to countries are highly concentrated and hence this segment faces high business risk on the demand side.

13.4.9.4 Import distribution across items and countries

Table 13.47: Import share of top five Packtech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
42021250	With outer surface of plastic or of textile materials: Other Travel goods	23
42022290	With outer surface of sheeting of plastics or of textile materials: Other	10
63051040	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303: Jute sacking bags	8
53101012	Unbleached: Containing 100% By Weight of Jute: Sacking Fabrics	8
42021290	With Outer Surface of Leather or of Composition Leather: or of Patent Leather: Other	7
Share of top five items		55

Outer surface of plastic or of textile materials (42021250) has largest share of import value in 2019-20 at 23%. Its annual share has more than doubled from 9% in 2012-13 to 23% in 2019-20. It has remained one of the top five Packtech importing products in each of the last eight years.

In contrast, there has been a reduction in the share of Outer Surface of Leather (42021290) among the imported items from constituting a high of 26% in 2016-17, when it was also the largest imported Packtech product to 7% in 2019-20.

The share of top five Packtech products has remained more than 55% of imports in this segment in each of the past eight years. This shows that import expenditure is incurred only on a small number of products.

Table 13.48: Five largest exporters of Packtech items to India (2019-20)

Country	Total Value of Exports (Rs. Crores)	Share in total imports (%)
China P RP	2,348	55.7
Bangladesh PR	754	17.9
Nepal	390	9.2
Hong Kong	144	3.4
Singapore	101	2.4
Total	3,737	88.7

Exports from China have the largest share in India's imports of Packtech goods in 2019-20. India has consistently imported more than half the total value of imported Packtech products from China for the past eight years. The share of Chinese imports has increased from approximately 51% in 2012-13 to approximately 56% in 2019-20.

Bangladesh is the second largest source of imports of Packtech products for India. It has a share of approximately 18%. Apart from China and Bangladesh, Nepal, Hong Kong, and Singapore are the other big sources of Packtech imports for India. Imports from these top five countries add up to 89% of total imports of Packtech products. This shows India's high dependence for Packtech imports on a few select countries.

13.4.10 Protech

The following section presents the international trade analysis of 27 ITC HS codes corresponding to Protech segment in India.

Figure 13.14: Value of Exports and Imports of Protech Segment (2012-13 to 2019-20) (Rs. Crores)

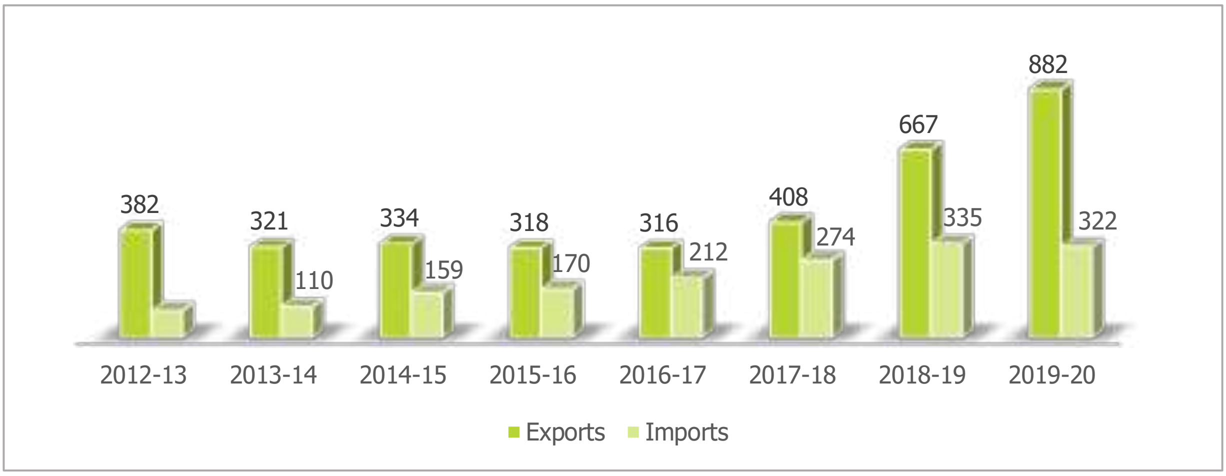


Table 13.49: Comparison of Exports and Imports of Protech segment (Rs. Crores)

Period	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Aggregate for eight years
Exports	382	321	334	318	316	408	667	882	3,629
y-o-y growth		-16%	4%	-5%	-1%	29%	63%	32%	13%
Contribution in total exports of TT	0.8%	0.6%	0.6%	0.5%	0.5%	0.6%	0.9%	1.2%	0.7%
Imports	97	110	159	170	212	274	335	322	1,680
y-o-y growth		13%	44%	7%	24%	29%	22%	-4%	19%
Contribution in total imports of TT	0.3%	0.3%	0.4%	0.4%	0.5%	0.6%	0.6%	0.6%	0.5%
Trade Status	285	211	176	148	104	134	332	560	1,950
	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.10.1 Overview

Total exports of Protech segment products in the eight-year period are valued at Rs. 3,629 Crores whereas total imports during this period are Rs. 1,680 Crores. Yearly exports have grown from Rs. 382 Crores to Rs. 882 Crores at a CAGR of 13%. During the same period, imports have also grown significantly from Rs. 97 Crores to Rs. 322 Crores at a CAGR of 19%.

13.4.10.2 Balance of Trade

India has been reporting a trade surplus in all the products under Protech segment for last eight years. India’s exports and imports for this segment in 2019-20 were Rs. 882 Crores and Rs. 322 Crores respectively. Exports have been higher than imports for each of the eight years. The trade surplus has almost doubled from Rs. 285 Crores in 2012-13 to Rs. 560 Crores in 2019-20 over the last eight years.

The percentage share of yearly exports of Protech products to overall exports of technical textile ranges from 0.8% to 1.2% and for imports, it ranges from 0.3% to 0.6%. The share of exports of Protech products in total technical textiles exports has grown from 0.8% in 2012-13 to 1.2% in 2019-20. The share of imports has also doubled from 0.3% in 2012-13 to 0.6% in 2019-20.

13.4.10.3 Export distribution across items and countries

Table 13.50: Export share of top five Protech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
62019990	Men's or Boys' Overcoats, Carcoats, Cloaks, Anoraks (Including Ski-Jackets), Windcheaters, Wind Jackets and Similar Articles Other Than Those of Heading 6203: of Other Textile Materials: Other Than Silk	18
62104010	Men's or Boys' Personal Protective Garments, Not Knitted or Crocheted: Bullet Proof Jackets, Bomb Disposal Jackets etc.	16
62101000	Garments, Made Up of Fabrics of Heading 5602, 5603, 5903, 5906 or 5907: of Fabrics of Heading 5602 or 5603	15
61161000	Gloves, Mittens and Mitts, Knitted or Crocheted Impregnated, Coated or Covered with Plastics or Rubber	12
63072090	Life Jackets & Life Belts Excluding Cotton	12
Share of top five items		73

Men's or Boys' Overcoats (62019990) has largest export value in 2019-20 with a share of 18% in India’s Protech exports. Its share has increased from a meagre 2% in 2012-13 to 18% in 2019-20. It has been among top five Protech products exports since 2016-17.

Personal Protective Garments for Women & Girl's (62105000) and Women's or Girls’ Overcoats, etc. (62021300, 62021200) saw a significant reduction in exports from over 25% in 2012-13 to 6% in 2019-20.

The top five Protech products have a total percentage share of more than 60% in exports in each of the past eight years. The share of top five products has hovered between 63% to a high of 80% in the past eight years. This shows that the product diversity is less in terms of export value contribution.

Table 13.51: Five countries with largest imports of Indian Protech items (2019-20)		
Country	**Total Value of Imports (Rs. Crores)**	**Share in total exports (%)**
USA	286	32.4
Philippines	115	13.1
France	56	6.3
Belgium	35	4.0
China P RP	32	3.7
Total	524	59.4

In terms of countries, USA is the biggest importer of Indian Protech goods in 2019-20. Exports to USA make up for a share of 32.4% of India's Protech exports. The share of USA has increased from around 20% in 2012-13 to more than 32% in the period under study. In 2012-13, Egypt was the second largest importer of Indian Protech products with a share of around 9%. However, its share has fallen to less than 0.2% in 2019-20. Along with USA, it is Philippines, France, Belgium, and China which are leading importers of Indian Protech products. The value of India's exports to these top five export destination countries is more than 55% and that indicates India's high dependence for export orders on these countries.

13.4.10.4 Import distribution across items and countries

Table 13.52: Import share of top five Protech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
40159030	Articles of Apparel and Clothing Accessories (Including Gloves, Mittens and Mitts) For All Purposes, or Vulcanised Rubber Other Than Hard Rubber: Other: Industrial Gloves	21
61161000	Gloves, Mittens and Mitts, Knitted or Crocheted Impregnated, Coated or Covered With Plastics or Rubber	19
62104090	Other Men's or Boys' Personal Protective Garments Not Knitted or Crocheted	13
62101000	Garments, Made Up of Fabrics of Heading 5602, 5603, 5903, 5906 or 5907: of Fabrics of Heading 5602 or 5603	11
62021300	Women's or Girls' Overcoats, Raincoats, Car-Coats, Capes, Cloaks and Similar Articles: of man-made fibres	7
Share of top five items		70

Apparel and Clothing Accessories including Gloves, Mittens and Mitts (40159030) have largest share in value of imports at 21% in 2019-20. The share of items under this code has remained high in the annual imports of the segment and has ranged from 19% to 28% in the study period. This product has occupied the top slot among the Protech products being imported by India in each of the years except in 2018-19, when it was the second most imported product.

The share of Articles of Apparel and Clothing Accessories (39262029) in value of imports has reduced from 10% in 2013-14 to less than 5% in 2019-20.

The share of top five Protech products in imports has always been more than 65% in each of the last eight years. It shows that there are only a few select items of Protech imports which consume a major part of expenditure on imports of products of this segment.

Table 13.53: Five largest exporters of Protech items to India (2019-20)

Country	Total Value of Exports (Rs. Crores)	Share in total imports (%)
China P RP	154	47.8
Malaysia	34	10.6
Vietnam SOC REP	23	7.2
USA	18	5.7
Spain	17	5.3
Total	247	76.5

China was the largest exporter of Protech goods to India in 2019-20 with a significantly large share of more than 47%. China's share has increased from approximately 36% in 2012-13 to approximately 48%, and it has always remained the largest among the exporters of Protech products to India.

Malaysia is the second largest exporter of Protech products to India with a share of around 11% of India's imports in this segment. The other significant sources of imports for India are USA, Vietnam, and Spain. Imports from these top five countries are around 76% in value terms.

13.4.11 Sportech

The following section presents the international trade analysis of 46 ITC HS codes corresponding to Sportech segment in India.

Figure 13.15: Value of Exports and Imports of Sportech Segment (2012-13 to 2019-20) (Rs. Crores)

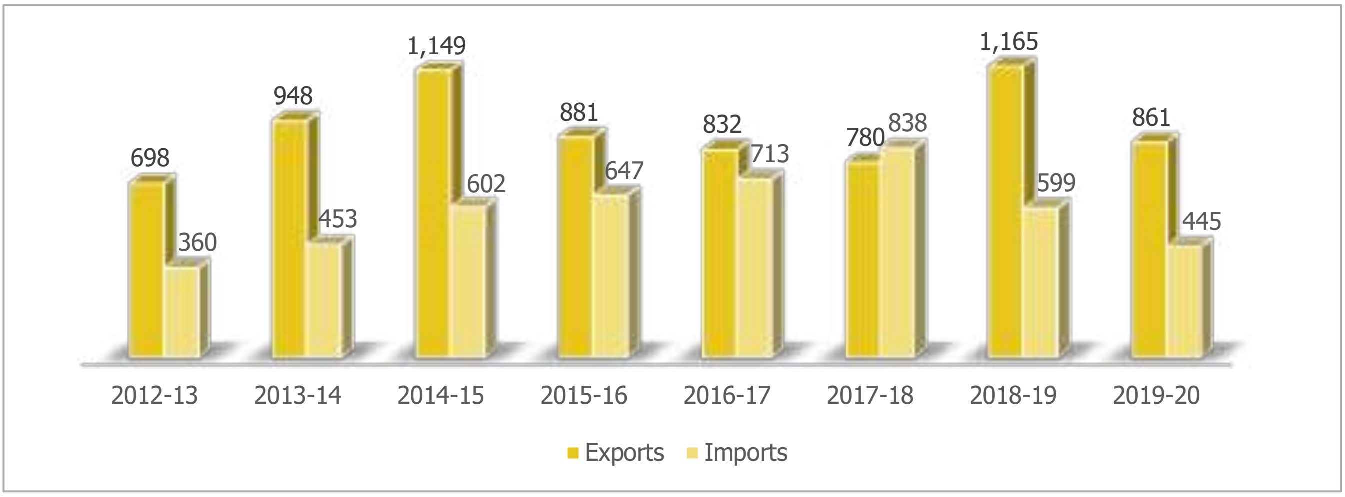


Table 13.54: Comparison of Exports and Imports Data of Sportech segment (Rs. Crores)									
Period	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**Aggregate for eight years**
Exports	698	948	1,149	881	832	780	1,165	861	7,314
y-o-y growth		36%	21%	-23%	-6%	-6%	49%	-26%	3%
Contribution in total exports of TT	1.5%	1.7%	2.0%	1.5%	1.4%	1.2%	1.5%	1.2%	1.5%
Imports	360	453	602	647	713	838	599	445	4,658
y-o-y growth		26%	33%	7%	10%	18%	-29%	-26%	3%
Contribution in total imports of TT	1.2%	1.4%	1.7%	1.7%	1.8%	1.8%	1.1%	0.9%	1.4%
Trade Status	338	495	546	234	119	(59)	567	416	2,656
	Surplus	Surplus	Surplus	Surplus	Surplus	Deficit	Surplus	Surplus	Surplus

Source: Department of Commerce, GOI (IIT Delhi Analysis)

13.4.11.1 Overview

The value of exports of products of Sportech segment for the eight-year period is Rs. 7,314 Crores and that of imports is Rs. 4,658 Crores. Annual exports of this segment have seen a rise from Rs. 698 Crores to Rs. 861 Crores at a CAGR of 3%. During the same period, annual value of imports has grown from Rs. 360 Crores to Rs. 445 Crores, at a CAGR of 3%.

13.4.11.2 Balance of Trade

India has reported trade surplus for all the years except in one year of the eight-year period under study. India's exports and imports in 2019-20 for this segment were Rs. 861 Crores and Rs. 445 Crores respectively. Due to higher absolute growth in exports than imports, the surplus has increased from Rs. 338 Crores in 2012-13 to Rs. 416 Crores in 2019-20.

The percentage contribution of year-on-year exports of Sportech goods to the overall exports of technical textiles industry in each year has ranged from 1% to 2% and contribution to imports has also been between 1% and 2%.

13.4.11.3 Export distribution across items and countries

Table 13.55: Export share of top five Sportech items in 2019-20 along with item description		
ITC HS Code	**Item Description**	**Share (%)**
95069990	Articles and Equipment For General Physical Exercise, Gymnastics, Athletics, Other Sports (Including Table-Tennis) or Out-Door Games, Not Specified or Included Elsewhere in this Chapter; Swimming Pools and Paddling Pools: Other: Other	41
95069960	Sports Nets	15
95069920	Leg Pads and Bats For Cricket	12
95066210	Articles and Equipment For General Physical Exercise, Gymnastics, Athletics, Other	8

	Sports (Including Table-Tennis) or Out-Door Games, Not Specified or Included Elsewhere in This Chapter; Swimming Pools and Paddling Pools: Inflatable: Football	
62111200	Swimwear: Women's or Girls'	4
Share of top five items		81

Articles and Equipment for General Physical Exercise, Gymnastics, Athletics, Other Sports (95069990) have largest value in 2019-20 with a share of 41% in India's Sportech exports.

Top five exported products have a share of 81% of total value of Sportech exports which implies that exports in this segment are concentrated among few products.

Table 13.56: Five countries with largest imports of Indian Sportech items (2019-20)

Country	Total Value of Imports (Rs. Crores)	Share in total exports (%)
UK	180	20.9
USA	173	20.1
Australia	98	11.4
Germany	48	5.5
South Africa	30	3.5
Total	528	61.4

UK was the leading importer of Indian Sportech goods in 2019-20 and it had a share of 21% of India's exports. However, its share has decreased from 25% in 2012-13 to 21% in 2019-20. USA is the second largest importer of Indian Sportech goods in 2019-20 with a share of 20%. The share of USA has increased from 15% in 2012-13 to 20% in 2019-20.

Australia, Germany, and South Africa are also among the five leading importers of Indian Sportech products. Total exports to top five countries are around 61% it shows that exports in Sportech segment are moderately concentrated in terms of countries and therefore the exports in this segment are prone to country risks.

13.4.11.4 Import distribution across items and countries

Table 13.57: Import share of top five Sportech items in 2019-20 along with item description

ITC HS Code	Item Description	Share (%)
95069990	Articles and Equipment for General Physical Exercise, Gymnastics, Athletics, Other Sports (Including Table-Tennis) or Out-Door Games, Not Specified or Included Elsewhere In This Chapter; Swimming Pools and Paddling Pools: Other: Other	32
95065910	Other: Squash or Racquetball Badminton Rackets, Whether Strung	25
63061990	Other Tarpaulins, Awnings and Sunblind; Tents; Sails for Boats, Sailboards or Land craft; Camping Goods	7
61124100	Women's or Girls' Swimwear: of Synthetic Fibre	5

62029310	Women's or Girls' Overcoats, Car-Coats, Capes, Cloaks, Anoraks (Including Ski-Jackets), Windcheaters, Wind-Jackets and Similar Articles, Other Than Those of Heading 6204: Other: of Man-Made Fibres: Wind and Ski-Jackets, Windcheaters	5
Share of top five items		73

Articles and Equipment for General Physical Exercise, Gymnastics, Athletics, Other Sports (95069990) have the largest share of import value in 2019-20 at 32% of India's Sportech imports. The share of imports of top five Sportech products is 73% of the total in this category. It shows that imports of only a few products consume a major share of import bill.

Table 13.58: Five largest exporters of Sportech items to India (2019-20)

Country	Total Value of Exports (Rs. Crores)	Share in total imports (%)
China P RP	219	49.3
Japan	59	13.2
USA	22	4.9
Spain	16	3.5
Netherland	14	3.2
Total	329	74.0

China is the largest exporter of Sportech goods to India in 2019-20. China's share has decreased from more than 60% in 2012-13 to 49% in 2019-20. Japan, USA, Spain, and The Netherlands are other leading exporters of Sportech goods to India. The import from top five countries constitutes around 74% of India's imports in this segment. It highlights that India is highly dependent on a few countries for its imports.

13.5 Summary of International Trade of India's technical textiles industry

Eight Technical Textiles segments – Packtech, Clothtech, Hometech, Mobiltech, Protech, Agrotech, Sportech, and Buildtech have witnessed trade surplus during 2019-20. Indutech, Meditech, and Geotech segments have witnessed deficit during 2019-20.

Table 13.59: Surplus and Deficit segments (2019-20)

Surplus Segments		Deficit Segments
Agrotech Buildtech Clothtech Hometech	Mobiltech Packtech Protech Sportech	Indutech Meditech Geotech

Table 13.60: Fastest growing segments in terms of exports 2012-13 to 2019-20 (Rs. Crores)			
Segment	**CAGR of Exports**	**Exports in 2019-20**	**Exports in 2012-13**
Geotech	20.5%	247	67
Buildtech	19.5%	367	105
Meditech	14.0%	2,178	868
Protech	12.7%	882	382
Packtech	10.0%	17,185	8,844
Hometech	8.0%	9,497	5,525
Indutech	7.0%	9,924	6,160
Clothtech	5.6%	9,340	6,380
Mobiltech	3.7%	21,095	16,394
Sportech	3.0%	861	698
Agrotech	-2.4%	665	791
Total	6.6%	72,241	46,215

Indian technical textiles industry (based on 449 ITC HS codes considered here) has consistently witnessed trade surplus over the last eight years from 2012-13 to 2019-20. Exports have grown for ten segments out of total eleven segments in the eight-year period from 2012-13 to 2019-20. Exports have grown at around CAGR of 7% and the surplus value has increased from Rs. 15,210 Crore in 2012-13 to Rs. 20,644 Cr in 2019-20. Eight out of eleven segments have higher exports than imports in 2019-20. Mobiltech is the largest segment in terms of export value. Exports in Geotech, Buildtech, Meditech and Protech segments are rising at relatively faster rates (higher than CAGR of 10%) when compared to other segments. USA has emerged as the largest destination for exports of Indian technical textile products and it is followed by Germany and UK at second and third place respectively in terms of value of India's exports to them.

Table 13.61: Fastest growing segments in terms of imports from 2012-13 to 2019-20 (Rs. Crores)			
Segment	**CAGR of Imports**	**Imports in 2019-20**	**Imports in 2012-13**
Protech	18.7%	322	97
Meditech	13.2%	3,090	1,298
Geotech	12.7%	493	213
Hometech	12.3%	2,914	1,292
Agrotech	12.0%	139	63
Buildtech	12.0%	224	102
Packtech	11.2%	4,215	1,999
Indutech	11.1%	19,142	9,188
Clothtech	4.9%	2,491	1,778
Mobiltech	3.1%	18,122	14,615
Sportech	3.1%	445	360
Total	7.5%	51,597	31,005

Import of technical textile products by India has grown at a CAGR of about 7% from 2012-13 to 2019-20. However, the absolute growth in value of imports has been lower than absolute growth of value of exports thus translating into a growing trade surplus for India in technical textile products. Indutech is the largest segment in terms of import value. Imports for Protech, Meditech, and Geotech items are increasing at relatively faster rates as compared to that for other segments. The value of imports has increased for all segments from 2012-12 to 2019-20. China is the largest exporter of technical textile products to India and Korea and Germany are at second and third place respectively.

It can be seen that Geotech, Meditech and Protech segments have seen the highest growth during the eight-year period both in terms of exports and imports indicating a high potential for growth in the coming years. The items in Clothtech, Mobiltech and Sportech segments have seen a sluggish growth during the period under study. The Indutech, Meditech and Geotech segments have witnessed trade deficits indicating a critical need to scale up the domestic production for the items considered in these segments. The overall growth in imports over the study period is higher than the growth in exports. It indicates a need to boost the exports and create avenues for higher domestic output so as to also achieve import substitution a part of *Atmanirbhar Bharat* (Self-reliant India).

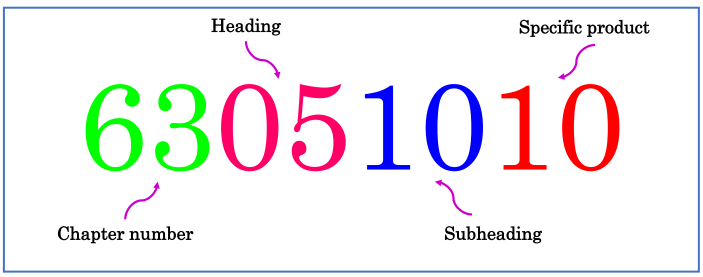
13.6 Identification of 449 HSN codes for Technical Textiles trade in India

13.6.1 Harmonized System of Nomenclature (HSN)

The Harmonized System (HS) is an internationally accepted standard for the classification of different products for facilitating monitoring of international trade data. This classification is often used to identify the rate of tax that needs to be levied and incentives which need to be provided for different products in the domestic and international markets. The HS codes are known as HSN codes in India. The HSN coding system is used to classify products and it consists of 8-digit codes along with their respective description. These codes are also referred to as ITC-HS codes where ITC stands for Indian Trade Classification or Indian Tariff Code.

The ITC-HSN codes are classified into 21 sections and divided into a total of 99 chapters where each chapter denotes a specific category of a product. These chapters are further categorised into headings, subheadings, and tariff items. As an example, one 8-digit code is specified as follows:

Figure 13.16: Representation of 8-digit HSN code



13.6.2 HSN codes for technical textile products

The HSN codes contained in Chapters 50 to 63 (Section XI of ITC HS Code Classification) are specifically assigned for textile and textile-based articles. Government of India has notified a list of 207 items specifically as technical textile items to help boost the growth of technical textile industry in India. The classification helps to monitor import and export data of technical textiles consistently and provide fiscal support to deserving Indian enterprises in an objective manner.

However, it was observed by IIT Delhi that the current coding system consisting of 207 HSN codes needed augmentation in order to be more representative of evolving range of technical textiles products. A committee consisting of in-house experts was constituted by IIT to deliberate upon each of the 207 codes and to propose a new and augmented scheme of codes.

13.6.3 Methodology used for revising HSN codes of technical textiles

13.6.3.1 Collection of ITC-HS codes

As a first step, identification was carried out for all the technical textile items from the exhaustive list of textile items that was compiled for the purpose. It was observed that many items of technical textiles so identified were not featured in the list of 207 HSN codes that Government of India had notified in January 2019 and which is the current basis of classification. An effort was made to identify more products and their respective ITC-HS codes which were appropriate for inclusion in a comprehensive list of technical textiles. Compilation of 532 ITC-HS codes was carried out using three different secondary databases:

- Government of India's Initiatives in Technical Textiles & Notification of HSN Codes for Technical Textiles by Ministry of Textiles, Government of India, 2019 (MOT)
- Baseline Survey of the technical textile industry in India by Office of the Textile Commissioner, 2016
- Enhancing Exports of Technical Textiles, EXIM Bank, 2018 (EXIM)

A total of 532 codes were earmarked for various technical textile products in these documents. In the observations by the team of experts from IIT Delhi, about these 532 codes are summarised in the table below. The EXIM report mentioned just the codes without corresponding descriptions, whereas the report of the Ministry of Textiles and the Baseline survey mentioned the codes along with their respective descriptions.

Table 13.62: Identification of 532 codes from three different sources

Specifications	Total Number
Common codes in all three sources	106
Unique codes in 207 HSN Code List (MOT)	16
Unique codes in Exim Report (EXIM)	32
Unique codes in Baseline Survey Report (BL)	257
Common codes in Baseline and EXIM Report	36
Common codes in 207 HSN Code List and EXIM Report	61
Common codes in 207 HSN Code List and Baseline Survey Report	24
Total	**532**

13.6.3.2 Rationalisation and revision of list of codes

The definitions of each of the 532 codes were carefully examined and discussed for their relevance in the context of technical textiles. It was noted that 28 codes from the 532 codes should be removed from the ITC (HS) 2017 chapters as these HSN codes undergo repeated revisions year after year. Therefore, these 28 ITC-HS codes were eliminated. There were 56 HSN codes which also were eliminated by the team of experts as in their view, those 56 codes did not represent items of technical textiles. There was One code assigned by Ministry of Textiles that was included in the list.

The list of HSN codes that is being recommended by the team of experts from IIT Delhi comprises 449 codes which include 207 codes already notified by Ministry of Textiles. The team at IIT Delhi team has analysed and segregated all the proposed 449 codes into various segments of technical textiles. It is to be noted that as of now, there no item that could be categorised as part of Oekotech segment.

Table 13.63: Total 449 HSN codes after revision

Specifications	Total Number
Unique in HSN Code (207)	16
Unique codes given by Ministry of Textile (MT)	1
Unique codes in Exim Report (EXIM)	21
Unique codes in Baseline Survey (BL)	186
Common codes in Baseline and EXIM Report	34
Common codes in HSN and EXIM Report	61
Common codes in HSN and Baseline Report	24
Common codes in all 207, EXIM, BL	106
Total	**449**

Annexure 1 and Annexure 2 present the proposed list of 449 codes with their description and segment classification.

Annexure 1 presents the codes and description of 207 items that have already been notified by the Ministry of Textiles, Government of India as technical textiles. It also contains the segment classification of each of these codes as per the experts from IIT Delhi and mentions all the differences that the proposed classification of codes has, as compared to the classification of codes that has been notified by the Ministry of Textiles.

Additional 242 codes (449 proposed less 207 notified) that are proposed have been presented in Annexure 2 along with their individual segment classification as proposed by IIT Delhi.

14. International Trade of Technical Textiles & India's contribution

The status of international trade of technical textile products and India's position in it needs to be understood to enable better positioning of India in the international market. An analysis of data of international market has been carried out specifically for the products that are important from India's standpoint. The trends in exports of products reflect the market demand for the products and also help in identifying the countries that are world leaders in the market for respective technical textile products.

This export analysis is expected to be of use to policy makers within the Government, policy influencers outside the Government and business firms associated which are or desire to be a part of the technical textile industry.

14.1 Export Data

Export data of 63 key products of technical textiles using classification based on HS (Harmonized System) Codes is presented in the tables below. The data has been sourced from WITS (World Integrated Trade Solutions) Database provided by World Bank, UN (United Nations) Comtrade Database and ITC Trade Map. The HS Codes used to extract data from these global databases are 6-digit codes; the first two digits indicate the chapter the goods are classified in, the second two digits indicate the groupings within the chapter and the last two digits further subgroup the product categories.

Table 14.1: Export data based on HS Codes of 63 key products (US$ Million)

S. No.	Name of key product	HS Code	2018 (World)	2019 (World)	2018 (India)	2019 (India)	% share of India (2018)	% share of India (2019)
1	Crop Covers*	392690	75,765.76	75,524.22	543.58	591.18	0.72%	0.78%
2	Fishing Nets	560811	891.16	1,410.67	58.93	63.55	6.61%	4.51%
3	Mulch Mats	530500	484.31	496.75	252.87	271.43	52.21%	54.64%
4	Shade Nets*'	392690	75,765.76	75,524.22	543.58	591.18	0.72%	0.78%
		560819	1,086.21	1,000.74	9.77	10.67	0.90%	1.07%
5	Architectural Membranes	392190	17,573.26	17,165.79	302.32	333.88	1.72%	1.95%
6	Awnings and Canopy	761090	10,707.74	10,574.01	30.63	26.39	0.29%	0.25%
7	Canvas Tarpaulin	630619	391.47	409.88	3.30	2.31	0.84%	0.56%
8	Scaffolding Nets'	560819	1,086.21	1,000.74	9.77	10.67	0.90%	1.07%
9	Interlining	590390	4,358.74	4,328.01	46.34	65.59	1.06%	1.52%

S. No.	Name of key product	HS Code	2018 (World)	2019 (World)	2018 (India)	2019 (India)	% share of India (2018)	% share of India (2019)
10	Elastic Narrow Tape	600290	136.99	116.73	6.12	4.20	4.47%	3.60%
		580620	1,190.36	1,200.14	20.56	22.22	1.73%	1.85%
11	Labels and Badges"	580632	2,517.89	2,482.64	11.13	11.88	0.44%	0.48%
12	Specialised and Industrial Sewing Thread	540110	1,249.30	1,216.86	11.80	11.01	0.94%	0.90%
		540120	161.39	143.34	0.46	0.59	0.28%	0.41%
		550810	721.01	699.61	7.25	6.23	1.01%	0.89%
		550820	17.36	9.53	0.12	0.13	0.70%	1.33%
13	Umbrella Cloth (TT Component)	540710	1,680.54	1,589.06	152.83	152.83	9.09%	9.62%
14	Zip Fastener Tape (TT Component)	960720	1,101.22	1,058.05	25.39	18.94	2.31%	1.79%
15	Geogrids*	392690	75,765.76	75,524.22	543.58	591.18	0.72%	0.78%
16	Geomembranes and Geocomposites	392010	18,562.44	17,349.99	71.10	81.34	0.38%	0.47%
17	Geotubes#	591190	3,025.12	3,013.69	20.90	21.98	0.69%	0.73%
		392590	6,762.82	6,675.90	20.66	57.90	0.31%	0.87%
18	Blinds	392530	1,757.93	1,802.59	0.77	1.34	0.04%	0.07%
		630392	3,875.59	4,024.94	7.75	7.05	0.20%	0.18%
19	Carpet Backing Cloth	531010	92.48	89.40	72.55	72.34	78.44%	80.91%
20	Fibre Fill (Polyester Staple Fibre)	550390	684.81	745.60	0.03	0.17	0.00%	0.02%
		550320	5,017.11	4,382.74	321.03	295.01	6.40%	6.73%
21	Filter Fabric (HVAC and Vacuum Cleaner)#	591190	3,025.12	3,013.69	20.90	21.98	0.69%	0.73%
		842139	26,333.73	30,003.91	132.21	129.84	0.50%	0.43%
22	Mosquito Nets	630492	1,096.20	1,053.89	733.75	729.10	66.94%	69.18%
23	Nonwoven household Wipes	630710	2,417.77	2,460.94	38.08	33.22	1.57%	1.35%
24	Stuffed Toys (Plush Fabric)	950300	46,212.50	51,870.99	101.62	131.50	0.22%	0.25%
25	Conveyor Belts (TT Component)	401012	1,602.49	1,514.36	77.69	79.02	4.85%	5.22%
26	Decatising Cloth**	540710	1,501.77	1,427.50	147.35	152.83	9.81%	10.71%
27	Drive Belts (TT Component)	848390	12,054.80	11,598.42	169.78	146.16	1.41%	1.26%
28	Industrial Webbings & Slings	560749	928.21	920.46	71.93	77.39	7.75%	8.41%
29	Ropes and Cordages	560790	314.88	316.86	25.70	22.16	8.16%	6.99%
30	Baby Diapers^	961900	16,354.32	16,015.61	31.91	37.59	0.20%	0.23%
31	Ear Buds	630790	11,907.52	12,408.69	474.47	393.92	3.98%	3.17%
32	Extra Corporeal Devices##	901890	54,619.21	57,825.23	210.21	292.42	0.38%	0.51%
33	Incontinence Diapers^	961900	16,354.32	16,015.61	31.91	37.59	0.20%	0.23%

S. No.	Name of key product	HS Code	2018 (World)	2019 (World)	2018 (India)	2019 (India)	% share of India (2018)	% share of India (2019)
34	Orthopedic Implants^^	901850	4,272.81	4,290.55	22.62	25.87	0.53%	0.60%
35	Sanitary Napkins^	961900	16,354.32	16,015.61	31.91	37.59	0.20%	0.23%
36	Surgical Disposables^^	901850	4,272.81	4,290.55	22.62	25.87	0.53%	0.60%
37	Vascular Grafts##	901890	54,619.21	57,825.23	210.21	292.42	0.38%	0.51%
38	Wipes	481890	1,469.67	1,586.85	4.85	5.86	0.33%	0.37%
39	Airbags~	870899	93,054.82	86,880.29	2,769.67	2,633.07	2.98%	3.03%
40	Automotive Interior Carpets	391890	1,459.37	1,612.65	11.71	34.08	0.80%	2.11%
41	Car Body Covers	630790	11,907.52	12,408.69	474.47	393.92	3.98%	3.17%
42	Headliners (TT Component)~	870899	93,054.82	86,880.29	2,769.67	2,633.07	2.98%	3.03%
43	Insulation Felts (TT Component)	681510	5,631.33	5,961.99	0.73	0.73	0.01%	0.01%
44	Seat Belt Webbing	580632	2,234.21	2,232.08	0.04	0.03	0.00%	0.00%
45	Seat Cover Fabrics	630499	469.40	351.54	0.10	0.13	0.02%	0.04%
46	Sun visors/sunblind	630619	367.89	388.82	0.08	0.08	0.02%	0.02%
47	Tyre Cord Fabric	590210	1,389.40	1,226.42	0.15	0.15	0.01%	0.01%
48	FIBC	630532	2,355.36	2,243.75	0.17	0.15	0.01%	0.01%
49	Jute Hessian and Sacks	630510	193.77	179.03	0.07	0.08	0.04%	0.04%
50	Leno Bags	392329	5,132.61	5,141.74	0.03	0.02	0.00%	0.00%
51	Polyolefin Woven sacks	392321	11,662.74	11,114.87	0.03	0.04	0.00%	0.00%
52	Tea Bags filter paper	482320, 480540	889.49	865.87	0.47	0.39	0.05%	0.05%
53	Bullet Proof Jackets	621040	3,372.55	3,342.46	0.21	0.29	0.01%	0.01%
54	Fire Retardant apparel	621790	1,033.61	874.05	0.03	0.04	0.00%	0.00%
55	Fire Retardant Fabrics for furnishings	590320	6,010.65	5,799.93	0.02	0.03	0.00%	0.00%
56	High Visibility Clothing	630720	511.06	506.43	0.03	0.04	0.01%	0.01%
57	Industrial Gloves	611699	185.08	175.87	0.02	0.03	0.01%	0.01%
58	Artificial Turf	391890	1,423.33	1,592.07	0.21	0.29	0.01%	0.02%
59	High Performance Swimwear & Sportswear	950619	425.48	435.37	0.00	0.01	0.00%	0.00%
60	Parachute Fabrics**	540710	1,444.63	1,345.71	2.77	2.63	0.19%	0.20%
61	Sleeping Bags	940430	535.44	518.06	0.01	0.03	0.00%	0.01%
62	Sports Composites	950699	6,023.81	6,266.25	0.47	0.39	0.01%	0.01%
63	Tents	630629	332.76	324.24	2.77	2.63	0.83%	0.81%

Source: WITS Database*, UN Comtrade Database, ITC trade map*

Note: HS Code system comprises 6-digit codes and each such code represents broad range of products some of which may not be classified as technical textiles

14.2 Major Exporting Countries

The export data of the three major exporter countries for each of the 63 key products is presented in the table below. The data presented in the table indicates the relative dominance of various countries in the international market for the 63 key products.

Table 14.2: Major exporting countries for 63 key products (US$ Million)

S. No.	Name of key product	HS Code	Country (Rank 1)	2018	2019	Country (Rank 2)	2018	2019	Country (Rank 3)	2018	2019
1	Crop Covers*	392690	China	12440.68	14379.86	Germany	9008.08	8769.56	EU	8396.1	8345.28
2	Fishing Nets	560811	China	325.45	350.08	India	58.93	63.55	Korea	51.62	64.59
3	Mulch Mats	530500	India	252.87	271.43	Sri Lanka	40.47	160.65	Brazil	40.07	44
4	Shade Nets*'	392690	China	12440.68	14379.86	Germany	9008.08	8769.56	EU	8396.1	8345.28
		560819	China	341.89	353.91	EU	103.29	109.52	Vietnam	95.62	94.16
5	Architectural Membranes	392190	Germany	2258.1	2082.46	EU	2050.22	1970.47	USA	1241.35	1250.55
6	Awnings and Canopy	761090	China	2681.78	2816.76	Germany	1261.31	1325.12	EU	1201.62	1171.9
7	Canvas Tarpaulin	630619	China	206.65	205.42	Poland	35.58	34.34	EU	19.14	19.53
8	Scaffolding Nets'	560819	China	341.89	353.91	EU	103.29	109.52	Vietnam	95.62	94.16
9	Interlining	590390	China	1046.12	1084.56	Germany	609.14	562.63	EU	543.41	536.73
10	Elastic Narrow Tape	600290	China	32.46	31.39	Hong Kong	23.4	25.03	Italy	10.28	8.16
		580620	China	429.47	443.36	Hong Kong	209.95	204.88	EU	80.86	74.43
11	Labels and Badges"	580632	China	686.54	738	Germany	230.36	224.39	EU	223.79	221.47
12	Specialised and Industrial Sewing Thread	540110	China	274.81	298.43	Germany	189.11	170.22	EU	148.39	144.17
		540120	China	101.71	93.44	Germany	14.36	12.91	EU	11.39	9.47
		550810	China	427.28	416.9	Hong Kong	56.35	53.5	EU	26.1	22.44
		550820	China	2.04	2.37	EU	1.32	1.78	Spain	1.27	1.47
13	Umbrella Cloth (TT Component)	540710	Germany	173.88	171.63	EU	185.81	165.18	India	154.78	152.83
14	Zip Fastener Tape (TT Component)	960720	China	292.79	312.45	Japan	217.94	173.4	Indonesia	86.1	85.72
15	Geogrids*	392690	China	12440.68	14379.86	Germany	9008.08	8769.56	EU	8396.1	8345.28
16	Geomembranes and Geocomposites	392010	Germany	2340.06	2163.71	EU	1991.71	1906.18	China	1603.5	1784.99
17	Geotubes#	591190	USA	416.17	428.64	China	388.62	418.99	EU	393.06	418.99
		392590	China	1150.19	1336.04	Germany	1099.93	1039.19	EU	681.66	633.85
18	Blinds	392530	China	483.88	452.34	Belgium	162.65	177.51	Mexico	151.05	165.66
		630392	China	2152.38	2287.34	Mexico	385.48	384.9	Germany	211.93	225.44
19	Carpet Backing Cloth	531010	India	77.56	72.34	China	2.21	4.51	Germany	2.77	2.51
20	Fibre Fill (Polyester Staple Fibre)	550390	Japan	143.94	140.12	China	121.48	126.13	Korea	103.31	111.59
		550320	China	1237.36	1042.95	Korea	1130.83	881.41	Thailand	407.37	371.03

S. No.	Name of key product	HS Code	Country (Rank 1)	2018	2019	Country (Rank 2)	2018	2019	Country (Rank 3)	2018	2019
21	Filter Fabric (HVAC and Vacuum Cleaner)#	591190	USA	416.17	428.64	China	388.62	418.99	EU	393.06	418.99
		842139	EU	4007.85	5212.53	Germany	4541.01	4940.77	USA	3496.2	3549.33
22	Mosquito Nets	630492	India	733.75	729.1	China	157.91	133.92	Germany	46.8	46.85
23	Nonwoven household Wipes	630710	China	1075.09	1133.8	Pakistan	441.71	407.89	Germany	132.48	137.4
24	Stuffed Toys (Plush Fabric)	950300	China	25467.88	31342.5	Czech Republic	2591.76	2691.96	Germany	2268.6	2270.01
25	Conveyor Belts (TT Component)	401012	China	476.4	463.19	Netherlands	150.62	138.69	USA	144.87	111.36
26	Decatising Cloth**	540710	Germany	174.2	171.72	India	147.35	152.83	USA	154.78	138.94
27	Drive Belts (TT Component)	848390	Germany	3022.86	2802.58	China	2406.34	2253.97	USA	1288.5	1341.42
28	Industrial Webbings and Slings	560749	China	247.26	240.31	India	71.93	77.39	Portugal	82.63	72.01
29	Ropes and Cordages	560790	China	79.65	84.68	Bangladesh	16.1	22.95	India	25.7	22.16
30	Baby Diapers^	961900	China	1801.59	2087.52	Germany	1519.15	1426.67	Poland	1059.9	1075.98
31	Ear Buds	630790	China	5132.26	5445.66	Vietnam	546.05	670.93	Germany	860.5	860.2
32	Extra Corporeal Devices##	901890	USA	13195.29	14259.38	Germany	6827.51	6940.28	Netherlands	4364.0	5106.9
33	Incontinence Diapers^	961900	China	1801.59	2087.52	Germany	1519.15	1426.67	Poland	1059.9	1075.98
34	Orthopedic Implants^^	901850	USA	1099.04	1112.02	Germany	777.53	844.07	Netherlands	303.85	322.87
35	Sanitary Napkins^	961900	China	1801.59	2087.52	Germany	1519.15	1426.67	Poland	1059.9	1075.98
36	Surgical Disposables^^	901850	USA	1099.04	1112.02	Germany	777.53	844.07	Netherlands	303.85	322.87
37	Vascular Grafts##	901890	USA	13195.29	14259.38	Germany	6827.51	6940.28	Netherlands	4364.0	5106.9
38	Wipes	481890	China	374.18	409.75	Germany	120.92	127.96	Netherlands	82.12	85.02
39	Airbags (TT Component) ~	870899	USA	10078.03	9213.64	Korea, Republic of	8570.78	8681.57	Germany	9219.5	7979.54
40	Automotive Interior Carpets	391890	China	892.92	1073.96	Germany	80.66	77.46	Taipei, Chinese	48.33	51.97
41	Car Body Covers	630790	China	5132.26	5445.66	Vietnam	546.05	670.93	Germany	860.5	860.2
42	Headliners (TT Component) ~	870899	USA	10078.03	9213.64	Korea, Republic of	8570.78	8681.57	Germany	9219.5	7979.54
43	Insulation Felts (TT Component)	681510	USA	1260.37	1432.01	Germany	1067.43	1091.96	Japan	782.7	830.64
44	Seat Belt Webbing"	580632	China	686.54	738	Germany	230.36	224.39	USA	173.09	153.4
45	Seat Cover Fabrics	630499	India	33.83	47.11	China	76.13	50.13	Czechia	30.57	36.25
46	Sun visors/sunblind	630619	China	206.65	205.42	Poland	35.58	34.34	Germany	9.67	9.61
47	Tyre Cord Fabric	590210	China	439.58	380.83	Turkey	75.87	75	USA	71.51	44.97
48	FIBC	630532	India	726.55	702.57	China	557.86	501.49	Turkey	212.65	184.72

S. No.	Name of key product	HS Code	Country (Rank 1)	2018	2019	Country (Rank 2)	2018	2019	Country (Rank 3)	2018	2019
49	Jute Hessian and Sacks	630510	India	119.88	110.92	Pakistan	3.48	10.21	China	5.94	5.01
50	Leno Bags	392329	China	1232.63	1458.33	India	344.67	380.96	Italy	351.88	328.87
51	Polyolefin Woven sacks	392321	China	2928.07	2624.29	Germany	1048.9	987.58	USA	773.12	746.11
52	Tea Bags filter paper	482320 480540	Germany	221.82	206.41	Italy	144.65	135.56	UK	132.12	114.74
53	Bullet Proof Jackets	621040	China	1673.63	1560.05	Italy	199.44	184.6	Germany	184.36	206.99
54	Fire Retardant apparel	621790	Republic of Korea	332.59	302.52	Spain	112.09	64.28	Italy	103.74	94.65
55	Fire Retardant Fabrics for furnishings	590320	China	2236.76	2310.09	Republic of Korea	602.87	554.61	USA	511.28	457.43
56	High Visibility Clothing	630720	China	217.61	229.55	Poland	48.43	32.04	USA	27.24	24.22
57	Industrial Gloves	611699	China	98.61	90.5	Pakistan	17.67	16.1	India	5.03	5.18
58	Artificial Turf	391890	China	892.92	1073.96	Germany	80.93	77.93	USA	62.22	63.65
59	High Performance Swimwear and Sportswear	950619	China	128.34	144.64	France	32.69	34.58	Italy	24.64	22.02
60	Parachute Fabrics**	540710	Germany	173.88	171.63	India	147.04	152.83	USA	154.78	138.94
61	Sleeping Bags	940430	China	353.26	347.94	Germany	21.99	20.52	Spain	24.37	12.79
62	Sports Composites	950699	China	2264.52	2560.53	USA	502.9	504.46	Germany	307.06	283.51
63	Tents	630629	China	114.89	115.75	Pakistan	55.16	46.32	USA	22.75	13.73

Source: WITS Database, UN Comtrade Database, ITC Trade Map, Analysis by IIT Delhi

China is the world's leading exporter for 39 out 63 key products whereas USA dominates international export market of eight key products and Germany is the foremost exporter in seven key products. India is the top exporter for four key products as per the code based data extracted and analysed from sources that were referred to conduct this analysis.

* Crop Covers, Shade Nets and Geogrids fall under the same code 392690 which contains items titled 'other articles of plastics and articles of other materials of heading 3901 to 3914

′ Shade Nets and Scaffolding Nets fall under the same code 560819 which contains items titled 'Knotted netting, nets not fishing of manmade textiles'

″ Labels and Badges and Seat Belt Webbing fall under the same code 580632 which contains items titled 'Woven fabric manmade fibres, less than 30 cm. wide'

Geotubes and Filter fabric (HVAC and Vacuum Cleaner) fall under the same code 591190 which contains items titled 'Textile products and articles, for technical uses, specified in Note 7'

** Decatising Cloth and Parachute Fabrics fall under the same code 540710 which contains items titled 'Woven fabrics obtained from high tenacity yarn of nylon or other polyamides or of polyesters'

^ Baby Diapers, Incontinence Diapers and Sanitary Napkins fall under the same code 961900 which contains items titled 'Sanitary towels (Pads) and tampons, napkins and napkin liners for babies and similar articles of any material'

Extra Corporeal Devices and Vascular Grafts fall under the same code 901890 which contains items titled 'Other instruments and appliances'

^^ Orthopaedic Implants and Surgical Disposables fall under the same code 901850 which contains items titled 'Other ophthalmic instruments and appliances'

~ Airbags and Headliners fall under the same code 870899 which contains items titled 'Parts and accessories of closed die forged steel, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles

63 products were classified as key products of technical textiles on the basis of volume of their global trade as well as their export potential for India. High trade potential was identified on the basis of reasonably high demand and/or production capacity in India. China, the European Union, Germany, India and the USA are major exporters of the identified key products. India's share as a percentage of total world export is highest for carpet backing cloth at 80.91%. India is also a major exporter of mosquito nets and mulch mats with a share of 69.18% and 54.64% respectively in world exports. India has significant share in export of industrial webbings and slings, decatising cloth, umbrella cloth, and ropes and cordages as well.

It is also observed that India's share in exports for a large number of products is minuscule at less than 1% contribution (Awnings and canopy, geomembranes, tyre cord fabric) for each; in some cases, it is nearly at zero percent (High performance swimwear and seat belt webbing). This implies a huge untapped potential for the Indian manufacturers for increasing their share in global market for technical textile products.

15. National and State Policies and Schemes

15.1 Introduction

Ministry of Textiles (MoT), Government of India has been making efforts to facilitate the development of country's technical textiles industry. These efforts of the MoT have specially been aimed at supporting manufacturers, speeding up the growth rate of the industry, promoting exports, reducing dependence on imports, increasing the penetration level of the industry, inducing creativity, encouraging innovation, diversifying the applications of technical textiles products, improving skill levels of the manpower and attracting foreign investment into domestic technical textiles industry.

Many schemes and policies have been introduced in the last few years to give a fillip to the technical textiles industry.

15.2 National level policies and schemes

Major national level policies and schemes for India's technical textiles industry are summarised and presented in the following table.

Table 15.1: National level policies and schemes for technical textile industry

S. No.	Government initiative	Year of launch	Implementation period	Total outlay (Rs. Crores)	Main aim(s) & objective(s)
1	Technology Up-gradation Fund Scheme (TUFS) & Revised-Restructured Technology Up-gradation Fund Scheme (RR-TUFS)	1999	1 April 1999 - 28 June 2010 and 28 April 2011 - 31 March 2017	11,952 (for RR-TUFS)	It is meant for entire textile industry including technical textiles. Its objectives are: Leveraging investments in technology upgradation in the textile sector to enable Indian industry to face global competition with focus on balanced development across the value chain by (a) addressing the issues of fragmentation and promoting forward integration (b) promoting investments with smaller investment in MSME sectors; (c) introduction of a Hire Purchase Financing Model for weaving sector

2	Concessional custom duty for specified technical textiles machinery	2002	It is in force	-	To reduce the final cost of technical textile products produced by Indian manufacturers by imposing concessional rate of 5% for the customs duty paid on the listed machineries used for the manufacturing of the technical textile products
3	Scheme for Integrated Textile Parks (SITP)	2005	Launched in 2005. Latest extension was from 1 April 2017 to 31 March 2020	-	To provide the industry with world-class infrastructure facilities in integrated textile parks for setting up their textile units that will meet international environmental and social standards
4	Scheme for growth and development of technical textiles (SGDTT)	2007	2007-08 to 2010-11	46.60	To encourage investment in the technical textiles industry
5	Technology Mission for Technical Textiles (TMTT)	2010	2010-11 to 2014-15 Extended (2015-16 to 2016-17)	200	Standardisation, creating common testing facilities and indigenous development of prototypes and resource centres with IT infrastructure, market development support for technical textiles
6	Scheme for promoting usage of Agrotextiles in northeast region	2012	2012-13 to 2018-19	55	To encourage use of Agrotextiles in improving the agriculture, horticulture & floricultural produce of the north-eastern states through creating demonstration set-up
7	Scheme for promoting usage of geotechnical textiles in northeast region	2014	2014-15 to 2018-19 Extended till 2019-20	427	To promote the usage of geotextiles in infrastructure development in north-eastern states
8	Amended Technology Upgradation Fund Scheme for textiles industry (ATUFS)	2016	2015- 2016 to 2021-22	17,822	Meant for textile industry as a whole. Promoting investment in technology upgradation to enhance productivity, quality, employment, exports and import substitution in textiles industry. It will also indirectly promote investment in textile machinery manufacturing.
9	Samarth (Scheme For Capacity Building In Textile Sector)	2017	2017-18 to 2019-20	1,300	Meant for textile industry as a whole. To provide demand-driven, placement-oriented skilling programme to incentivise the efforts of the industry in creating jobs in the organised textile and related sectors to promote skilling and skill up-gradation in the traditional sectors. To provide livelihood opportunity.

10	Mandatory use of Technical Textiles	2019	-	-	Deriving the benefits of technical textiles in various fields of applications. Currently Ninety-Two (92) application areas have been identified for mandatory use across ten Central Ministries/Departments. Mandatory use notifications have been issued for 68 (sixty-eight) applications
11	Standardisation	2019	-	-	To improve the acceptability of Indian technical textile products. Bureau of Indian Standards (BIS) has published IS standards for 377 technical textiles products
12	Launch of 207 HSN Codes for technical textiles	2019	-	-	To improve monitoring of import-export data of technical textiles and to provide well-directed financial support to exporters of technical textiles and impose appropriate duties on imports as per their proper classification
13	Focus Product Incentive Scheme (FPIS)	2020	2020-21 to 2024-25	10,683	To incentivise export of 40 Manmade fibre (MMF) apparel and 10 technical textile products that have high export intensity or employment potential
14	National Technical Textiles Mission	2020	2020-21 to 2023-24 (4 years)	1,480	To position the country as a global leader in technical textiles Market. To take domestic market size of technical textiles industry to US$ 40-50 Bn by the year 2024 with an average growth rate of 15-20% per annum.

Source: Analysis by IIT Delhi

15.3 Details of the national policies and schemes

The details of the policies and schemes introduced for the technical textiles industry have been presented as follows:

15.3.1 Technology Upgradation Fund Scheme (TUFS)

This scheme was introduced in 1999 with an aim to leverage investments in technology upgradation by the firms in textile industry as a whole. Under this scheme, the government provided funds to previously existing as well as new manufacturing and processing units. The initial period of TUFS ended in 2004 and the scheme was further extended till 2007.

Modified Technology Upgradation Fund Scheme (MTUFS)

MTUFS was introduced for a period of five years (from 2007 to 2012). According to the modification made in the scheme, technical textiles manufacturing machinery was included under TUFS and was eligible for 5% interest reimbursement. The machinery specified for technical textiles was also made eligible for 10% capital subsidy in addition to 5% interest reimbursement.

MTUFS was discontinued between June 2010 and April 2011 to pave the way for 'Restructured Technology Upgradation Fund Scheme (RTUFS)'. Various subsidies amounting to Rs. 1,972 Crores were disbursed between 2011 and 2013. RTUFS attracted an investment of Rs. 37,655 Crores (as per the details in the UID application). Subsequently, the Government came out with the Revised Restructured Technology Upgradation Fund Scheme (RRTUFS). Under the provisions of that scheme, the benefits provided to technical textiles (including nonwoven) was 5% interest subsidy and 10% capital subsidy on specified machinery that was used for manufacture of technical textiles.

Amended Technology Upgradation Fund Scheme (ATUFS)

The union cabinet approved a new scheme, ATUFS in January 2016. The Government has updated the RRTUFS and brought it in alignment with its other initiatives such as 'Make in India' and 'Zero-effect and Zero-defect manufacturing'. The amendments have been made in terms of benefits and easing of claim procedures.

ATUFS provides a one-time capital subsidy for investments eligible benchmarked machinery in the employment and technology-intensive segments of textile value chain with a view to substitute imports and promote exports. The scheme is credit-linked and only those projects for technology upgradation that are financed by term loan sanctioned by the lending agencies will be eligible for grant of benefits under it.

Under this scheme, there are two broad categories:

- Apparel, garment and technical textiles: For these sub-sectors, a 15% subsidy is being provided on capital investment with a ceiling of Rs. 30 Crores for entrepreneurs over a period of five years.
- Remaining sub-sectors: For these sub-sectors, 10% subsidy is being provided with a ceiling of Rs. 20 Crores to entrepreneurs.

Budget provision of Rs.17,822 Crores has been approved for seven years from 2015-16 to 2021-22 to meet the committed liabilities of Rs.12,671 Crores and Rs.5,151 Crores for existing and new cases respectively under ATUFS. It is likely to attract an investment of Rs. 100,000 Crores and create more than 35 lakh jobs.

The scheme is implemented through web-based MIS system (i-TUFS) and subsidy is released directly to the unit after installation of machinery and inspection. 100% joint physical inspection to verify purchase of benchmarked machinery is done under the scheme.

As per the Annual report of 2020-21 of Ministry of Textiles, for the entire textile industry, 11107 UIDs have been issued with project cost of Rs. 46,860.70 Crores and provisional subsidy value of Rs. 3,378.06 Crores committed till 25.03.2021. Progress of ATUFS as regards only the technical textiles is given as under:

Table 15.2: Progress of ATUFS as regards technical textiles

S. No.	Segment Name	No. of UID Issued	Project Cost (Rs. Crores)	Subsidy Amount (Rs. Crores)	Employment		
					New	Existing	Total
1	Technical Textiles (15%)	403	2669.83	246.08	6221	20315	26536

The guideline of ATUFS has been revised on 02.08.2018 with a view to streamline the web-based process and to make i-TUFS an end-to-end solution in implementation of the scheme.

Following steps have been taken towards simplification of the processes:

1. Automatic UID generation
2. Submission of documents through digital signature
3. Less number of documents
4. Simplification of procedure for machinery enlistment
5. Uploading Geo-tagged and time stamped photographs in i-TUFS software during Joint Inspection Team (JIT) inspection
6. Subsidy released directly to beneficiary unit account through Public Financial Management System (PFMS)
7. Machine Identification Code engraved on machinery for identification

In addition, a number of steps have been taken to streamline the procedure and processing of JIT reports/subsidy claims under ATUFS.

iTUFS

Ministry of Textiles has introduced an online portal iTUFS (Integrated Software for Technology Upgradation Fund Scheme) in 2015, wherein applications for amended TUFS subsidy can be submitted. The portal helps in bringing transparency to the entire subsidy claim process. Other than the online portal, there is also an iTUFS mobile application, which is an android based app. The app can be used by any designated inspection officer of the Textiles Commissioner of India. It helps to monitor the physical progress of installation and commissioning of machines by beneficiaries so that they can prepare themselves for entitlement of the next instalment of financial assistance under TUFS schemes.

The timelines for various TUFS schemes are summarised in the table below.

Table 15.3: Technology Upgradation Funds schemes (TUFS) through the years

Name of the Scheme	Initial time-period	Extended time-period
TUFS	1 April 1999 - 31 March 2004	1 April 2004 - 31 March 2007
Modified TUFS	1 April 2007 - 31 March 2012	
Revised TUFS	28 April 2011 - 31 March 2012	1 April 2012 - 31 March 2013
Revised Restructured TUFS	1 April 2013 - 31 March 2017	
Amended TUFS	13 January 2016 - 31 March 2022	

Source: Analysis by IIT Delhi; TUFS was discontinued for 29 June 2010 – 27 April 2011

15.3.2 Scheme for Integrated Textile Parks (SITP)

The scheme was introduced in 2005 and its latest extension was from 2017 to 2020. The scheme provides for financial support for setting up textiles parks across the country. These parks are planned to have world-class, state-of-the-art infrastructure in textiles hubs. The main objective of the scheme is to increase investments, boost entrepreneurship by providing financial support, generate employment opportunities and expand exports in the textiles sector.

Under the provisions of this scheme, the proposed project cost covers common infrastructure and buildings for production/support activities (including textiles machinery, textiles engineering, accessories, packaging) depending on the needs of the Integrated Textiles Parks. The financial support from Government of India amounts to 40% of the project cost subject to a maximum of Rs. 40 Crores. However, GOI support will be provided at 90% of the project cost subject to a ceiling of Rs. 40 Crores for first two projects (each) in the States of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, Himachal Pradesh, Uttarakhand and UT of Ladakh and UT of Jammu & Kashmir.

The following five SITPs in the country are specifically dedicated to the technical textiles segment:

i. Goutham Budha Textiles Park Pvt. Ltd. (Andhra Pradesh)

ii. Great Indian Linen & Textiles Infra Structure Co. (P) Ltd. (Tamil Nadu)

iii. Mundra SEZ Integrated Textiles and Apparel Park Pvt. Ltd. (Gujarat)

iv. Pallavada Technical Textiles Park (Tamil Nadu)

v. Vraj Integrated Textiles Park Ltd. (Gujarat)

The detailed status of SITPs in technical textile industry has been presented in Section 22 of this report. It is observed that three of the five SITPs are functional viz. Mundra SEZ Integrated Textiles and Apparel Park Pvt. Ltd. (Gujarat), Pallavada Technical Textiles Park (Tamil Nadu) and Vraj Integrated Textiles Park Ltd. (Gujarat). It is reported that Pallavada Technical Textiles Park (Tamil Nadu) has requested Government of India to change its status from a textile park devoted to technical textiles to a textile park devoted to general textiles.

15.3.3 Scheme for Growth and Development of Technical Textiles (SGDTT)

SGDTT was launched during the XI Five Year Plan in 2007-08 with the aim of encouraging investments in the technical textiles industry. The total allocation of funds for the scheme was Rs.46.60 Crores and its tenure ended in the year 2010-11. The scheme had three main components:

i. Baseline Survey

ii. Awareness Campaigns

iii. Creation of four Centres of Excellence (CoE)

Table 15.4: List of four CoEs established initially under SGDTT			
S.No.	**Location of CoE**	**City, State**	**Segment**
1	South India Textiles Research Association (SITRA)	Coimbatore, Tamilnadu	Meditech
2	Synthetic & Art Silk Mills' Research Association (SASMIRA)	Mumbai, Maharashtra	Agrotech
3	Bombay Textiles Research Association (BTRA)	Mumbai, Maharashtra	Geotech
4	Northern India Textiles Research Association (NITRA)	Ghaziabad, Uttar Pradesh	Protech

15.3.4 Technology Mission for Technical Textiles (TMTT)

Ministry of Textiles, Government of India, launched Technology Mission for Technical Textiles (TMTT) in December 2010 for a time period of five years (2010-11 to 2014-15) with a financial outlay of Rs. 200 Crores. It was extended by another two years till 2016-17. This mission was aimed at eliminating the impediments obstructing the production of technical textiles in the country and to fulfil the increasing demand for these in the export as well as in domestic market. TMTT comprised of two Mini-Missions.

1. Mini Mission-I: It was aimed at standardisation, creation of common testing facilities, indigenous development of prototypes and establishment of Resource Centres with adequate IT infrastructure in eight Centres of Excellence (CoEs). It entailed creation of four new CoEs and upgradation of the existing four CoEs which were set up under SGDTT. The four new CoEs setup under Mini Mission-I are mentioned in table below:

Table 15.5: Four CoEs established under TMTT			
S. No.	**Location of CoE**	**City, State**	**Segment**
1	DKTE Society's Textile and Engineering Institute	Ichalkaranji, Maharashtra	Nonwoven
2	PSG College of Technology	Coimbatore, Tamil Nadu	Indutech
3	Ahmedabad Textile Industry's Research Association (ATIRA)	Ahmedabad, Gujarat	Composites
4	Wool Research Association (WRA)	Thane, Maharashtra	Sportech

2. Mini Mission-II: It focused on supporting development of domestic and export market for technical textiles by providing assistance for business start-ups, contract research, buyer-seller meets and participation in international exhibitions/seminars for technical textiles.

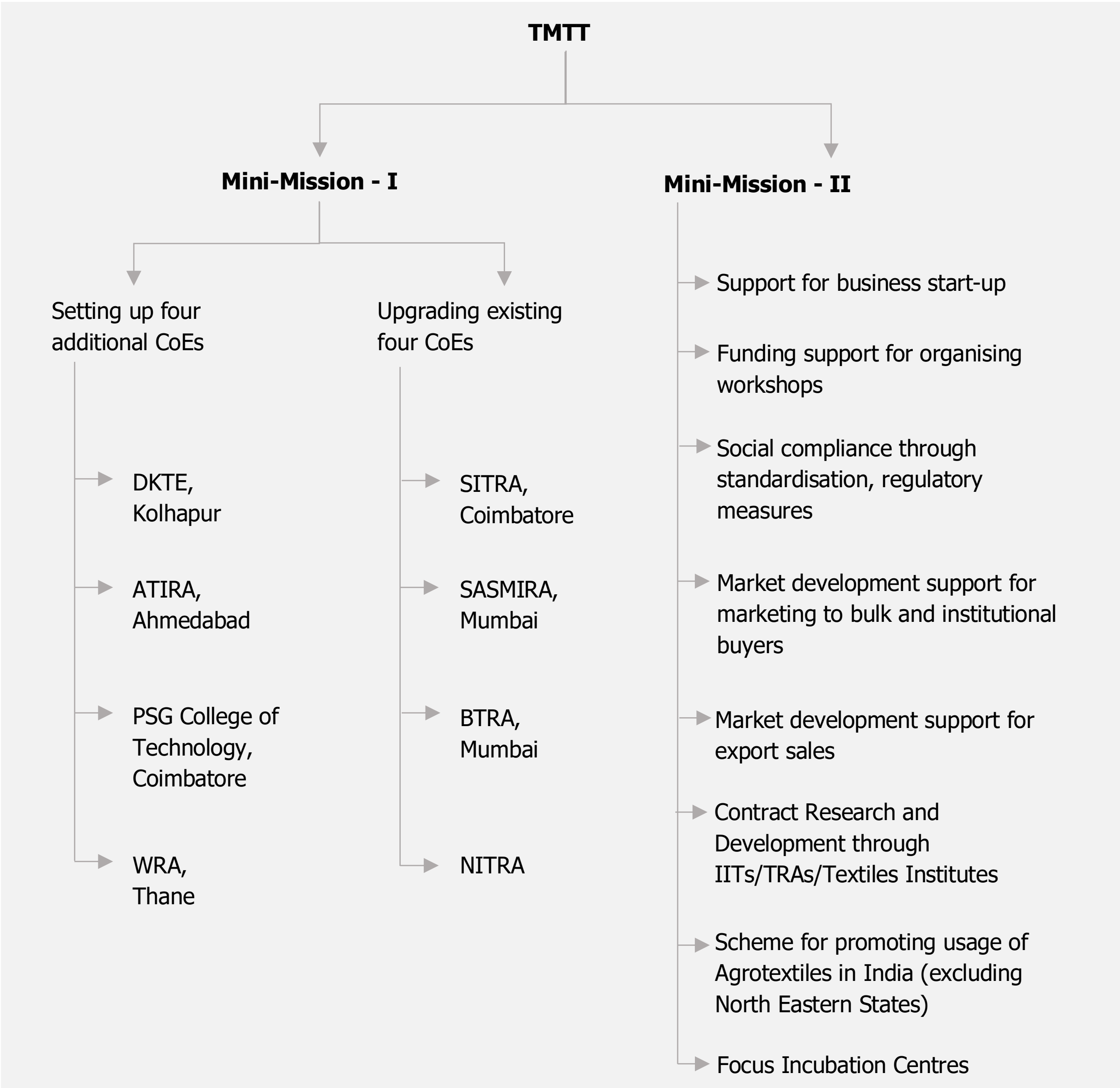
The following progress has been reported for the mission till FY 2018-19:

- 530 prototype samples have been developed
- 22147 persons have been trained in the industry

- 360 Technical consultancy assessments have been taken up
- 105 Detailed Project Reports (DPRs) have been prepared to set-up technical textiles units
- 654 training programmes/ seminars/ conferences have been organised
- 297 standards have been formulated

A schematic diagram regarding the two missions under TMTT is given in the figure below:

Figure 15.1: Details of TMTT scheme (Schematic representation)



Source: Analysis by IIT Delhi

As reported by the Ministry of Textiles, the scheme has met its objectives and it stands closed.

15.3.5 Scheme for promoting usage of Agrotextiles in Northeast Region

Ministry of Textiles launched a scheme in December 2012 which was aimed at encouraging the use of Agrotextiles in Northeast (NE) region. The scheme strives to improve horticulture, sericulture and floricultural produce in states of India's NE Region by utilising Agrotextile products. The scheme got operationalised in 2013 and had a fund allocation of Rs. 55 Crores.

The scheme had two components:

i. Component I: Create awareness, set up demonstration centres and developing capacities
ii. Component II: Distribute Agrotextile kits in NE region

Progress of the scheme as of FY 2019-20:

- A total of 44 demonstration centres were set up in NE region to promote the usage of agro textiles
- Against a target of 1242 Agrotextiles kits, 1218 were distributed
- An amount of Rs. 48.23 Crores was utilised

Financial progress of the scheme is given in the table below.

Table 15.6: Financial progress of the scheme for promoting usage of Agrotextiles in North East Region

Financial Year	Fund Allocation (Rs. Crores)	Expenditure (Rs. Crores)
2012-13	0.32	0.32
2013-14	Nil	Nil
2014-15	9.00	9.00
2015-16	10.00	10.00
2016-17	14.99	14.99
2017-18	9.99	8.15
2018-19	7.60	0.00
2019-20	3.10	5.77
Total	55.00	48.23

Source: Ministry of Textiles, Government of India

The major benefits reported (as per Annual Report 2019-20, Ministry of Textiles, Government of India) are:

i. 30-45% water conservation was achieved
ii. There was two-fold increase in farm productivity
iii. 60% Increase in farmers' income was reported

The scheme was closed in FY 2019-20.

15.3.6 Scheme for promoting the usage of Geotechnical textiles in the North East Region

Ministry of Textiles introduced a scheme for development of north-eastern states and give a boost to the use of products of Geotextile segment of technical textiles. The scheme has a total outlay of Rs. 427 Crores and was initially approved for implementation period of five years (from 2014-15 to 2018-19). The objective of the scheme was to promote the use of Geotextiles for infrastructure development in country's north-eastern states. Sikkim, even though a north-eastern state is outside the footprint of this scheme.

The scheme had two major components:

i. Component 1 (Geotextiles Material application) is aimed at promoting the use of Geotextiles in the northeastern region. Financial and technological support has been provided for infrastructure projects covering hill-slope protection, road construction, riverbank erosion control and lining of water reservoirs. The onsite installation accounted for Rs. 374 Crores of the total outlay of the scheme.
ii. Component 2 (Training and others) involves market studies, awareness campaigns, specification formulation, design solutions, site inspection and techno-economic viability studies, training, on-site testing and capacity building for skilling of workers in Geotextiles.

Under the scheme, 12 road projects, 11 water reservoir projects and 17 slope stabilisation projects were undertaken. Life of infrastructure that has been created has been observed to have increased and maintenance cost has reduced by as much as 50% in some cases. It was also found that there was a prevention of water loss to the extent of 30%.

The financial progress of the scheme is presented in the following table:

Table 15.7: Financial progress of the scheme for promoting the usage of Geotechnical textiles in the North East Region

Financial Year	Fund Allocation (Rs. Crores)	Expenditure (Rs. Crores)
2014-15	8.00	4.00
2015-16	15.00	3.63
2016-17	19.99	17.24
2017-18	19.82	19.82
2018-19	15.00	0.00
2019-20	10.01	1.42
Total	87.82	46.11

Source: Ministry of Textiles, Government of India

The scheme has been continued beyond its earlier conclusion date in order to meet the committed liability.

15.3.7 Launch of ITC Harmonized System of Nomenclature Code (HSN Code)

Ministry of Textiles, Government of India has classified and assigned 207 HSN Codes to technical textiles. The codes so assigned were notified in January 2019. Through the assignment of specific HSN codes to technical textiles, India intends to correct anomalies arising out of misclassification and improve the monitoring of imports and exports of technical textiles. It will also help in better targeting of financial and other relevant incentives to technical textiles manufacturers and rationalise the levying of custom duties on imports. In addition to these 207 codes, the Ministry is in the process of finalising more codes specific to technical textiles.

Table 15.8: Trade statistics for 207 technical textile items (Rs. Crores)

Period	Exports	Imports	Trade Balance (Exports-Imports)
2018-19	14,021.82	15,577.71	(1,555.89)
2019-20	12,924.32	14,290.58	(1366.26)
April-September 2020	6,539.84	4,772.33	1,767.51

15.3.8 Focus Product Incentive Scheme (FPIS)

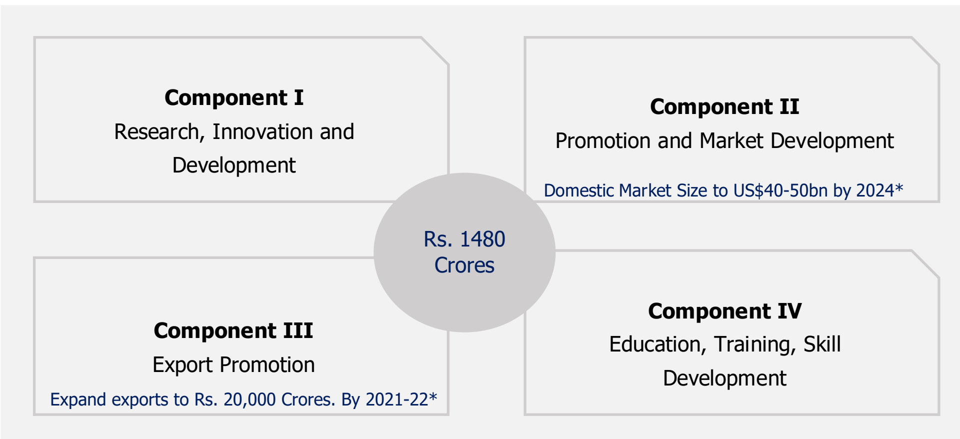
Government of India has approved Production-Linked Incentive (PLI) Scheme for 10 key sectors for improving India's manufacturing capabilities and competitiveness in global markets as a part of '*Aatmanirbhar Bharat'* initiative. Similarly, for Ministry of Textiles, a scheme called Focus Product Incentive Scheme (FPIS) has been approved in November 2020. The scheme will emphasise the promotion of 40 Man-made fibre (MMF) apparel and 10 technical textiles lines with the aim of creating 60-70 global champions. Financial outlay of Rs. 10,683 Crores over a period of five years has also been approved.

15.3.9 National Technical Textiles Mission

Ministry of Textiles, Government of India launched National Technical Textiles Mission in February 2020. This mission aims at increasing the domestic use of technical textiles so as to take domestic market of technical textiles industry to US$ 40-50 Bn by 2024 at an average growth rate of 15-20% per annum and also attaining a leading position in the global market for technical textiles. The total outlay approved for this mission is Rs. 1,480 Crores (US$ 194 Million). The four-year implementation period of this mission will be from FY 2020-21 to 2023-24.

The Mission will have four main components which are presented in the Figure below:

Figure 15.2: Four Components of National Technical Textiles Mission



Source: Analysis by IIT Delhi

a. Component I: Its focus is on research, development and innovation and has an outlay of Rs. 1,000 Crores. It includes fundamental research as well as application-based research in Agrotech, Geotech, Meditech, Mobiltech and Sportech. It will also focus on the development of bio-degradable technical textiles and indigenous textiles machinery. The fundamental research activities will be based on ‘pooled resource’ method and will be conducted in various Centre for Scientific & Industrial Research (CSIR) laboratories, Indian Institute of Technology (IIT) and other scientific/industrial/ academic laboratories of repute. Application based research will be conducted in CSIR, IIT, Research Design & Standards Organisation (RDSO) of Indian Railways, Indian Council of Agricultural Research (ICAR), Defence Research & Development Organisation (DRDO), National Aeronautical Laboratory (NAL), Indian Road Research Institute (IRRI) and other such reputed laboratories.

b. Component II: Its focus is on the promotion and development of the technical textiles market via collaborating at the international level, promoting investment and 'Make in India' initiatives. Indian technical textiles segment is estimated at USD 16 Billion which is approximately 6% of the 250 billion USD global technical textiles market. The penetration level of technical textiles is low in India varying between 5-10% against the level of 30-70% in developed countries. The mission aims to expand the current domestic market size from USD 16 Billion to USD 40-50 Billion by 2024, with an average growth rate of 15-20% per annum.

c. Component III: Its focus is on promoting exports and for this an Export Promotion Council for technical textiles will be set up. Technical textiles exports from India for FY 2018-19 are valued at Rs. 14,013 Crores and it is the aim of the mission to increase it to Rs. 20,000 Crores by FY 2021-22. In addition, the mission aims to maintain the average annual growth rate of 10% till FY 2023-24.

d. Component IV: Its focus is on education, training and skill development in the Indian technical textiles industry. It will promote technical education related to technical textiles and its application areas at higher engineering and technology levels.

The Mission will focus on usage of technical textiles in various flagship missions, programmes of the country including strategic sectors. Promotion of innovation amongst young engineering / technology/ science standards and graduates will be taken up by the mission; alongwith creation of innovation and incubation centres and promotion of ‘start-up’ and ‘ventures’. A sub-component of the research will focus on development of bio-degradable technical textiles materials, particularly for agro-textiles, geo-textiles and medical textiles. It will also develop suitable equipment for environmentally sustainable disposal of used technical textiles, with emphasis on safe disposal of medical and hygiene wastes. A Mission Directorate in the Ministry of Textiles headed by an eminent expert in the related field will be made operational.

15.3.10 Concessional custom duty for specific technical textiles machinery

Ministry of Textiles offers a concessional rate of 5% for the customs duty to be paid for major machinery required for technical textiles manufacturing. The list of 26 types of machinery placed under concessional customs duty has been notified.

15.3.11 Mandatory use of Technical Textiles

In order to promote domestic use of technical textiles and give a fillip to the market, Government of India has identified ninety two application areas for mandatory use across ten Central Ministries/Departments. So far, mandatory use notifications have been issued for sixty eight applications. The issuance of notification for twenty four areas is under process.

15.3.12 Standardisation of technical textiles

The Bureau of Indian Standards (BIS) has published Indian Standards (IS) for 377 technical textiles products. Details of the process and outcome of BIS efforts at establishing standards for technical textiles has been provided in Section 16 of this report.

15.3.13 Samarth (Scheme for Capacity Building in Textile Sector)

Indian textile industry is facing scarcity of skilled workers. In order to address the scarcity, Government of India has launched *Scheme for Capacity Building in Textile Sector (SCBTS)* and named it SAMARTH Scheme in 2017. The objectives of the scheme are to provide demand-driven, placement-oriented skilling programme to incentivise the efforts of the industry in creating jobs in the organised textile and related sectors to promote skilling and skill up-gradation in the traditional sectors through respective sectoral divisions/organisations of Ministry of Textile and to provide livelihood to all sections of the society across the country. The scheme aims to train 10 lakh persons over a period of 3 years (2017-20) and has an estimated budget of Rs. 1300 Crores.

The skilling programmes will be implemented through following implementing agencies:

- Textile Industry
- Institutions/Organisation of the Ministry of Textiles/State Governments having training infrastructure and placement tie-ups with textile industry
- Reputed training institutions/ NGOs/ Societies/ Trusts/ Organisations/ Companies /Start Ups / Entrepreneurs active in textile sector having placement tie-ups with textile industry

15.4 State level policies and schemes

15.4.1 Andhra Pradesh 'Revised Policy for Textiles and Apparel 2018-23'

Andhra Pradesh launched its 'Revised Policy for Textiles and Apparel 2018-23' with the following aims:

(a) To convert the major portion of yarn produced in the State into Fabric and Garments within the State

(b) To promote the State as a destination for global textile majors

This policy has the following targets:

(a) To attract new investments in value added textile activities worth Rs. 15,000 Crores by 2023

(b) Create employment for 2.5 lakh people by 2023

Benefits and incentives that the state government offers under this policy are as follows:

i. Land and infrastructure support: For new enterprises-
   a. 50 percent of the land cost or 5 percent of the project cost, whichever is less
   b. 25 percent of external infrastructure cost for standalone projects not allotted land in the Industrial Parks/Textile Parks with maximum capping according to category

ii. Capital Subsidy: New /Expansion enterprises will be eligible for capital subsidy ranging from 10-20 percent with upper limits of Rs. 15-50 Crores depending on the Fixed Capital Investment (FCI).

iii. Interest Subvention (Interest Subsidy): Interest subsidy @ 8% per annum for weaving units, preparatory units, knitting units, processing units, technical textiles and integrated units (with investment matching. Interest subsidy will be for 7 years with a moratorium of 2 years.

iv. Skill Support: One-time grant amounting to 50 percent of the training cost with an upper limit of Rs. 7500-10000 (depending on the scale of project) will be provided for the persons trained and employed in the unit.
   a. To boost skill development in the sector, financial assistance of 75 percent of the project cost with a maximum limit of Rs. 4 Crores has been provided to training institutions for setting up new training facilities in the state.

v. Power cost Reimbursement (Power Subsidy): Power cost reimbursement @ Rs.2/- per unit for a period of 5 years from the date of commencement of commercial production for value added activities such for weaving units, preparatory units, knitting units, processing units, technical textiles, Integrated units (with investment matching) in addition to standalone garmenting and apparel units.

vi. Employment Based Incentives: New /Expansion Enterprises engaged in the production for value added activities such as for weaving units, preparatory units, knitting, processing units, technical textiles, integrated units (with investment matching) in addition to standalone garmenting and apparel units and generating employment for people of Andhra Pradesh domicile will be eligible for monthly employment subsidy for the employees ranging from Rs. 1,000- Rs. 3,750 on the rolls, for a period of 5 years for all activities in textile value chain (except ginning and spinning).

15.4.2 Bihar Industrial Investment Promotion Policy, 2016 for High Priority Sectors

The Industrial Investment Promotion Policy 2016 has an integrated approach to industrial growth in the state and gives investors coming to Bihar a wide range of benefits.

Provisions relevant to technical textiles in Bihar as per the policy are as follows:

- Technical textiles have been recognised as a high priority sector in this policy
- The Bihar Government has provided investment opportunities for twelve segments of technical textile sector along with following two special segments:
    - Multi-processing units for banana fibres and the production of goods such as fabric and other items using banana fibres.
    - Combined processing units for jute fibres and the manufacture of goods such as cloth and other objects using jute fibres.

Package of incentives that are beneficial specially for technical textile units in Bihar

i. 10% return on interest guarantees or real interest rates on term loans (the lower one) will be available to high priority sectors

ii. The total capital subsidy would be 50 % of the approved project bill. The upper limit of capital for this subsidy is Rs. 20 Crores.

iii. The State Government shall provide a skill development subsidy of Rs. 20,000 per employee/ Bihar Skill Development Mission (BSDM) rates whichever is lower.

iv. The State Government is now expanding the assistance of the Project Management Unit (PMU) to High Priority Sector Units. These units will aim to promote investment plans and to support entrepreneurs and developers in setting up their state units.

v. With an investment of Rs. 42.36 Crores, a jute park is being set up in Maranga, Purnea by registered SPV M/s Punrasar Jute Park Ltd. The state government has given 44.30 acres of land as equity and Rs. 2 Crores as a grant under the PPP mode. Two units viz. M/s Tirupati Commodities Private Ltd. & M/s Punrasar Jute Park Training Centre have been developed and are functional in the jute park at the moment. Jute thread, jute twine, jute cloth and other jute items are produced by them.

15.4.3 Gujarat State Scheme for Assistance to Strengthen Specific Sectors in the Textile Value Chain (2018-23) [Extension to Gujarat Textile Policy, 2012]

Government of Gujarat announced 'Gujarat Textile Policy 2012-17' which was later extended till 2018. The objective of the policy was to have an integrated approach to strengthen the (textile) value chain - "Farm to Fibre to Fabric to Fashion to Foreign" (5 Fs), which will enhance sustainable growth of farmers and industry. The policy provided for interest subsidy for value-addition chain from ginning to spinning, weaving, processing, garment manufacturing and technology up-gradation. It provided power tariff concession for new cotton spinning and weaving units; gave financial assistance to Skill Development Centres for textile industry and offered financial assistance for technology acquisition for value chain. It provided for 'Credit linked Interest Subsidy in Technical Textiles' with maximum interest subsidy at the rate of 6 percent per annum, for a period of 5 (five) years or for the period of repayment of loan whichever is earlier. The scheme aimed to benefit those units who had taken term loans from banks and financial institutions. There were extra benefits provided by the Government of Gujarat for purchase of machinery (towards technology upgradation). These benefits were over and above the benefits provided by Government of India under its Technology Upgradation Scheme for textiles.

Government of Gujarat has implemented 'Scheme for Assistance to Strengthen Specific Sectors in the Textile Value Chain (2018-23). It provides for the following schemes for the textile industry as a whole:

Scheme I – Interest subsidy

The scheme will be known as financial assistance by way of credit linked interest subsidy for term loans taken from scheduled commercial/cooperative banks recognised by the RBI by the enterprises for eligible activities (New enterprise, expansion and forward/backward integration). The rate of interest subsidy is 6 percent for MSMEs and varies from 4-6 percent for Non-MSME enterprises depending on the number of people for which the employment is generated by the non-MSME enterprises. The maximum limit on amount of interest subsidy is Rs. 20 Crores per annum and the maximum duration permitted is 5 years.

Scheme 2 – Power tariff subsidy

Enterprises will be eligible for a Power Tariff Subsidy for a status of new enterprise, expansion and forward/backward integration. The subsidy will be Rs. 3 (for LT power connection) and Rs. 2 (for HT power connection) for weaving activity. For enterprises engaged in non-weaving activities, the power subsidy will be Rs. 2 per unit.

Scheme 3 – Assistance for environment and water conservation and environmental compliances

Assistance of 20 % of cost of machinery and equipment with a maximum of upto Rs. 30 lakhs can be provided. It will be applicable separately in each case of energy conservation, water conservation and environment compliance. Assistance of 50 percent of the fee paid towards energy audit up to maximum of Rs. 1 Lakh can be provided separately in each case of audit.

Scheme 4 – Assistance for technology acquisition and upgradation

The enterprises acquiring new or improved or upgraded technology either indigenously or imported from recognised R & D institutions or collaborators will be considered eligible under the scheme. Mere import of machinery or technology will not be considered as technology acquisition or upgradation.

Financial assistance of up to 50 percent of the investment for technology acquisition/upgradation, with maximum of Rs. 25 lakhs can be provided once during operative period of the scheme.

Scheme 5 – Support for establishing textile park

The textile park will be provided financial assistance @ 25 percent of capital expenditure for establishing common facilities, common infrastructure and additional infrastructure (except land cost), maximum up to Rs. 15 crores. The developer of park will be eligible for reimbursement of 100 percent of stamp duty paid on purchase of land required for the new park. The individual enterprise which is set up in the park will also be eligible for reimbursement of 100 percent stamp duty paid on purchase of plot/shed in the textile park. In addition to this, the park will be provided financial assistance @ 25 percent of the cost of Hostel/ Dormitory Housing within the park for a minimum of 100 workers domiciled in Gujarat, up to a maximum of Rs. 7.50 Crores, if prior approval is obtained for the same.

State government of Gujarat does not have a specially formulated, separate, exclusively focused provisions and incentives for technical textiles despite having a good share in technical textile market.

Skill support

- The state Government shall provide assistance for setting up a training institution of up to 85 percent of project cost subject to a maximum limit of Rs. 3 Crores.

Employment and employee related support

- To boost employment, the state Government shall provide 50 percent of the wages @ Rs. 4,000/- for female employee and Rs. 3,200 for male employee per month for a period of 5 years as payroll assistance to new enterprises. Moreover, an amendment has been passed for the provision of ramp-up period of 6 months to applicants to ensure that the industry gets maximum benefit of payroll assistance under the policy.

15.4.4 Haryana Textile Policy 2019

Haryana has announced its textile policy in 2019 according to which the following incentives are offered by the State Government:

i. Financial assistance or common facilities in Textile parks: 50% of total project cost with maximum limit of Rs. 10 Crores for establishing common infrastructure facilities. In addition, the park will be provided financial assistance @50% of project cost of Hostel/ Dormitory Housing for domicile workers maximum up to Rs. 2 Crores and @25% of the investment towards purchase of equipment and machinery (including installation cost) upto a maximum of Rs. 20 Lakhs for skill training of work force.

ii. In case of technical textile projects located in textile parks, capital subsidy @ 15 %, maximum up to Rs. 25 lakhs shall be provided on the eligible capital investment for new/expansion/diversification/ modernisation projects to all categories of such units.

iii. To attract Anchor units, capital subsidy @25 percent is provided, up to a maximum of Rs. 50 Crores. For technical textile projects, a subsidy of 15 percent is administered with a maximum of Rs. 25 Lakhs. Also, a capital subsidy @15 percent of Gross FCI is granted to textile machine manufacturers.

iv. Interest subsidy @3 percent per annum is allowed for textile machine manufacturers.

v. Collaboration with premier engineering and research institutes such as IIT Delhi for Skill Training/Entrepreneurship and New Product Development in 'Textiles' including Technical textiles.

vi. State government shall collaborate with IIT Delhi for reserving 20 seats per quarter for entrepreneurs from Haryana for skill training workshops at the Focus Incubation Centre for technical textiles.

vii. State government shall provide 50 percent sponsorship to these 20 entrepreneurs and in lieu of reserving these 20 seats, government shall additionally adequately reimburse the recurring expenses incurred by IIT Delhi for running this incubation centre subject to a ceiling.

viii. To encourage entrepreneurship in technical textiles, State Government shall reimburse 25% of cost (with a cap of Rs. 15 Lakhs/product) incurred by the entrepreneur for any such new product development in technical textile industry.

ix. There is a 100 percent reimbursement of stamp duty paid for units set up in certain specified locations.

x. An Employment Generation Subsidy is granted up to Rs. 36,000 per year per employee for 5 years or 20 percent of the SGST deposited, whichever is less , applicable to all categories of Textile enterprises.

15.4.5 J&K Start-up Policy 2018

J&K Industrial policy was announced in 2004 and it remained in force for next 10 years. In addition to this, a special incentive package for industrial growth was announced by Government of India in June 2002 and it was in force till June 2012. This tenure of the package was extended by GOI for further five years to carry on till 2017. Textile (especially silk and wool sector) areas were identified among thrust areas in this package. The 'J&K State Industrial Policy 2016' was announced with the objectives of strengthening the industry of J & K and create employment opportunities to attract bigger and larger investment. The tenure of the policy was envisaged at 10 years, i.e. up to 2026. In this policy, textile cluster was among the special focus activity. In 2018, J&K state administrative council (SAC) approved the 'J&K Start-up Policy 2018' to inspire young brains to pursue innovation and entrepreneurship, empower start-ups and generate employment opportunities. In this start-up policy, Textiles, Apparel & Fashion Technology have been identified as among the focus areas.

Apart from this, in the recent textile policy of 2020 by GOI two textile parks, J&K Textile Park and Kashmir Wool & Silk Textile Park in Kathua were proposed for operations.

There has not been any specific mention of technical textiles in any of the policies of J&K so far.

15.4.6 Jharkhand Textile, Apparel and Footwear Policy 2016

The Jharkhand state proposed its 'Industrial policy in 2001' to accelerate the flow of investment for industrial development in the state. Textile was identified as one of the thrust areas for industrial development. After the tenure of this policy, the state announced 'Industrial Policy 2012' with the objective of achieving a higher degree of development and reaching a higher rate of growth than had been envisaged earlier. In this policy, textile and apparel was identified as one of the focus areas. There was no separate mention of technical textiles in the policy. In the year 2016, the state government announced 'Jharkhand Textile, Apparel and

Footwear Policy 2016’ in which technical textile was identified as one of the major thrust areas for development.

Objectives of Jharkhand Textile, Apparel and Footwear Policy 2016 that concern technical textiles

- To pursue greater and sustainable development in the entire textile supply chain from fibre to finished goods, to improve and expand the capability of Technological Textiles' critical value chain and other supporting ancillary operations, including the development of textile machinery.
- To promote emerging technical textiles in key areas such as manufacturing, infrastructure and research and development.

Special incentives for technical textiles

i. The policy states that, “Jharkhand has the potential to become a global manufacturing centre for technical textiles and nonwovens, with a large domestic and foreign demand”.

ii. The Government of Jharkhand proposes that textile and apparel industrial units, including joint venture projects, PPP mode, State Government owned etc. may be encouraged to obtain access to all existing Government of India schemes such as Technology Up-gradation Fund Scheme (TUFS), Scheme for Integrated Textile Parks (SITP), Scheme for Integrated Skill Development etc.

iii. The Government of Jharkhand supports the creation of textile parks of more than 75 acres in size. This would facilitate textile units to meet international environmental and social standards.

iv. Centre of Excellence (CoE) for technical textiles: In a cooperative agreement with the Government of Jharkhand, a Centre of Excellence for textiles will be established in the State as the lead partner, properly supported by other institutions with the requisite capacity, such as the Bombay Textiles Research Association (BTRA) or any leading technical institution of the State. The State Government will finance the Centre of Excellence.

v. The CoE will assist manufacturers in the production of standard technical textile products and consumers with the most scientific adoption of technical textile products. Quality certification would also be provided by CoE for the production process and finished products.

vi. The CoE will help the units comply with international standards that would promote exports.

vii. An incubation centre will be created to catalyse new product creation, channel production and marketing activities of technical textile products. The incubation centre will offer to start-up an expanded basket of business strategies as well as a secure and appropriate venture space.

viii. Special attention shall be paid to the development of the fibres needed for technical textiles.

ix. The technical textile industry is eligible for a maximum capital subsidy rate of 15 per cent on machines per person agency of Rs. 30 Crores.

x. Land and infrastructure support: 50 percent rebate is allowed on land cost that will be disbursed during 5 years in 10 equal installments.

xi. Capital subsidy: To promote capital investment, a subsidy of 20 percent of investments made in fixed capital with an upper limit of Rs. 50 Crores is provided.

xii. Interest subsidy: Interest subsidy of 7 percent p.a. or 50 percent of interest per annum with maximum limit of Rs. 1 Crores for 7 years is allowed.

xiii. Power Cost Support: Support of @50 percent for 7 years on power tariff and 100 percent exemption on electricity duty for 7 years is granted.

xiv. Stamp Duty Exemption: There is a 100 percent exemption on stamp duty.

xv. Skill support: To facilitate training and skill development, a one-time support of Rs. 13000 (per worker) can be availed.

xvi. Quality certification and R&D support: To foster R&D, 50 percent of the cost incurred on BIS / ISO / SAS / LEED subject to a limit of Rs. 10 lakhs is provided. 50 percent of the cost incurred on patent registration, subject to a limit of Rs. 10 lakhs [of this, up to 4 lacs is on cost of patent filing etc.; the balance is payable on final registration of the patent] can be availed.

xvii. Employment and employee related support: Employee-related support activities constitute an assistance of 50 percent land cost with upper limit of 50 Lakhs for construction of dormitories.

15.4.7 Karnataka Textile and Garment Policy 2019-2024

Initially, the State Government came up with a 'Textile policy 2004-09' which was followed by a new 'Textile Policy 2008-13 (Suvarna Vastra Neethi 2008- 2013)' in order to overcome the deficiencies noticed in the first policy. Technical textiles and machinery manufacturing have been elaborately addressed in the Textile Policy 2008-13. However, once the policy period got over, the new Textile Policy- Nuthana Javali Neethi 2013-2018 was introduced and once again, the technical textile sector was elaborately mentioned and supported in the policy. The facilitating initiatives meant for new technological textiles in crucial aspects such as manufacturing, technology and research & development were the key focus areas of the strategy. After 2018, this policy has once again got improvised and the State government has brought out a new textile and garment policy 2019-24, with the aim to attract investment of ₹10,000 crore and generate five lakh jobs during the five-year period. It has goal to raise the Karnataka textile manufacturing market to national and international levels. The policy offers incentives to technical textile industry.

The objectives of New Textile Policy of Karnataka that specifically cover technical textiles are as follows:

- To achieve higher and sustainable growth in the technical textile industry through capital infusion, transfer of technology, world-class infrastructure and upgradation of skills.
- To give a boost to the local economy and develop a comprehensive textile ecosystem in the technological textile sector within the province.

Major strategy to upgrade technical textile industry which are a part of the policy are mentioned as follows:

- To give special focus on technical textiles as a thrust sector of the policy to create an internationally competitive textile industry in the State.
- To make Karnataka into a major production hub and a net exporter of technical textiles. At present, the units from Karnataka have a noticeable performance in Buildtech, Clothtech, Hometech and Meditech with Mysore, Hassan and Bangalore emerging as leading areas for growth in technical textile sector.

Specific support activities envisaged for technical textile sector are as follows:

- Set up a centre of excellence for technical textile in association with academia at a cost of Rs. 10 Crores
- Provide assistance for developing standards for TT products and for promoting more user adoption for TT products
- Provide encouragement to R&D projects in technical textile sector especially for that related to raw materials i.e. fibre manufacturing process
- Support the technical textiles industry through new product development, channelised production and market development strategies
- Spread information about technical textile products through awareness programmes, sample exhibition, publications and technical know-how to the manufacturers and users of the technical textile products

Following incentive schemes are also proposed for the technical textile industry:

Table 15.9: Classification of zones in Karnataka

Zones	Definitions
Zone 1	Entire Kalyana Karnataka Region, (Bidar, Kalburgi, Yadagiri, Raichur, Koppal and Bellary)
Zone 2	All areas other than Municipal Corporations, District Headquarters in Non Kalyana Karnataka Region
Zone 3	All Municipal Corporations and District Headquarters in Non Kalyana Karnataka Region
Zone 4	Bangalore Urban District

Table 15.10: Incentive schemes for technical textile sector as part of Karnataka State textile policy

S. No.	Nature of Incentive	Specific provisions for incentive for technical textile sector
1	Capital Subsidy	30, 25 and 20% are allowed for MSME Enterprise of zone 1, 2 and 3
		25, 20 and 15% are allowed for Large Enterprise of zone 1, 2 and 3
2	Power Subsidy	Reimbursement of cost of power paid at Rs. 1.0 per unit for a period of 5 years for both Large and MSME Enterprise located in zone 1,2 and 3
3	Setting up Centre of Excellence for Textiles / Technical Textiles	Grant of Rs. 10 Crores to be funded by the State Government

4	Interest Subsidy	5% per annum on term loans for the first 5 years for units in zone 1, 2 and 3
5	EPF and ESI Subsidy	75% reimbursement of employer's contribution of wage rate per employee per month for all the new units for 5 years for MSMEs located in zone 1,2 and 3
6	Effluent Treatment Plant	50% capital subsidy or Rs. 5 Crores whichever is less for establishment of Effluent Treatment Plants (ETPs) Covering an assistance up to 50 percent, a maximum limit of Rs. 50,000 for Energy Audit/Water Audit/Environmental Compliance (applicable in each case separately) is commissioned.
7	Stamp Duty Exemption and Concessional Registration Charges	Stamp duty exemption and concessional registration charges rate of Rs. 1.00 per Rs. 1000
8	Common Infrastructure for Greenfield Textile Park	One time grant support for development of common infrastructure for Greenfield Parks with individual promoters up to 25% of the project cost or Rs. 25 Crores per Park project, whichever is less (in all zones)
		One time grant support for the development of common infrastructure for Greenfield Parks of up to 40% of the project cost or Rs. 40.00 Crores per Park project, whichever is less (for SPV)
9	Common Infrastructure for Brown Field Textile Park	One time grant support for the development of common infrastructure for Brownfield Parks of up to 40% of the project cost or Rs. 12.00 Crores per Park project, whichever is less (for SPV)

Source: Unique Exim, Karnataka- Textile Policy 2020-25 for MSME and Large Industries

15.4.8 Kerala Industrial & Commercial Policy 2018

Kerala does not have a separate textile policy for the State. The provisions related to garment sector of textile was covered in the State's 'Industrial & Commercial Policy 2015'. There was no mention of technical textiles in that policy. The industrial policy of the State has been improvised into 'Kerala Industrial & Commercial Policy 2018' with the aim of transforming Kerala into a vibrant investment destination through eco-friendly and sustainable economic development with creation of employment opportunities with reasonable wages. In this policy, some aspects of technical textile sector, textile park, Geotech, industrial textile etc. have found a mention alongside the incentives that are offered by the State government. Some of the initiatives to be taken under the policy are as follows:

i. The Government of Kerala has proposed construction of industrial parks, which among others also have textile units so that the growth of textile industry can be encouraged in the State.

ii. Skills learning centres will be set up for the textile industry in conjunction with the industrial parks.

iii. Current efforts will be multiplied to promote the use of coir as Geotextiles for better conservation of water and soil. It is expected to increase its demand in the local market through MNREGA projects. If this is successful, the entire coir procured by Coirfed will be converted into coir net and used for water and soil conservation. This will be included under employment guarantee scheme and will help in meeting the aim of Hairtha Keralam (Green Kerala). The State Government intends to invest more efforts towards market development of coir fibres for Geotextile application.

iv. To promote infrastructure development, a fixed capital rebate of Rs.20-30 Lakhs depending on the category of unit for investment in land, building, plant & machinery, electrification, essential office equipment, pollution control devices and other fixed assets is facilitated.

15.4.9 Madhya Pradesh Industrial Promotion Policy 2014

Madhya Pradesh does not have a separate, exclusive textile policy. However, it has special provisions for textile & apparel industry as a part of the Industrial Promotion Policy 2014. The support and incentives offered are as follows:

One Time Incentive offered

i. Land Cost Rebate: The state provides 50-75 percent rebate on land premium depending on the land size requirement for MPIDC developed industrial areas. The percentage of rebate is dependent on the area of the land parcel. Rebate at the rate of 50 percent is also offered if undeveloped land parcel is leased from MPIDC - 50% rebate will be offered upto a fixed land size on the basis of investment categories given in the policy. Maximum area admissible for rebate is up-to 40 Hectares.

ii. Development Fee related subsidy for Apparel/Garment Sector: 50% discount in the development fee is offered in case of taking lease land in the industrial area.

iii. Fixed Capital Rebate: Investment Promotion Assistance (IPA): A tax delinked investment assistance is offered to large scale industries ranging from 40% to 10% of investment in plant and machinery with minimum investment of Rs. 10 Crores.

iv. Stamp Duty Exemption: Investor can demand for Stamp duty Exemption under customised package for Mega projects.

v. Reimbursement of Patent Charges: The state offers reimbursement of Patent Charges @100 percent upto an amount of Rs. 5 lakhs per patent.

vi. Infrastructure Development Subsidy: The state gives infrastructure development subsidy @50 percent with a maximum limit of Rs. 1.00 Crores each for developing water, power and roads infrastructure for private or undeveloped Govt. land.

vii. Assistance for Plant & Machinery, Expansion/Diversification/Technical Upgradation: The state offers VAT plus CST reimbursement with maximum ceiling of 100% investment in plant and machinery approved under TUFS scheme.

viii. On the technology upgradation front, support is available as per different categories of upgradation.

ix. SGST Reimbursement: MP has a tax-delinked policy. Investor can demand for SGST reimbursement under customised package for Mega projects.

x. Skill Development/ Training Incentive: Investor can demand for skill development/training incentive under customised package for Mega projects.

xi. Interest Cost Subvention/ Interest Subsidy for textile units: State offers to new textile units, an interest subsidy @2 percent for 5 years on term loan taken for TUFS approved P&M subject to ceiling of maximum Rs. 5 crores is offered for units having investment upto Rs. 25 Crores in Plant & Machinery. Whereas for existing stand-alone textile units with an investment of more than Rs. 25 Crores, the interest subsidy is available @ 5% for 5 years on term loan taken for TUFS approved P&M. The Composite textile unit with an investment more than Rs. 25 crores can avail interest subsidy @ 7% for 5 years on term loan taken for TUFS approved P&M.

xii. Power Tariff Rebate/Power Subsidy as well as Electricity Duty rebate: Investors can demand for power tariff rebate as well as electricity duty rebate under customised package for Mega projects.

15.4.10 Maharashtra Textile Policy 2018-23

Keeping the concept of 'Fibre to Fashion' in mind, the Government of Maharashtra declared its 'Textile Policy 2011-17' in January 2012. Technical textiles were not part of that policy. After this, the new 'Textile Strategy of the State for 2018-23' was unveiled. It is aimed at creating 10 lakh new jobs in the next 5 years and doubling the income of farmers by 2022. In this strategy document, technical textile is specifically mentioned as an emerging sector. As part of the strategy, 9% of project cost up to Rs. 25 Lakhs is provided to technical textile parks set up under Scheme for Integrated Textile Parks (SITP).

Objectives of 'Textile Strategy of the State for 2018-23' which are relevant to technical textiles

- Place special emphasis on emerging technical textiles market
- Provide textile industry with latest technological expertise established by institutions such as IITs, SASMIRA and WRA, which are actively involved in the textile industry's research & development.

Benefits and incentives for technical textiles units

i. Capital Subsidy: The capital subsidy for technical textiles units is presented in the table below.

Table 15.11: Subsidies offered to various categories of technical textile production units

Subsidy to units in	Technical Textile (% of eligible amount)
General category	40
SC/ST/Minority Category	45
Production of yarn, cloth and other non-conventional yarn products	10
Additional Capital	20
Units having Forward/Backward Integration	5

In addition to above, a 10 percent capital subsidy for textile units located in areas of Vidharbha, Marathwada and North Maharashtra can be availed.

ii. Interest subsidy: The state government will extend an interest subsidy so as to curtail effective rate of interest payable by eligible units to 0-2 percent.

iii. Power Cost Support: Power subsidy of Rs. 2.00 to Rs. 3.77 per unit shall be administered depending on the category of enterprise. All eligible news units in Group C, D and D+ areas and No-Industry district(s) and Naxalism affected areas will be exempted from the payment of electricity duty during the eligible time period, not exceeding 15 years.

iv. Technology upgradation support: A 5 percent subsidy on capital equipment for technology upgradation, subject to a maximum of Rs. 25 lakhs is extended. In addition, a 25 percent subsidy on capital equipment for cleaner production measures subject to a limit to Rs. 5 lakhs can also be availed.

v. Stamp Duty Exemption: Stamp duty exemption of 50 percent, 75 percent and 100 percent exemption is available to units depending on their category/classification.

vi. Skill Support: State Textile University is proposed to be set up in Vidarbha aimed at providing specialized courses in the focused sectors.

vii. Quality improvement and R&D: A 75 percent subsidy on expenses incurred on quality certification limited to Rs.1 lakh is allowed. Moreover, a 75 percent subsidy on the expenses incurred on patent registration with a capping of Rs.10 lakh is made available for the National patents and Rs.20 lakh for the International patents.

15.4.11 Odisha Industrial Policy Resolution 2015

The aim of State's industrial policy introduced in 2007 was to promote rapid industrialisation and facilitate more investment. Textile was one of the prominent industries that was focused on in that policy although there was no mention of technical textiles. The main objective of 'Industrial policy resolution 2015' was reinforcement and acceleration of the growth of various industries in the state. Textile and apparel sector was one of the prominent industries that was to be focused on. In this policy resolution of 2015, technical textile was mentioned in the context of industries proposed for Special Economic Zones (SEZ) that were planned to be set up. Technical textiles find mention in the industrial policy of Odisha as one of the priority sectors.

i. Land and Infrastructure Support: The government of Odisha promotes land availability at subsidised rates for all industries including textile industry.

   To boost the setting of anchor industrial units of a technology park, the policy provides subsidy of 25 percent on cost of land.

   The policy further exempts the industrial units from premium payment due to change of land-use charges as per below criteria:

   - 100 percent up to 100 acres and 50 percent for balance area

ii. Capital Subsidy: The capital subsidy will be 50 percent to the maximum limit of Rs 10 crores for green field industrial park/cluster and 50 percent to the maximum limit of Rs 5 crores for up-gradation of brown field clusters.

   For MSME sector, the capital subsidy will be 25 percent for general and 30 percent for SC/ ST.

Table 15.12: Capital Subsidy under Odisha Industrial Policy resolution 2015

Nature of Incentive	Provision of incentive	
Capital Subsidy for Plant and Machinery	Capital subsidy of 10% upto maximum as indicated based on employment and investment in Auto and Auto Components, Agro and Food Processing, Textile including Technical Textile & Apparel, Pharmaceuticals and Plastics sectors	
	Category of location	Maximum Capital Subsidy
	A1/ B1	10% of investment with a max. of Rs. 10.0 Crores
	A2/ B2	10% of investment with a max. of Rs. 20.0 Crores
	A3/ B3	10% of investment with a max. of Rs. 50.0 Crores

iii. Interest Subsidy: Interest subsidy will be 5 percent per annum on term loan for a period of five years upto a maximum limit of Rs. 1 crore.

iv. Power Cost Support: The state government offers reimbursement of Rs. 0.25 – 1.25 per unit for a period of 5 years, based on employment and investment levels as defined in the policy.

    100 percent Exemption on Electricity duty for a contract demand of 5 MVA for 5 years.

    The policy also offers one-time reimbursement of energy audit cost for MSMEs with ceiling of Rs. 3 lakhs.

v. Plant & Machinery/Technology upgradation related support: The policy offers Environmental Protection Infrastructure Subsidy of 20 Lakhs or 20 percent of capital cost of setting ETP for MSMEs.

    The state government shall also provide an assistance of 100 percent of cost of purchase of technical know- how up to Rs. 1 Lakh in case of indigenous technology and up to Rs. 5 Lakhs in case of imported technology.

vi. Stamp Duty Exemption: The state government has granted 100 percent exemption with respect to land allotted by the Government to IDCO or Govt/IDCO to Private Industrial Estate Developers or when transfer of land/shed by Govt, IDCO and Private Industrial Estate developer to industrial units, on Loan agreements, credit deeds, mortgages and hypothecation deeds executed by the Industrial Units in favour of banks or financial institutions.

vii. Skill Support: To encourage entrepreneurship in technical textiles, State Government has introduced an Entrepreneurship Development Subsidy program which offers

    - Reimbursement of 75 percent of course fee limited to Rs. 50,000 per course.
    - Reimbursement of training cost up to Rs. 1750 – 4000 per person, for every person newly trained or undergoing skill upgradation for a period of three years, based on employment and investment levels.

    The state government shall also provide 50 percent of cost incurred for skill upgradation or training for local manpower:

    - For MSMEs: Up to Rs. 3000 per person for maximum 10 persons in micro and 20 persons in Small and Medium enterprises.
    - Additional amount of Rs. 1000 per women trainee.

viii. Quality development and R&D support

- To promote innovation in the sector, the government has introduced a policy to grant reimbursement of 100 percent of the Patent Registration cost up to maximum of Rs. 10 Lakhs.
- The policy will also support any cost incurred on Quality Certification along with renewal for consecutive two years i.e. for a period of 3 years @ 100 percent to a total maximum limit of Rs. 3 Lakhs.

- Employment and employee related support: The state government has drafted a policy that offers discounted rates for Workers' Hostel at 50 percent of the prevailing market rates of IDCO for 1-3 acres of land, based on employment and investment levels.
- To promote employment in the sector, the government has come up with an incentive of Rs. 1500 per worker per month for 36 months if 90 percent of workers are domicile of Odisha with minimum 200 employees.
- 100 percent reimbursement of Employment Cost Subsidy (ESI/ESF) was also stated in the policy as follows:
    - For 3 years for displaced employees and for 5 years for disabled employees
    - 75 percent for male; 100 percent for female
    - For Micro & small units for 5 years @ 50 percent for male; 100 percent for female: For Medium units for 3 years

15.4.12 Punjab Industrial and Business Development Policy 2017

Industrial policies were formulated by the State Government in 1978, 1982, 1989, 1992, 1996, 2003, 2009, 2013 and Punjab Industrial Policy was last notified in 2017. The State has defined technical textiles as one of the Thrust Sector only in the current 2017 scheme, taking into account the potential for their future growth in the state and the generation of jobs.

Initiatives to support technical textiles as per the policy

i. A Technology Centre for Advanced Textiles will be set up by the state. The technology centre will serve as a research and demonstration centre for the latest tools and know-how in technology, engineering and design facilities, prototyping, testing and calibration, incubation and training.

ii. The state government has granted a 5% interest grant to MSMEs for new/expansion/diversification in addition to the ATUF benefits for technical textiles for a period of three years subject to a maximum of Rs. 10 Lakhs per year.

iii. Land and Infrastructure Support: The government of Punjab has offered land cost rebate: Land cost is counted under fixed capital investment for incentives under Punjab's Industrial & Business Development Policy 2017.

    The policy further provides 100 percent exemption to the industrial units from premium payment due to change of land-use charges and external development charges.

iv. Power Cost Support: The state government shall provide electricity to all industrial units at subsidised tariff of $0.07 (INR 5) per unit.

    The policy also offers 100 percent exemption from payment of electricity duty for 15 years.

v. Stamp Duty Exemption: The state government has granted 100 percent exemption or reimbursement of stamp duty on purchase or lease of land and building.

vi. Employment and employee related support: To promote employment in the sector, the government has offered employment generation subsidy with no domicile restriction as per criteria mentioned below:

- o Upto Rs. 36,000 per employee per year upto 5 years
- o Upto Rs. 48,000 per employee per year for Women & SC/BC/OBC upto 5 years

15.4.13 Rajasthan Special Customised Package for Textile Sector enterprises-2013

i. There is no separate full-scale textile policy declared by the state. 'The Special Customised Package for Textile Sector enterprises' came into effect in 2013 and was implemented till 31st March 2020. There has also been a declaration of 'State Industrial Development Policy in 2019'. In this policy, the MSME textile sector (textile & apparel) has been identified as one of the focus sectors and the technical textile has been identified as one of its segments.

ii. A special Interest subsidy @ 7% per annum has been approved for new enterprise in technical textile sector. It is applicable for 5 years on a term loan availed from Public Financial Institutions / banks.

15.4.14 Rajasthan Investment Promotion Scheme 2019

The state does not have a full-fledged textile policy but the benefits and incentives to textile industry are available through the provisions of 'Special Customised Package for Textile Sector Enterprises 2013'. 'Rajasthan Investment Promotion Scheme 2019 (revised from its version of 2014)'. The benefits and incentives offered by the state government are as follows:

iii. Land and infrastructure support

- The state government has offered 100 percent exemption from payment of stamp duty, land conversion charges and land tax for 7 years.

iv. Power Cost Support

- The state government has offered 100 percent exemption from payment of electricity duty for 7 years

Enterprises making an investment equal to or above rupees twenty-five lakh in the textile sector shall be granted the following benefits/incentives.

v. Capital Subsidy

Capital Subsidy on zero liquid discharge based effluent treatment plant equivalent to 20% of the amount paid to the suppliers for the plant excluding civil work, subject to a maximum of Rs. 1 Crore, to enterprises of textile & apparel sector; and

or

Capital subsidy equivalent to 25% of the investment made on the plant & machinery as specified under the TUF Scheme of Government of India, subject to a maximum of Rs. 50 Lakhs.

vi. Interest Subsidy

5% interest subsidy for a period of five years on term loan taken by enterprise from financial institutions or State Financial Institutions (SFIs) or banks recognised by RBI.

or

6% interest subsidy on term loan taken by enterprise from financial institutions or State Financial Institutions or banks recognised by Reserve Bank of India, for making an investment in plant & machinery as specified under the TUF Scheme of Government of India, for a period of five years, for enterprises making investment more than Rs. 25 Crores.

or

7% interest subsidy on term loan taken by enterprise from, Financial institutions or State Financial Institutions or banks recognised by Reserve Bank of India, for making an investment in plant & machinery as specified under the TUF Scheme of Government of India, for a period of five years, for Apparel Sector and enterprises manufacturing Technical Textiles and Khadi & Handlooms.

15.4.15 Tamilnadu Integrated Textile Policy 2019

The State government of Tamilnadu launched 'Tamilnadu Integrated Textile Policy 2019'

Under this policy, the state government has categorised the technical textiles sector as a focus area of intervention and these offer various assistance and incentives as follows:

i. Credit Linked Capital Investment Subsidy @ 15 percent for investments on eligible machinery in technical textiles under ATUFS

ii. Concessional Custom Duty for specific technical textile machinery @ 5 percent

iii. Financial support to Technical Textile Park @ 9 percent of project cost, subject to a maximum ceiling of Rs. 9 Crores will be provided as state government grant for setting up of Technical Textile Parks under Scheme for Integrated Textile Parks (SITP). This assistance is in addition to the assistance provided by Government of India but is subjected to the maximum ceiling of Rs. 9 Crores.

iv. Interest subsidy of 6 percent for technical textile projects will be provided in addition to any other incentives available from the Government of India.

v. Funds will be earmarked and overseas study will be conducted to identify potential technical textile markets and products.

vi. Stamp duty exemption of the entire 100% amount will be given for technical textile projects.

vii. Capital Subsidy: An additional 5 percent Capital Subsidy is also provided for new / expansion of textile units set up in southern districts.

viii. Power Cost Support: The policy offers Electricity Tax exemption for 2 years to 5 years on power purchased from TANGEDCO or generated or consumed from captive sources.

ix. Skill Support: 25 percent subsidy will be provided for setting up of new training centres for Apparel and Textiles linked with ITIs, towards machinery purchased, subject to a maximum ceiling of Rs.20 lakh per centre. Subsidy will be given through Tamil Nadu Skill Development Agency.

x. Quality development and R&D support: To promote innovation in the industry, the government shall provide subsidy upto Rs.2 Crores per CFC is provided for setting up of design centre / studio, testing facilities, training centre, information cum trade centre and common raw material / yarn / sales depot, water treatment plant, dormitory, worker's residential space, pre-weaving and post-weaving facilities etc.

xi. Employment and employee related support: To promote employment in the sector, the government shall provide soft loan to companies employing more than 1500 people and located in certain notified districts of Tamil Nadu.

15.4.16 Telangana Textile and Apparel Incentive Scheme 2017

Telangana issued its first 'Textile and Apparel Incentive Scheme' in 2017. This incentive scheme is valid for next five years for both new and existing units. One of the objectives is to have 'A proactive approach for manmade fibre segments owing to an increase in overall consumption of these fibres in the technical textile application'.

i. Scheme for Capital Assistance (S-CAP)

The model of financial assistance for capital assistance in technical textile units has been segmented in the following way:

Table 15.13: Model of financial assistance for capital assistance in technical textile units

Category	Definition		Capital Subsidy (for technical textiles)
	Investment (Rs. Crores)	Minimum employment (number)	
A1	<10	50	35% (cap of Rs. 2.5 Crores)
A2	10-50	200	35% (cap of Rs. 5 Crores)
A3	50-100	300	35% (cap of Rs. 10 Crores)
A4	100-200	500	35% (cap of Rs. 20 Crores)
A5	>200	1000	35% (cap of Rs. 40 Crores)

ii. Scheme for Operational Assistance

- Interest Subsidy: It was proposed that 75% of the interest rate of the loans availed by a unit, subject to a capital of 8% per annum, for technical textile related projects for 8 years.

- Power Tariff Subsidy: The power tariff subsidy is provided to all the technical textile units with an additional benefit of Rs. 0.50 per unit across all the following categories:

Table 15.14: Power tariff subsidy across categories

Category	Power Tariff Subsidy
A1, A2	Rs 1.00 / unit
A3	Rs 1.50 / unit
A4	Rs 1.75 / unit
A5	Rs 2.00 / unit

iii. Concession on SGST: 100% SGST reimbursement is accessible on taxable technical textile based end-product / intermediate product for seven years from the date of starting of marketable production, or up to the realisation of 100% fixed and eligible fixed capital investment.

iv. Investment Subsidy: Financial assistance of up to 50 percent of the investment in technology development, subject to a maximum amount of Rs. 10 Lakhs per process/product will be offered to eligible units.

v. Stamp Duty Exemption: 100 percent reimbursement of the stamp duty/transfer duty paid during purchase of land.

vi. Skill Support: Training subsidy of Rs. 3000 per employee to the companies to reimburse the cost incurred in skill upgradation and training the local manpower. The subsidy shall be Rs. 5000 per employee for units employing more than 1000 persons.

vii. Quality development and R&D support: 20 percent subsidy will be offered by state government for the annual expenditure of the firm on design and product development expenditure limited to a maximum subsidy of Rs. 2 Lakhs per year.

viii. Scheme for Infrastructure Support (S-IP): The anchor customer(s) and first movers will earn an extended rebate of 50 % of the cost in any new textile park, with an upper limit of rebate of Rs. 20 lakhs per acre. In the case of technical textile units, an additional 25 % rebate will be extended with a limit of Rs. 10 Lakhs per acre.

ix. Kakatiya Integrated Mega Textile Park

- Kakatiya Integrated Textile Mega Park is coming up over an area of nearly 2,000 acres in Warangal.
- Mega Park will have low-end SME units as well as high-end technical textiles, manmade fibres and textile machinery production units.
- The Mega Park will have an Incubation Centre to impart the spirit of entrepreneurship and introduce entrepreneurs into the innovative community so that their innovations are turned into new goods or services that can be promoted and sold.
- The Mega Park will have a Textiles Centre for Excellence. The Centre will be formed as a lead partner with the Government of Telangana, duly supported by leading technical institutions such as SIMA, SITRA,

BITRA, NIFT or industry federations/associations. The Centre will concentrate on R&D, Human Resource Development, Professional Textiles Testing and Evaluation, Consulting, Incubation Support and Instrumentation.

15.4.17 Uttar Pradesh Handloom, Powerloom, Silk, Textile & Garmenting Policy 2017

The state does not have any special provisions for technical textiles but, the state government offers following incentives and benefits to enterprises engaged in production of textile and garments under the Uttar Pradesh Handloom, Powerloom, Silk, Textile & Garmenting Policy 2017:

i. Land Subsidy @50 percent of land cost (30 percent in GB Nagar district) on land purchase from State Agencies

ii. Stamp duty exemption @100 percent (75 percent in GB Nagar district)

iii. SGST refund for 10 years @90 percent to MSME units, @80 percent to Mega units

iv. Electricity Duty exemption @100 percent to new units for 10 years

v. Capital Investment Subsidy @25 percent for plant and machinery based on investment

vi. Interest Subsidy @7 percent upto Rs. 1.5 Crores (upto Rs. 75 Lakhs for GB Nagar) for 7 years for procurement under TUFS

vii. Infrastructure interest subsidy @5 percent upto Rs. 1 Crore for 5 years per unit for developing infrastructural amenities

viii. Quality Development Subsidy @ 5 percent upto Rs. 1 Crore for 5 years per laboratory for research and quality improvement

ix. EPF reimbursement for 5 years to new unit @50 percent with minimum 100 workers & @ 60 percent with minimum of 200 workers

x. Special incentives for textile parks: Stamp duty exemption @100 percent to developer (except in GB Nagar district) and @50 percent to first buyer of plot/unit. Interest Subsidy @50 percent on purchase of land for 7 years upto Rs. 50 Crores and @60 percent for 7 years for construction of staff-quarters, hostel/dormitory

15.4.18 Uttarakhand Mega Textile Policy 2014

Uttarakhand Government has announced a 'Mega Textile Policy 2014' as part of which, it provided a variety of incentives for development of a series of textile parks in the Kumaon area. Three textile parks are being set up in Kashipur, Jaspur and Sitarganj where a host of benefits will be available to draw new investment. The Mega Textile Policy 2014 has been amended in 2016 and valid till 2021.

Following key incentives have been introduced for all textile units including technical textiles:

i. Interest subsidy of 7 percent for 7 years upto a maximum limit of Rs. 50 Lakhs to be paid annually
ii. 100 percent refund of stamp duty/tax
iii. Reimbursement of 1/- per unit on the energy bill and 100% electricity tax refund for 5 years
iv. 50 percent rebate on the prevailing land prices of the State Infrastructure and Industrial Development Company of Uttarakhand (SIDCUL)
v. The capital subsidy will be 15 percent to the maximum limit of Rs 50 Lakhs for MSMEs and 15 percent to the maximum limit of Rs 30 Lakhs for heavy industry
vi. 75% Mandi Duty Waiver for Textile Industries

15.4.19 West Bengal Textile Policy 2O13-2O18

West Bengal Textiles Policy 2007-12 recognised technical textile as one of the emerging sectors. Jute industry was marked as a part of technical textile industry. Following this, West Bengal textile policy 2013-18 was announced with a mission to double the share of State's textiles industry from 5.2% to 10% by the year 2022-23.

Special incentives for technical textiles

i. 10% additional subsidy is provided for setting up technical textiles unit. This subsidy is over and above the capital subsidy available under this policy and is also in addition to any capital subsidy available from Government of lndia (subject to a ceiling of Rs. 5 lakhs for small enterprises and Rs. 10 Lakhs for medium enterprises)
ii. An eligible Micro, Small or Medium enterprise engaged in manufacture of technical textile products irrespective of location are entitled to get annual payment of marketing incentive @5% on the sale value of its manufactured products which are exported.
iii. Capital Subsidy: 10 percent-40 percent capital subsidy is offered depending on category of unit and its location zone. Subject to a ceiling of Rs. 50 Lakhs for small enterprise. 20 percent additional subsidy is offered on admissible subsidy for all enterprises wholly owned by women, SC/ST and minority community entrepreneurs. This incentive would be in addition to what the unit gets under any scheme of GoI.
iv. Interest Subsidy: For micro and small units subsidy offered by state is 6 percent for all units and 7.5 percent to units set up in the C and D Zone districts for 5 years. For Medium Enterprise in Zone B & C – 25 percent of total Term Loan Interest subject to ceiling of Rs. 175 Lakhs per year for 5 years. For Medium enterprise in Zone D – 25 percent of total Term Loan Interest subject to ceiling of Rs. 175 Lakhs per year for 7 years.
v. Power Cost Support: Micro & Small Enterprise – 100 percent waiver for 4 years for Zone A & B and for 6 years for Zone C & D. Medium Enterprise in Zone B & C – 100 percent waiver of electricity on the electricity consumption for 5 years subject to maximum of Rs. 25 Lakhs per year or Rs. 1.25 Crore for 5

years. Medium Enterprise in Zone D – 100 percent waiver of electricity duty on the electricity consumption for 5 years and 75 percent waiver from the sixth year upto tenth year subject to maximum of Rs. 50 Lakhs per year or Rs. 2.50 Crores in 5 years

Incentives offered for Jute sector

i. The government offers a rebate of 25 % of the project expense subject to a cap of Rs 5 lakhs to help business growth, branding and design.

ii. The state government offers reimbursement of 50 % of cost up to a limit of a maximum of Rs. 5 lakhs for expenses incurred in securing registration of patent.

iii. The State Government will provide consulting and facilitation services to define and record the Geographical Indicator (GI).

iv. Reimbursement for expenditure incurred in Quality Certification: Micro & Small Enterprise- 50 percent of cost subject to a ceiling of Rs. 5 Lakhs for obtaining certification /accreditation like ISO-9000, ISO-14000, ISO-18000, Social Accountability Standards, OEKO-TEX etc.

16. Formulation of Indian Standards for Technical Textiles

A standard can be defined as a documented method to evaluate the quality of a material such as plastics, textiles, metal etc., using a predefined set of instructions. A Standards document contains an outline of the procedure and identifying characteristics which are essential for confirming quality. Application of standards has made it easier to ensure that products and services are harmonized and consistent. If a product fulfils the standard requirements, it gives consumers and users confidence that it is safe to use and consume.

Technical textiles are used in diverse applications where they are required to meet stringent functional requirements which can be consistently ensured only if they conform to certain standards. One of the major impediments to expansion of the technical textile industry in India is the lack of standards and regulations. Well-defined standards will help manufacturers develop and manufacture products as per requirement for a given application, and ensure customers consistent and high quality products. It will also help the government develop regulations to prevent sub-standard products from being manufactured or imported into the country. It will help investors take well informed investment decisions in development and manufacturing of technical textiles in India. It will help exporters increase their exports of technical textiles.

Bureau of Indian Standards (BIS) is responsible for development and notification of standards for technical textiles. It has so far developed 377 standards covering different areas of technical textiles. The overall framework of standards related to technical textiles, process of formulation of standards, status of the standards developed so far by BIS and a comprehensive list of standards that have been made available so far, are presented in the following sections.

BIS Committees for formulation of standards for technical textiles

The 13 committees which comprise experts and are involved in the development of standards at BIS are listed below:

1. TXD 3 Jute and Jute Products Sectional Committee (Packtech)
2. TXD 18 Textile Materials for Marine/Fishing Purposes Sectional Committee (Agrotech)
3. TXD 23 Textile Materials Made from Polyolefins Sectional Committee (Packtech)
4. TXD 30 Geosynthetics Sectional Committee
5. TXD 32 Textiles Protective Clothing Sectional Committee

6. TXD 33 Industrial Fabrics Sectional Committee
7. TXD 34 Technical Textiles for Buildtech Applications Sectional Committee
8. TXD 35 Technical Textiles for Agrotech Applications Sectional Committee
9. TXD 36 Technical Textiles for Meditech Applications Sectional Committee
10. TXD 37 Technical Textiles for Sportech Applications Sectional Committee
11. TXD 38 Technical Textiles for Mobiltech Applications Sectional Committee
12. TXD 39 Technical Textiles for Clothtech Applications including Narrow Fabrics and Braids Sectional Committee
13. TXD 40 Composites and Specialty Fibres Sectional Committee

Relevant industry and their associations, TRAs, COEs, Academic Institutes and Test Houses are the members of the Sectional Committees and have been actively participating in the standard development process. Heads of TRAs are also holding the Chairpersonship of Sectional Committees on technical textiles.

16.1 Process of development of standards at BIS

The steps involved in defining a new standard for a product starts with development of a proposal for formulation of a standard for a particular area or product. It is followed by setting up of a committee in this area. Various stages involved in the development of standards are shown in the figure given below:

Figure 16.1: Development process for standards at BIS

Available standards for method of tests published by ISO have been adopted by BIS to ensure uniform test procedures. The process involved in developing a new standard involves discussions, committee meetings, feedback from different stakeholders before a standard can be adopted. Availability of a working draft or preliminary draft on any new subject from stakeholders is the main constraint in developing a new standard. Adoption of product standards of any international origin depends upon the technological status of the Indian industry, user requirements, environmental considerations etc. The process of formulation and adoption of a new standard usually takes one to two years.

Steps taken by BIS to streamline standardisation

- The digitalisation of standardisation: BIS has moved its entire standard formulation activity to the digital mode. It has developed an online portal e-BIS (https://www.manakonline.in), which brings together a wide range of activities such as development of standards, conformity assessment, testing, etc.
- Standards National Action Plan: A Standards National Action Plan has been prepared to enhance stakeholders' involvement in standards formulation processes, make the process fast and efficient, harmonise standardisation activities, increase participation for international standardisation activities, increase awareness and implementation of standardisation. The details of the plan are available on the website of BIS (www.bis.gov.in)
- Strategic road map of the Division Council: BIS, in consultation with various stakeholders, has prepared a strategic road map of Textiles Division Council. Its goal is to align standardisation with the emerging needs and prevalent trends in view of rapidly changing economic and social scenario.
- Creation of Standardisation Cells: In order to broad-base the standardisation process and enhance stakeholder involvement, all central government ministries and state governments have been advised to establish Standardisation Cells and to be sensitised about their role in developing and implementing standards. The industry associations across all sectors have been advised similarly. Details of standardisation cells are available on the BIS website.
- MoUs have been signed with IITs, HBTI and NITRA to foster greater involvement of academia in the formulation of standards and their promotion.
- One Nation One standard- In order to avoid overlaps and duplication, the Accreditation of Standard Development Organisations (SDOs) scheme has been implemented.
- Free access to Indian standards- Indian standards have been made freely accessible and downloadable.

Table 16.1: Number of standards developed and being developed by BIS in different segments of Technical Textiles

Area of Technical Textiles	BIS Committee Number	Number of standards developed and being developed
Agrotech	TXD 35, TXD 18	44*
Buildtech	TXD 34	7
Clothtech	TXD 39	37
Geotech	TXD 30	81
Indutech	TXD 33	44

*Includes 25 Standards formulated by TXD 35 (Agrotextiles) and TXD 18 (Fishing Nets not including Fishing Gear)

Area of Technical Textiles	BIS Committee Number	Number of standards developed and being developed
Meditech	TXD 36	70
Mobiltech	TXD 38	17
Packtech	TXD 3, TXD 23	56
Protech	TXD 32	61
Sportech	TXD 37	3
Composite and speciality fibres	TXD 40	33
Ropes and Cordages	TXD 9	50

Source: BIS website page accessed on 30th Nov. 2021
URL: https://www.services.bis.gov.in:8071/php/BIS_2.0/dgdashboard/published/subcommtt?depid=NzE%3D&aspect=&from=&to=

16.2 New Standards under development on Technical Textiles

Details of some of the new standards that are under development, are presented in the tables below:

Table 16.2: New standards under development in Agrotech

S. No.	Title
1.	Textiles – Polypropylene spun bonded non-woven crop covers and fruit skirting bags for agricultural and horticultural applications – Specification
2.	Agro-Textiles – High density polyethylene HDPE laminated woven lay flat tube for use as lateral in rain irrigation system – Specification
3.	Agro-Textiles – Flexible water storage tank for agriculture and horticulture purposes – Specification
4.	Agro-Textiles – Hail protection nets for agriculture and horticulture purposes – Specification Part 1 - Warp knitted hail protection nets
5.	Agro-Textiles – Hail protection nets for agriculture and horticulture purposes – Specification Part 2 - Woven hail protection nets
6.	Agro-Textiles – Bird protection nets for agriculture and horticulture purposes – Specification Part 1 - Knitted bird protection nets
7.	Agro-Textiles – Bird protection nets for agriculture and horticulture purposes – Specification Part 2 - Woven bird protection nets
8.	Agro-Textiles – Bird protection nets for agriculture and horticulture purposes – Specification Part 3 - Extruded bird protection nets
9.	Agro-Textiles – Laminated woven orchard protection covers – Specification

Table 16.3: New standards under development in Geotech	
S. No.	**Title**
1.	Geotextile tubes for coastal and waterways protection
2.	Geosynthetics – prefabricated vertical drains for applications in infrastructure projects in coastal areas - specification
3.	Specification for geosynthetic in bitumen layers for flexible pavements

Table 16.4: New standards under development in Indutech	
S. No.	**Title**
1.	Needle punched nonwovens filters
2.	Industrial nonwoven wipes
3.	Nonwoven scrub pads

Table 16.5: New standards under development in Meditech	
S. No.	**Title**
1.	Disposable baby diaper – Specification
2.	Medical textiles – Eye pad – Specification
3.	Medical textiles – Caps – Specification
4.	Medical textiles – Bed sheet and pillow cover – Specification
5.	Medical textiles – Underpad – Specification
6.	Medical textiles – Nonwoven wipes – Specification
7.	Medical textiles – Nonwoven fabric for wipes – Specification

Table 16.6: New standards under development in Mobiltech	
S. No.	**Title**
1.	Textiles – Automotive tufted floor covering – Specification
2.	Textiles – Automotive non-woven carpet/mat – Specification

Table 16.7: New standards under development in Protech	
S. No.	**Title**
1.	Bullet resistant vest
2.	High altitude clothing

17. Status and Contribution of Textile Research Associations

Textile Research Associations (TRAs) were set up in India to provide technical consultancy to the textile industry and carry out research on various aspects of textile technologies.

TRAs are financially supported by Ministry of Textiles (MoT) to promote research and development to make Indian textile and allied industries internationally competitive. These associations carry out application-based scientific studies and foster excellence in technology, engineering and management.

Technical textiles cater to specific individual and industrial requirements; hence these are required to conform to international and national standards based on the type of product and nature of use. The TRAs have an important role in establishing test facilities for technical textiles so that conformance to standards can be ensured.

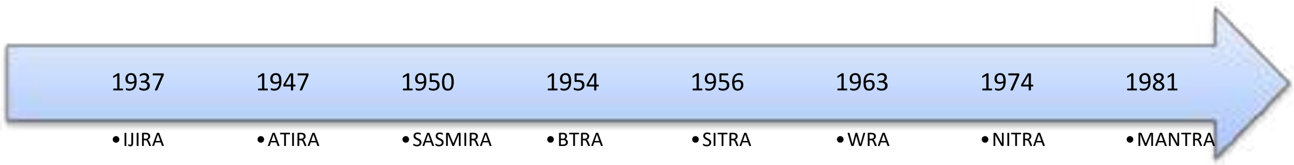
17.1 Methodology

A detailed questionnaire was developed by IIT Delhi and shared with all the TRAs to understand their key research areas, projects undertaken, collaborations, training, challenges and issues faced, and future perspective of the TRAs in the context of technical textiles. The following analysis is based on the responses received from six TRAs namely ATIRA, BTRA, MANTRA, NITRA, SITRA, and WRA.

17.2 Establishment of TRAs

Eight TRAs have been established so far for testing, research and development activities in the context of textiles.

Figure 17.1: Chronological order of establishment of TRAs in India



Source: http://texmin.nic.in/about-us/textile-research-associations

All the associations are well equipped with facilities to carry out research for the respective region and segments. They provide consultancy services and testing facilities, conduct trainings and workshops, and publish research findings from time to time. The details of these facilities are listed in the following table.

Table 17.1: TRAs and their specialisations

	Textile Research Association	Location	Specialisation in relation to Technical Textiles
1.	Ahmedabad Textile Industry's Research Association (ATIRA)	Ahmedabad	Composites & Buildtech
2.	Bombay Textile Research Association (BTRA)	Mumbai	Geotech & Oekotech
3.	Indian Jute Industries' Research Association (IJIRA)	Kolkata	Agrotech
4.	Man-Made Textile Research Association (MANTRA)	Surat	Agrotech
5.	Northern India Textile Research Association (NITRA)	Ghaziabad	Protech & Mobitech
6.	South India Textile Research Association (SITRA)	Coimbatore	Meditech
7.	Synthetic & Art Silk Mills' Research Association (SASMIRA)	Mumbai	Agrotech, Packtech
8.	Wool Research Association (WRA)	Thane	Sportech

17.3 Research

Research & development forms the backbone of TRAs. Scientists play prominent roles in TRAs ranging from suggesting policies to conducting research on new technologies, imparting training and publishing research findings. The data on existing research scientists and the deficit is shown below:

Table 17.2: Research Scientists in Textile Research Associations

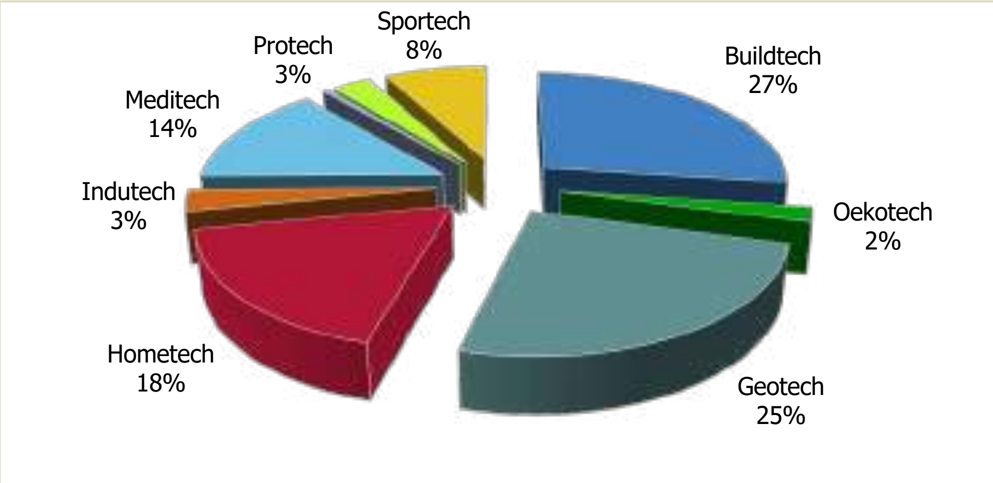
Textile Research Association	Existing number of Research Scientists	Deficit in Required Research Scientists
ATIRA	5	9
BTRA	84	NA
MANTRA	7	2
NITRA	31	NA
SASMIRA	21	NA
SITRA	17	6
WRA	6	NA

Source: Primary survey by IIT Delhi

17.3.1 Funded and sponsored projects

TRAs have undertaken various funded/sponsored projects related to technical textiles in the last six years (2015-2020). More than 50 funded projects worth around Rs. 44 Crores have been undertaken. The proportion and value of funded/sponsored projects across 12 segments are presented below:

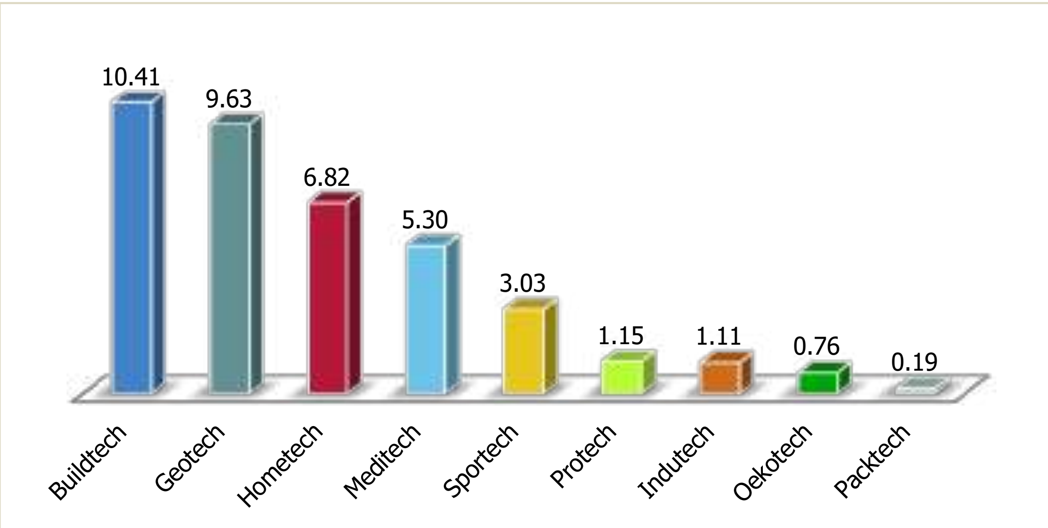
Figure 17.2: Funded and sponsored projects undertaken by TRAs in percentage (2015-2020)



Source: Primary survey by IIT Delhi

Most of the projects reported are related to Buildtech followed by Geotech, Hometech and Meditech segments. The value of funded/sponsored projects undertaken in last six years under each segment is depicted below:

Figure 17.3: Funded and sponsored projects undertaken by TRAs in Rs. Crores (2015-2020)

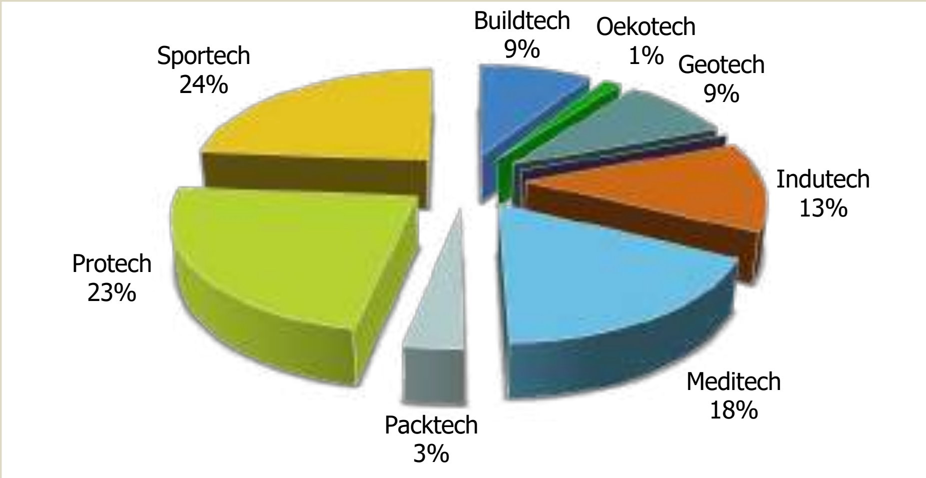


Source: Primary survey by IIT Delhi

17.3.2 In-house projects

The TRAs reported undertaking more than 50 in-house projects in the last six years (2015-2020). The proportion and values of in-house projects across twelve segments are as follows:

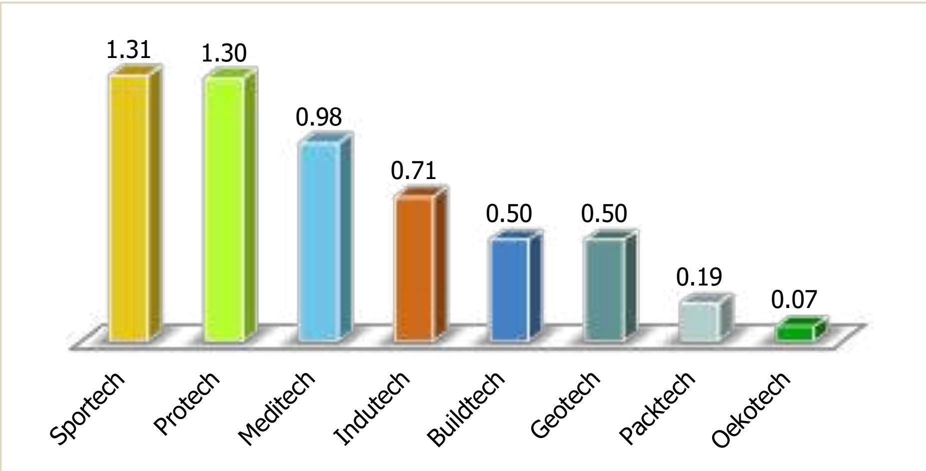
Figure 17.4: In-house projects by TRAs in percentage (2015-2020)



Source: Primary survey by IIT Delhi

The proportion of in-house projects in Sportech and Protech segments are the highest at around 24% and 23% respectively, followed by Meditech at 18% and Indutech segments at 13%.

Figure 17.5: In-house projects by TRAs in Rs. Crores (2015-2020)

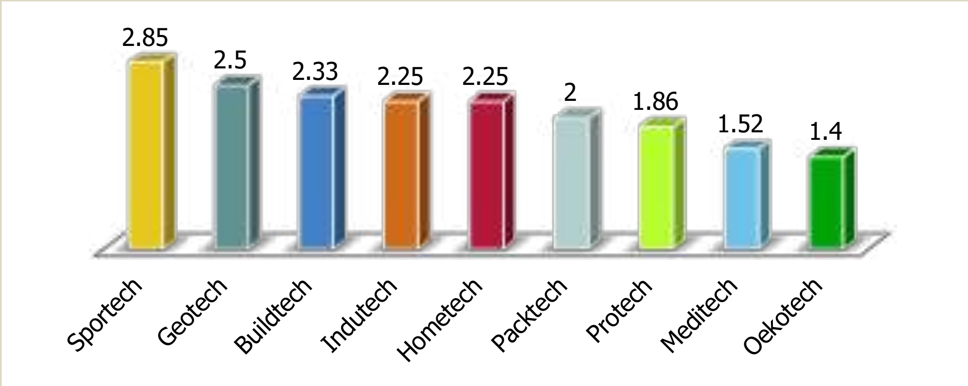


Source: Primary survey by IIT Delhi

17.3.3 Duration of projects

The duration of funded and in-house projects varied between one to three years indicating long-duration projects as well. Segment-wise average duration of projects is depicted in the following figure.

Figure 17.6: Average duration of projects (Segment-wise in number of years, 2015-2020)



Source: Primary survey by IIT Delhi

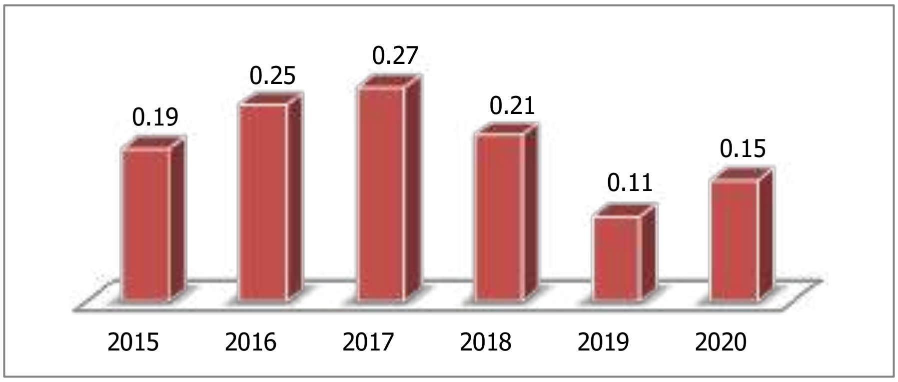
17.4 Knowledge Dissemination

Knowledge dissemination through training programmes, consultancy projects, workshops, national and international seminars and conferences have been an integral part of TRAs. In the last six years (2015-2020), over 250 training programmes and workshops have been conducted. More than 780 consultancy projects related to technical textiles have been undertaken by them generating revenue of more than Rs. 7 Crores. Also 40 international and national conferences, seminars and symposiums have been organised by them for over 2500 participants. Beyond 250 journal publications, around 100 papers in conferences, 5 book chapters, 35 research reports and 4 books have been published in the technical textiles domain by various TRAs to expand learning and foster development of new skills.

17.5 Consultancy projects

Consultancy projects have been an integral part of the activities of TRAs. The details of top ten consultancy projects related to technical textiles in last six years are shown in the figure:

Figure 17.7: Top ten consultancy projects by TRAs (Rs. Crores)

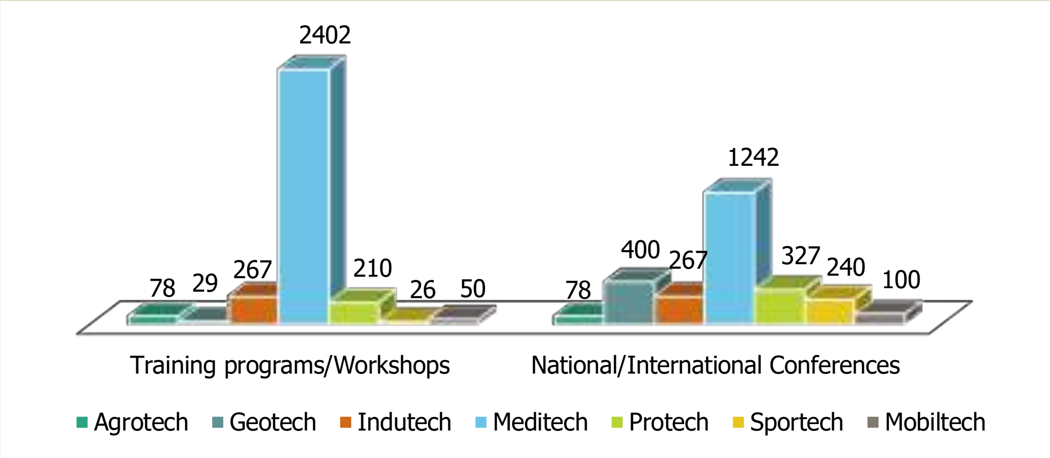


Source: Primary survey by IIT Delhi

17.6 Training Programmes and Workshops

Over the past six years (2015-2020), in addition to the funded projects, consultancies and assignments, TRAs have been actively engaged in conducting various training programmes and workshops related to technical textiles.

Figure 17.8: Number of participants trained by TRAs (2015-2020)



Source: Primary survey by IIT Delhi

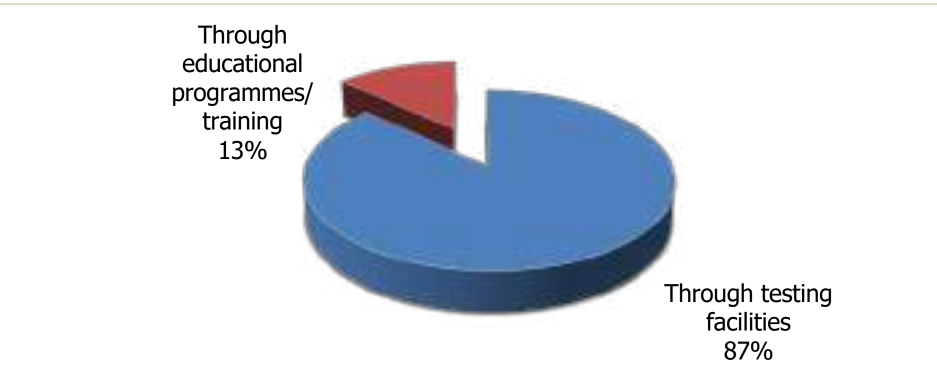
17.7 Publications by TRAs

TRAs have been actively engaged in disseminating knowledge in the form of journal articles, conference papers, books chapters and research reports. The TRAs reported 126 journal publications, 99 conference papers, 35 research reports, eight book chapters and books in last six years (2015-2020).

17.8 Revenue generated by TRAs

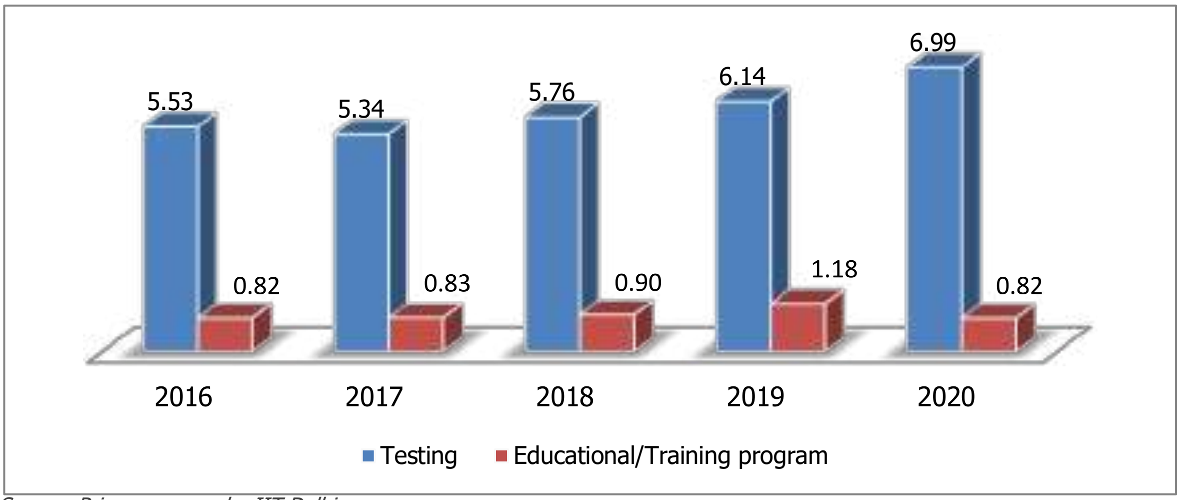
TRAs generate their revenue through testing facilities, educational programmes and training programmes. Around 87% of the total revenue can be attributed to testing facilities and remaining 13% revenue has been generated from educational programmes and training programmes over the last six years (2015-2020).

Figure 17.9: Revenue generated by TRAs (Activity-wise as percentage, 2015-2020)



Source: Primary survey by IIT Delhi

Figure 17.10: Revenue generated by TRAs (Activity-wise in Rs. Crores, 2016-2020)

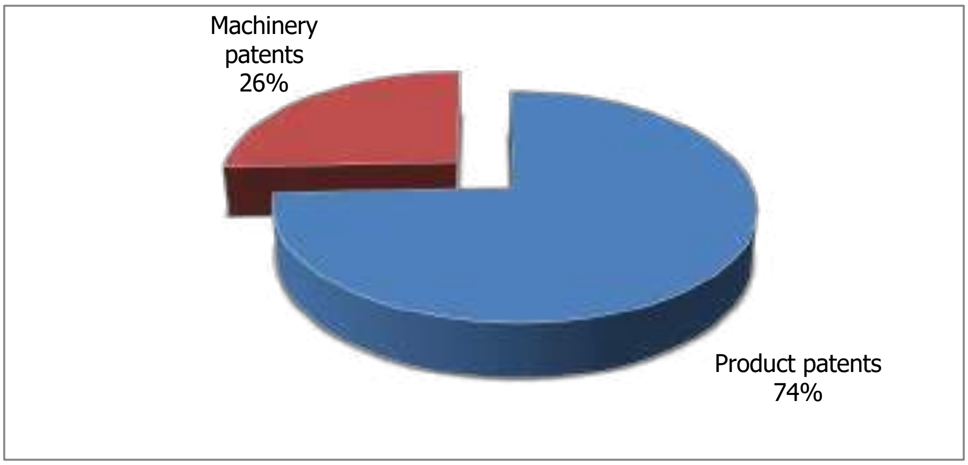


Source: Primary survey by IIT Delhi

17.9 Patent Information

In order to make India competitive in the global markets, the TRAs are focusing on innovation, research, and development of new products and technologies. There are 35 national patents which have been applied for over the past six years (2015-2020). Of the 35 patents applied in the six year period under study, 26 patents have been applied for products and 9 for machinery. There are two international patents filed for new products.

Figure 17.11: Patents applied for by TRAs (2015-2020)

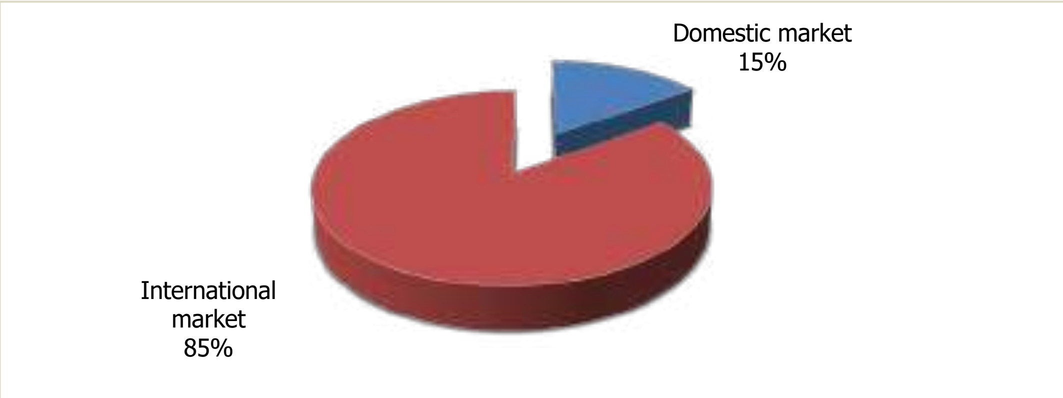


Source: Primary survey by IIT Delhi

17.10 Machines and Equipment

Over the past six years (2015-2020), 85% of total machines and equipment procured by TRAs were procured from international markets and only 15% were produced domestically.

Figure 17.12: Machines and equipment procured by TRAs (2015-2020)



Source: Primary survey by IIT Delhi

17.11 Emerging products and segments in technical textiles

Asia Pacific has dominated the technical textiles market owing to new technological advancements, increase in awareness among user groups, and rise in disposable incomes. Products from Meditech, Indutech, Mobiltech, Geotech, Oekotech, Buildtech, Protech and Sportech segments have emerged as promising ones. As per data collected from various TRAs in India, the following is the list of emerging products in various segments.

Table 17.3: Emerging products and segments in technical textiles

Segment	Products
Agrotech	• Natural fibres for weed control, organic tarpaulins • Products from jute fibres for maximum protection against weed and erosion control
Buildtech	• Glass fibre composites in marine industry • Composites, especially reinforced composites in construction and industrial sectors • Carbon fibre-based composites for civil engineering application e.g. bridge repairing • Honeycomb sandwich panel for various engineering application • Composites for manufacture of Wind Mill Turbine
Geotech	• Soft soil and water storage for pond application • Road and railway track construction • Seashore erosion control • Reinforcement of soil (specially for high strength application) • Drainage application
Indutech	• Use of textiles in environmental and manufacturing sectors • Textile with functional properties for high tenacity, better insulation and thermal resistance

Meditech	• Healthcare products • COVID 19 pandemic related products • Intelligent textiles with sensors (passive, active and adaptive) for sensing harness, stretch sensitive, safe distancing and measuring respiration rate, temperature, humidity, pulse, SpO2, pH, etc. • Biodegradable and/or recyclable medical and hygiene textiles • Artificial grafts & 3-D printing technology for better healing of injury and as an alternative technology • Anti-microbial textiles
Mobiltech	• Seat belts, airbags, carpets, inner fabrics. • Development of optimised textile components for automobiles like filters, roof linears, panels, seat cushions and covers etc.
Oekotech	• Applications in areas of erosion control • Applications in sewage treatment
Protech	• Protective Textile for enhanced security requirement • Fire and chemical protective clothing
Sportech	• Inflatable balls and protective equipment • Shock absorbing foam, breathable clothing

Source: Primary survey by IIT Delhi

17.12 Challenges faced by TRAs

The TRAs reported several challenges specific to them and the technical textiles industry at large.

17.12.1 Lack of infrastructure

Non-availability of machinery and specialised equipment for testing raw material related to technical textiles remains a major technology gap in India. Most of the machinery used to manufacture technical textile products is not available in India. This deficiency results in inefficiencies in manufacturing. Lack of adequate automated and semi-automated garment-making machines, lack of ability to create sensors for high-tech textiles and deficiency in digital printing technology are significant technology gaps faced by Indian technical textiles industry.

17.12.2 Lack of standardisation and related regulations

India lacks adequate testing machinery, standardised benchmarks and regulations in many areas related to technical textiles. This deficiency results in production of sub-standard low quality international sub-par technical textile products. In addition to that, lack of adequate and appropriate testing procedures as well as deficient BIS and AATCC norms for standardised quality products remain a significant gap in quest for achieving better competitiveness.

17.12.3 Lack of skilled manpower

Lack of skilled manpower is a major challenge faced by the Indian textiles industry. Less than 5% of the workforce in this industry attends any kind of formal training in comparison to around 65-95% workforce in other developed and developing nations. In India, shortage of skilled manpower can be seen across segments at all levels. This includes lack of trained entrepreneurs, workers, and skilled trainers.

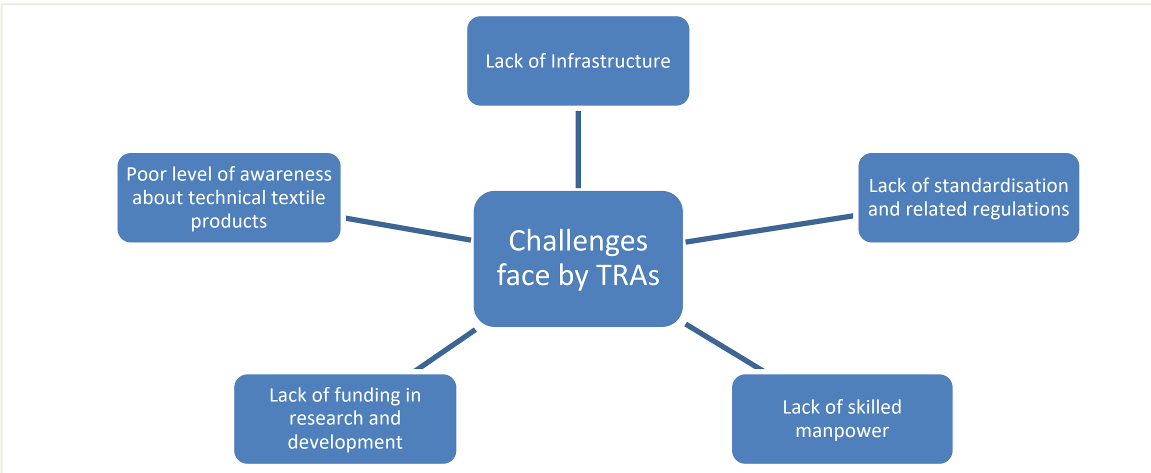
17.12.4 Lack of funding in research and development

Funding remains another significant gap for achieving better competitiveness. It hampers research and development, and impedes entrepreneurship in the manufacturing space.

17.12.5 Poor level of awareness about technical textile products among end users in India

Most end users of technical textile products are still unaware of the usage and benefits of technical textile products leading to lack of adoption. Training of entrepreneurs and workers is the need of the hour and will help spread awareness.

Figure 17.13: Challenges faced by Indian TRAs

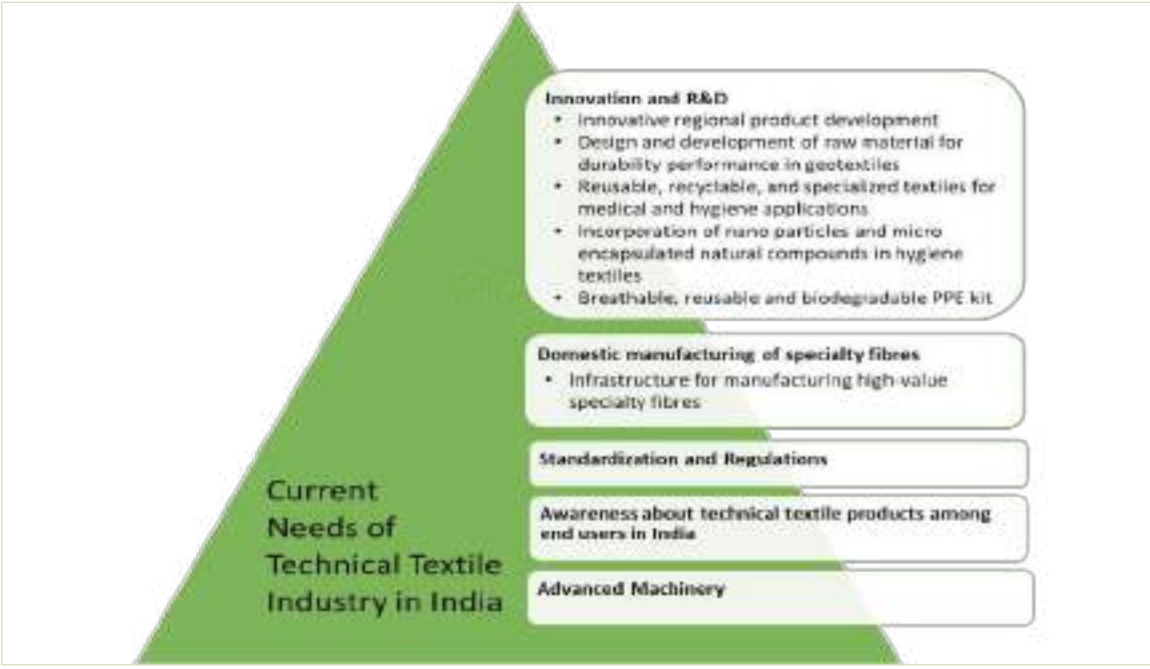


Source: Primary Survey by IIT Delhi

17.13 Suggestions offered by TRAs

Some possible ways to address the skill and technology gaps include awareness sessions, training, skill development, improvement in infrastructure, research funds and FDIs. TRAs have shared the following suggestions to address the gaps faced by Indian technical textiles industry in its drive to achieve better competitiveness.

Figure 17.14: Current needs of the Indian textile industry



Source: Primary Survey conducted by IIT Delhi

In order to attract investments and boost the technical textiles sector, the government needs to encourage manufacturing of high-tech machinery. In order to make Indian technical textile industry globally competitive, development of new technology through R&D, formation of joint-ventures, provision for import subsidies, impetus to foreign direct investors (FDIs) for promoting capital investment, facilitation for tie-ups and easy access to funding for start-ups could play crucial roles.

Through policy initiation, government can counter the problem of heavy imports of raw material as well as machinery to a great extent. Government needs to promote innovation and infrastructure for manufacturing high-value specialty fibres. A boost to manufacturing can be given in the form of relaxation in customs duty on imported raw materials and high-tech machinery. Government should provide funds and subsidies for promoting local production of some of the raw materials. Regulation should be brought in place to control and stabilise the price of raw material in implantable and extracorporeal textile materials.

In order to boost demand for technical textile products, safety related and other regulations need to be enforced across industries. Indian standards should be aligned with international standards in order to promote benchmarking against global standards. Regulatory reforms that support usage of standardised technical textile products such as flame resistant fabrics, seatbelts, airbags for cars, are essential. Such regulations will ensure better quality of life for consumers and expand the technical textiles market. Environment protection and safety rules for end users should be mandatory.

Textile education curriculum needs to be modified, soft skills should be improved and industrial experts should impart training to students in order to bridge the industry-academia gap. Since technical textiles is one of the emerging areas in the country and worldwide, existing curriculum of colleges offering degrees in textiles should have technical textiles as one of the compulsory subjects. Moreover, short-term courses for new as well as existing workforce should be planned with participation from existing technical textile manufacturers.

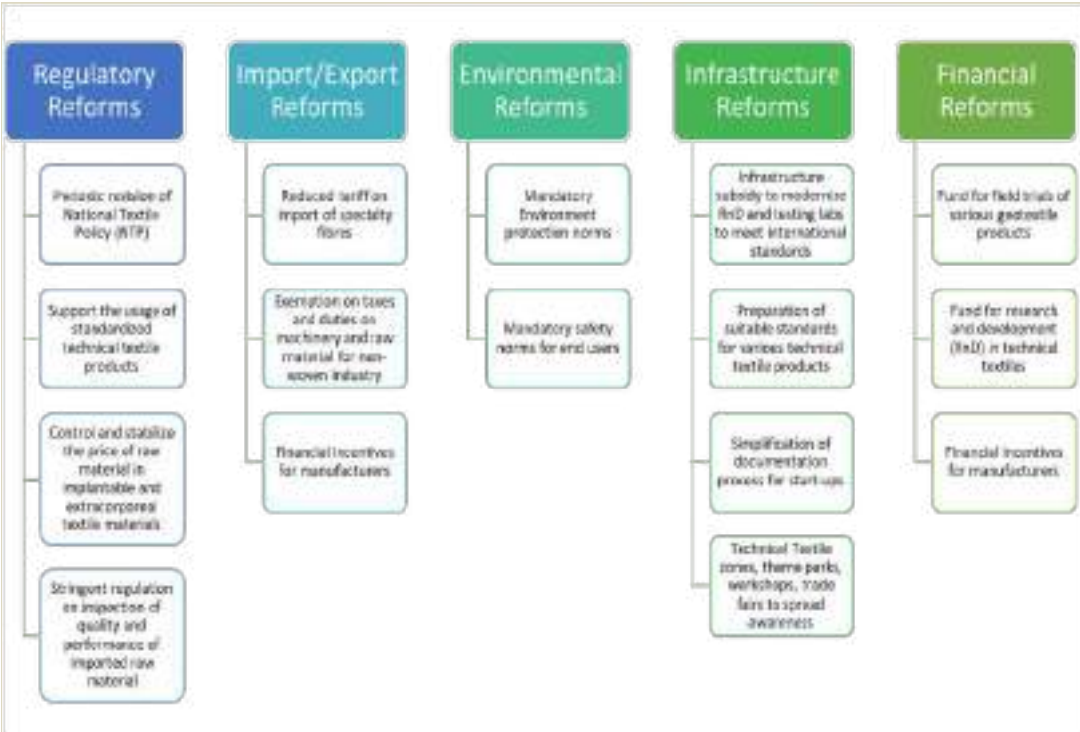
India is currently witnessing a boom in start-ups with fresh graduates opting for entrepreneurship. Government needs to work with various entrepreneurship development institutes for offering courses on entrepreneurship in technical textiles. Government should make funding available for entrepreneurs for establishment of start-ups and research and development (R&D). This will help in improving infrastructure and promoting better training facilities in the technical textiles sector. Documentation processes for start-ups must be simplified.

Many TRAs suggested collaboration with international educational institutions and Centres of Excellence (CoEs) for R&D and new product development by the industry.

TRAs lack information about availability of funds, investment mechanisms and government schemes for startups. To resolve this challenge, a platform should be created for sharing available information with TRAs and textile committees who conduct routine training programmes for entrepreneurs.

TRAs also suggested that the testing and incubation facility should be upgraded to provide the institutes with state-of-the-art equipment to provide the services to customers at affordable prices and meet both domestic and international needs.

Figure 17.15: Policy suggestions



Source: Primary Survey conducted by IIT Delhi

Awareness among the business community and end-users on technical textiles must be increased by creating technical textile parks, textile zones, and trade fairs.

Adoption of a PPP model by the government should be implemented in order to build trust amongst investors and encourage the technical textile industry towards a common goal of making India a global player.

18. Status and Contribution of Centres of Excellence in India

Technical textiles is one of the fastest-growing sunrise sectors and an emerging area for investment in India. In order to boost research and innovation in the technical textiles sector and to foster global excellence, Government of India has set up ten Centres of Excellence (COEs). These COEs specialise in various application segments of technical textiles and are equipped with internationally accredited testing labs and training facilities for trainers and technicians from the industry.

18.1 Methodology

In order to assess the performance of COEs in various activities related to technical textiles, a detailed questionnaire was developed by IIT Delhi and was shared with all the COEs as part of the primary survey exercise. The questionnaire was aimed at recording the information of COEs for understanding the key research areas, projects undertaken, revenue generated, challenges and issues faced, and plans for the future of the COEs.

The analysis that has been presented in the following section is based on responses received from ten COEs namely ATIRA, BTRA, DKTE Institute, IJIRA, MANTRA, NITRA, PSG College, SASMIRA, SITRA and WRA. The scheme for jute-based Geotextile undertaken by IJIRA is not operational yet. MANTRA is the active COE partner of SASMIRA in Agrotech segment. The key findings emanating from the primary survey are presented in the sections that follow.

18.2 Centres of Excellence

18.2.1 Details of the COEs

Details of the eight COEs (six product-oriented and two process-oriented COEs) are presented in the table below:

Table 18.1: Details of the COEs

S. No.	Designated institute for COE	Partner	Location	Key Segment	Other Focus Area	Year of Establishment
	PRODUCT FOCUSED COEs					
1.	The Bombay Textile Research Association (BTRA)	ATIRA	Mumbai	Geotech	Oekotech	2008
2.	Synthetic & Art Silk Mills Research (SASMIRA)	MANTRA, IIT Delhi	Mumbai	Agrotech	Packtech	2008

3.	Northern India Textile Research Association (NITRA)	IIT Delhi	Ghaziabad	Protech	Mobiltech	2008
4.	The South India Textile Research Association (SITRA)	Anna University, Chennai	Coimbatore	Meditech	-	2009
5.	PSG College of Technology	-	Coimbatore	Indutech	Hometech	2011
6.	Wool Research Association (WRA)	VJTI (Knowledge partner)	Thane	Sportech	-	2012
	PROCESS FOCUSED COEs					
7.	Ahmedabad Textile Industry's Research Association (ATIRA)	-	Ahmedabad	Composites	Geotech	2011
8.	DKTE's Textile & Engineering Institute	-	Kolhapur	Nonwovens	-	2011

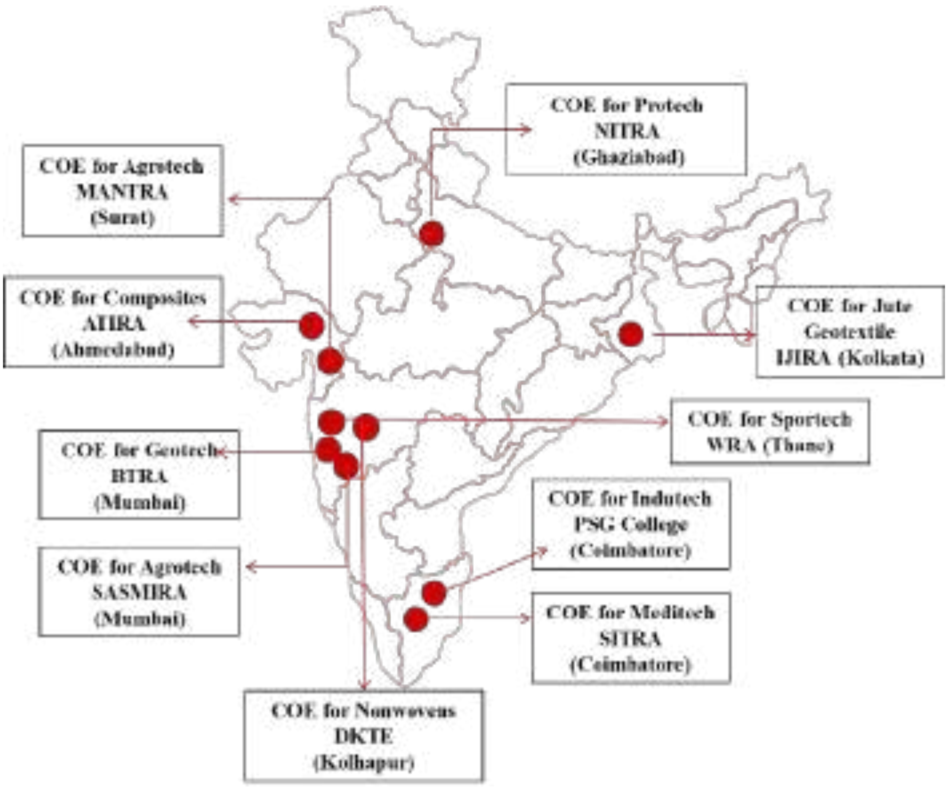
Four COEs were established under the scheme for Growth and Development of Technical Textiles (SGDTT) launched during 2007-08. These were established at SASMIRA (with MANTRA as partner), BTRA, NITRA, and SITRA in the areas of Agrotech, Geotech, Protech and Meditech segments respectively.

Four more COEs were set up between 2010-11 and 2014-15, under the Technology Mission on Technical textiles (TMTT). These COEs are established at DKTE, ATIRA, PSG College of Technology, WRA and were established to build national expertise in nonwovens, composites, Indutech, and Sportech, respectively.

18.2.2 Location

The map presented below shows the location of COEs; most COEs are in the western region of the country with maximum number (three) of them located in Maharashtra.

Figure 18.1: Geographical spread of COEs in India

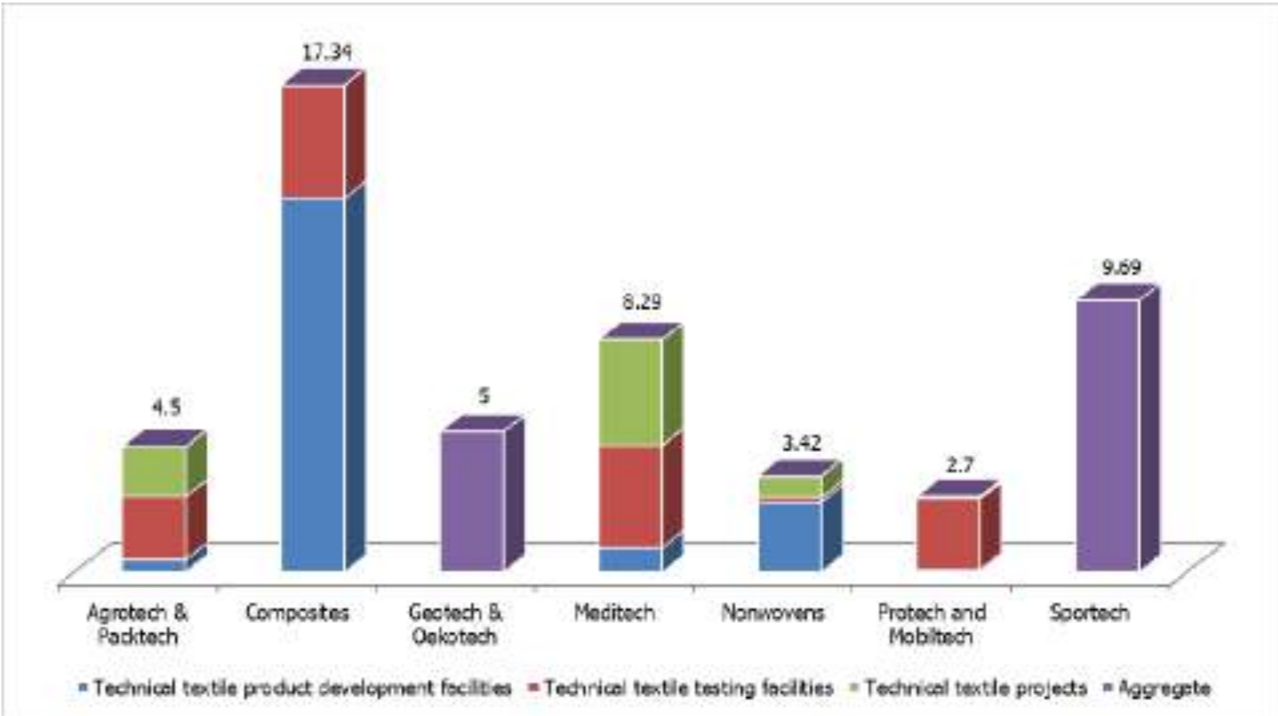


18.3 Findings from the Primary Survey of COEs

18.3.1 Revenues generated by COEs in the last six years (2015-2020)

COEs generate their revenues through product development facilities, technical testing facilities and technical textiles projects. The figure presented below depicts the aggregate revenues generated across various segments.

Figure 18.2: Revenues generated from various sources by COEs in Rs. Crores (2015-2020)



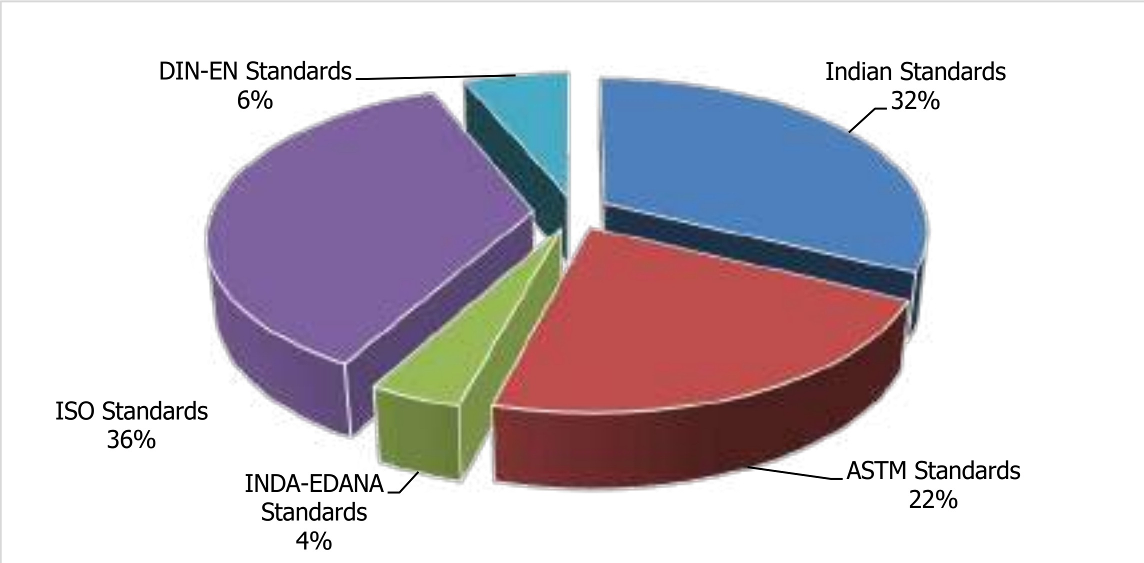
Source: Primary survey by IIT Delhi

From the figure above, it can be inferred that the total revenue generated during the last six years (2015-2020) is about Rs. 51 Crores. COEs generate revenue through product development facilities, technical testing facilities and technical textiles projects. Technical textiles product development facilities are the major source of revenue for the COEs. The maximum revenue per segment is Rs. 17.34 Crores generated by the composites segment which accounts for 33% of the total revenues generated by all the COEs put together. Sportech and Meditech segments contributed over 19% and 16% respectively to the total revenue generated. Agrotech segment generates only 1% of the total revenue, suggesting that there is a need to take steps to increase revenue generation in this segment.

18.3.2 Standards used for testing technical textiles across various segments of COEs

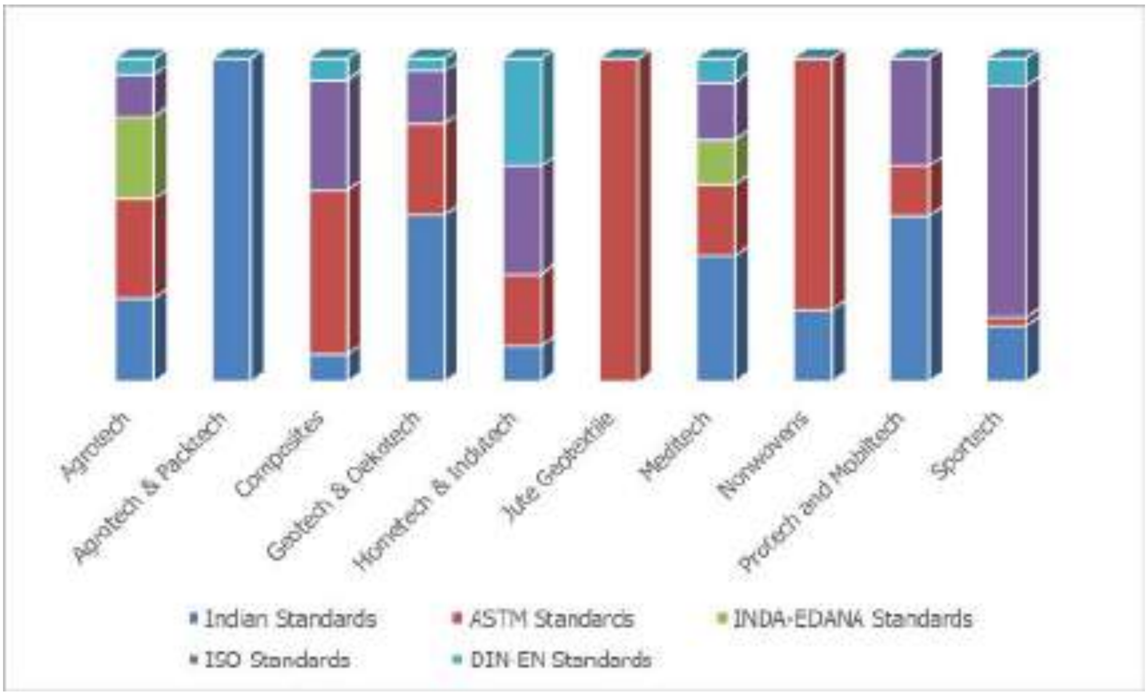
The COEs use Indian Standards, American Standard for Testing and Materials (ASTM), International Organisation for Standardisation (ISO), INDA- EDANA, and European Standards (EN) to cater to the needs of technical textiles industry.

Figure 18.3: Testing standards used by COEs (As percentage, 2015-2020)



Source: Primary survey by IIT Delhi

Figure 18.4: Testing standards used by COEs (Segment-wise as percentage, 2015-2020)



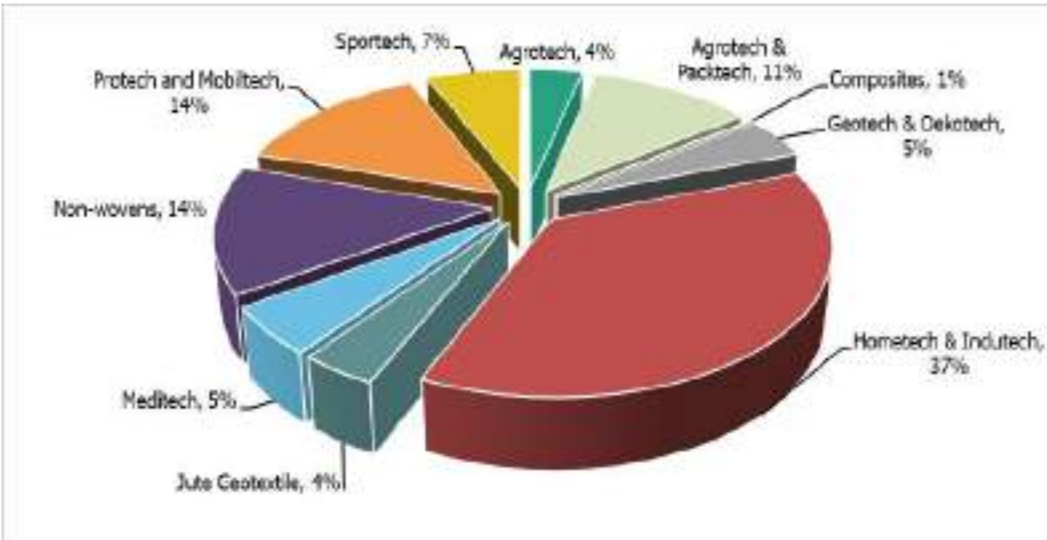
Source: Primary survey by IIT DELHI

From the figure and the table shown above, it can be inferred that the three most frequently used standards used by Indian COEs for testing the products are ISO (36%), Indian Standards (32%) and ASTM Standards (22%). Together, they comprise 90% of standards used by the COEs. About 64% of all standards used are international standards, implying that most COEs ensure that products are at par with global standards. Testing of products in composites, jute geotextile, nonwovens and Sportech segments is done mainly by using International standards. Indian Standards are used commonly for testing Agrotech, Packtech, Geotech and Meditech segments.

18.3.3 Publications by COEs (2015-2020)

COEs have also been engaged in knowledge creation and dissemination. The segment-wise distribution of publications contributed by the COEs over last six years is shown in the graph presented below.

Figure 18.5: Publications by COEs (Segment-wise as percentage, 2015-2020)



Source: Primary survey by IIT Delhi

The publications include journal papers, research reports, books, book chapters and working papers. Details of the publications in different technical textile segments across various categories are presented below:

Table 18.2: Number of publications by COEs (2015-2020)

S. No.	Segments	Journal publications	Research reports	Books	Others (Book chapters and working papers)	Total
1	Agrotech & Packtech	34	18	0	51	103
2	Composites	1	0	0	0	1
3	Geotech & Oekotech	18	12	0	1	31
4	Hometech & Indutech	216	0	11	27	254

5	Jute Geotextile	25	0	0	1	26
6	Meditech	15	13	0	8	36
7	Nonwovens	69	8	7	12	96
8	Protech & Mobiltech	32	0	4	58	94
9	Sportech	33	12	0	0	45
	Total	443	63	22	158	686

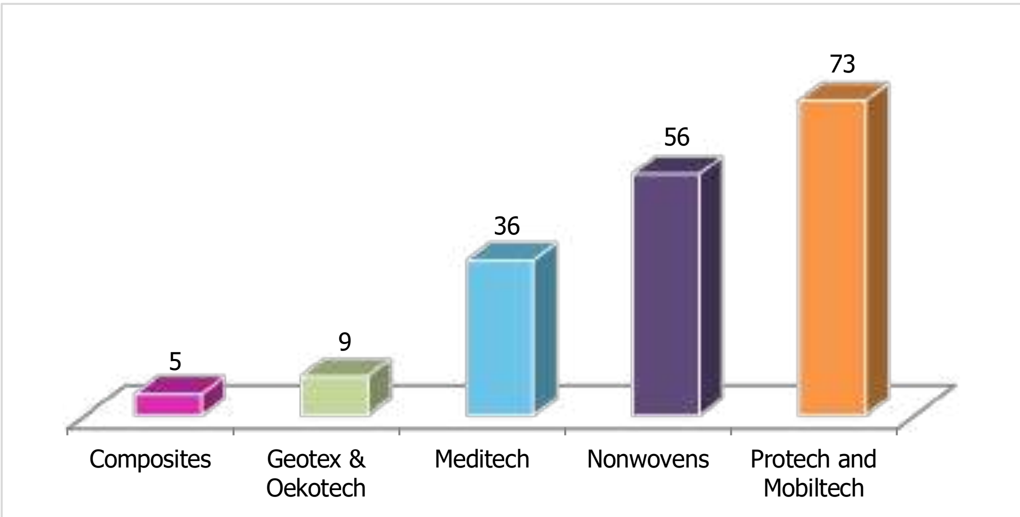
Source: Primary survey by IIT Delhi

From the data presented in the figure and table above, it can be inferred that the maximum number of publications have been in Hometech and Indutech segments of technical textiles (approximately 37%) followed by those in nonwovens and in Protech. Most of the research work by the COEs has been published as journal articles although working papers and research reports have also been published. In terms of journal papers and books, the highest number of documents has been published in Hometech and Indutech segments. In terms of research reports and working papers categories it is Agrotech & Packtech, Protech & Mobiltech which have the highest numbers respectively.

18.3.4 Academic projects undertaken by COEs (2015-2020)

The COEs have undertaken various academic projects during last six years. The figure show below depicts the segment-wise distribution of the total number of such projects undertaken by the COEs.

Figure 18.6: Number of academic projects completed (2015-2020)



Projects are undertaken by the COEs at three different levels – undergraduate, postgraduate and Ph.D. level. The information about the academic projects completed by COEs at different levels is presented in the following table:

Table 18.3: Number of academic projects completed at different levels (2015-2020)

S. No.	Name of the Segments	Number of projects at Undergraduate level	Number of projects at Postgraduate level	Number of projects at Ph.D. level
1	Composites	5	0	0
2	Geotech & Oekotech	5	3	1
3	Hometech & Indutech	30	20	2
4	Meditech	2	32	2
5	Nonwovens	40	12	4
6	Protech and Mobiltech	73	0	0
	Total	155	67	9

Source: Primary survey by IIT DELHI

From the table presented above, it can be inferred that the maximum number of projects have been undertaken in Protech and Mobiltech segments and lesser than those in nonwovens and Meditech. Most of the completed academic projects of the COEs are at undergraduate level. At the postgraduate level, the highest number of projects are in Meditech segment and lesser than that in Hometech, Indutech and nonwovens. At the Ph.D. level, the number of completed academic projects is about 4% of the total academic projects, whereas it is 67% and 29% at the undergraduate and postgraduate levels respectively. The information presented in the table suggests that there is a need for more projects to be taken up at the postgraduate and at Ph.D. level. Support from the government and the industry should be provided to meet this need.

18.4 Challenges and Suggestions of COEs

The COEs have experienced growth in terms of revenue generation, testing, and projects undertaken in recent years, however they are still facing several challenges. The key challenges faced by the COEs are mentioned below and these are accompanied by corresponding suggestions:

18.4.1 Skilled Scientific Workforce

The COEs need highly skilled workers with proficiency in various application domains such as chemistry, materials science, polymer science, agriculture, civil engineering, mechanical engineering and textile engineering, depending on the research area and product type. They should also have competence in laboratory testing methodologies and be able to handle different types of machinery like perspirometer, vibrodyne, electrospinning and warp knitting machine, among others. However, COEs have found it challenging to recruit and retain qualified manpower because the remuneration offered by the COEs is below that offered by industry and academia. Scientists are often recruited for entry level positions on contract basis which does not offer them long-term job security. This makes COEs a less attractive career option for young scientists. Special efforts have to be made to acquire COE-specific competencies by all those who join COEs because there also is a lack of specialised education and specific on-the-job training by academic institutions in India to prepare the students for the specific requirements of COEs.

The challenge stated above can be met by COEs imparting in-house and hands-on training on machine and testing instruments that they have. Further, the COEs must find resources to compensate the scientists at par with compensation of scientists working in CSIR laboratories. The COE personnel should be deputed in plants manufacturing nonwovens and in textile research associations for their training and knowledge upgradation. The COEs must arrange necessary funds for training and development of employed workforce and for developing training modules and inter-disciplinary courses related to various application segments. Academic institutions should also offer Continuing Education Programmes (CEP) for employees of the COEs.

18.4.2 Consumer Awareness

Consumers are unaware of the use and utility of various products of technical textiles. In addition to that, most of the consumers are price-conscious and not quality-conscious, preferring technical textiles of low-cost but poor quality even if it causes damage to health and hygiene.

The challenge referred above can be resolved by conducting workshops and seminars for promoting technical textiles products in India and encouraging the COEs to participate in exhibitions and consumer fairs so as to showcase the uses and applications of technical textiles.

18.4.3 Financial Resources for Research

Most COEs fail to undertake important research projects due to lack of funds. At present, there is a shortage of required financial assistance and grants, limiting the ability of COEs to undertake R&D projects, support incubation activities, or to conduct workshops and seminars.

The challenge mentioned above can be resolved by sponsoring and facilitating funds for R&D projects, infrastructure, start ups, incubation activities by government and industry.

18.4.4 Specifications and Standards

There is a lack of uniformity in processes and standards used for testing textile products. Many COEs use a different mix of Indian and international standards. Such lack of standardisation in product specifications leads to more deviations being permitted during testing and finalising results. COEs require significant support from the government to formulate and implement new standards.

The challenge mentioned above can be resolved by providing funding support so that COEs can develop various standards at par with international ones and by standardising product specifications.

18.4.5 International Collaborations

Most COEs have not expanded their operations outside India. This is in stark contrast with international COEs who have their clients in many countries.

The challenge mentioned above can be resolved by exploring and encouraging COEs to collaborate with other global COEs, participate in different nonwoven and technical textiles trade fairs and exhibitions at the international level.

International visibility can also be created by promoting joint R&D projects with foreign COEs.

19. Practices of Indian COEs and COEs in other countries: A comparison

19.1 Identification of Premier Centres of Excellence (COEs)

Centre of Excellence (COE) is an organisation located within or outside the traditional academic hierarchy of a university, college, or department. It is often established by bringing together industry and academia for pursuing an area of interest by fostering research, innovation, training and service activities. An examination of research, training, services, and projects of the premier COEs from around the globe can probably offer some directions about the changes that can be introduced to improve textile research centres in India. It is for this purpose that suggestions from faculty experts at IIT Delhi were sought and based on their suggestions, five premier foreign COEs which are working in the field of textile materials and technology (primarily technical textiles) were identified. The premier COEs so identified are as follows:

i. CLUTEX, Czech Republic
ii. Composites Research Group, University of Nottingham, UK
iii. Nonwoven Research and Innovation Institute (NIRI), UK
iv. Centre for Nanotechnology and Smart Materials (CeNTI), Portugal
v. Taiwan Textiles Research Institute (TTRI), Taiwan

19.2 Basic information about premier international Centres of Excellence

The information about the basic operational features of the five premier international COEs was collected from secondary sources ranging from their respective websites to those portals which carried news and views about technical textile industry prominently.

The following table shows some basic particulars about these premier international COEs:

Table 19.1: Particulars of premier international COEs

S. No.	COE	Description	Area of research	Weblink
1	CLUTEX, Czech Republic	CLUTEX is cluster of Czech companies, R&D institutions and other institutions focusing on technical textiles. The main objective of this cluster is to support development and innovation in areas specified by members and based on collective R&D results.	Nanotechnology in textiles, multifunctional textiles, personal protective textiles, design of customised textile structures, biotechnology and bio-based resources	http://www.clutex.cz
2	Composites Research Group, University of Nottingham, UK	This is a internationally respected research group which is located at University of Nottingham and is focused on supporting research in composite materials. The group has conducted R&D on Composites Science and Manufacturing projects for over 25 years. It has also focused on processing and performance of advanced fibre composites.	Biocomposites, composite manufacturing, textile composites	https://www.nottingham.ac.uk/research/groups/composites-research-group/index.aspx
3	Nonwoven Research and Innovation Institute (NIRI), UK	NIRI is a private limited company and a global leader in nonwoven engineering and product development. It has completed over 500 projects for over 200 companies.	Nonwoven textile material for application in various segments of technical textiles	https://www.nonwovens-innovation.com
4	Centre for Nanotechnology and Smart Materials (CeNTI), Portugal	CeNTI is a is a private, non-profit R&D institute which is collaborative venture of three Universities, two technological centres and one Institute of New Technologies. It is a centre that focuses on new technologies with a multi-sectoral orientation, it has machines and equipment based on cutting-edge technology.	Nanotechnology and smart materials	https://www.centi.pt/en/about/welcome
5	Taiwan Textiles Research Institute (TTRI), Taiwan	This is a government-funded centre which is regarded as an integrator of technology and leadership of industry. It offers customised multi-integrated and transformative service to interested textile enterprises. It is focused on textile R&D, service diversification, and expansion into international markets.	Textile materials (fibre, fabric, apparel, home textile, smart textile)	https://www.ttri.org.tw/en/index.aspx

19.3 Projects and collaborations of premier COEs

A perusal of information about premier international COEs suggests that the COEs engage in supporting strategic, applications-oriented research and lay special emphasis on development of expertise in those areas that relate to potential industrial applications. Such an approach improves their international competitiveness in research and development and attracts industry, government and even organisation in other countries to contribute funds. The projects taken up by the premier international COEs which were studied have been presented in the table below.

Table 19.2: Recent projects of premier international COEs

International COE	Project title	Collaboration (if any)	Aim
CLUTEX, Czech Republic	Textile 2020	Brings together 8 European technical textile clusters covering over 900 organisations	It is a European Strategic Cluster Partnership. The aim is to bring together the main advanced textile material clusters from Europe to develop and implement a long-term joint international strategy that contributes to securing, strengthening, and extending their competitiveness at the global level.
	Betitex	Gremi Tèxtil de Terrassa Spain, ATEVAL from Spain, GEM'INNOV from France, TEXCLUBTEC from Italy	This project aims to obtain textile materials capable of protecting against ticks and bedbugs. It is expected to obtain durable biocide-treated fabrics of slowly released repellent/insecticide effects (at least up to 50 washes).
Composites Research Group, University of Nottingham, UK	Advanced Manufacturing Supply Chain Initiative	University of Queensland	To drive down manufacturing cost, energy usage, and process time in producing lightweight high-end out-of-autoclave infused thermoset carbon composite products for aerodynamic performance and the highest quality aesthetic finish.
	Fibre-reinforced healthcare	University of Leeds and Smith & Nephew, UCL	To manufacture fibre reinforced composites based on linear aliphatic polyesters and high modulus fibres.
Nonwoven Research and Innovation Institute (NIRI), UK	The Sanguis filter	NHS Blood and Transplant (NHSBT), UK	The Sanguis nonwoven filter is aimed at developing medium and associated filtration technology that can remove the target antibodies from donated human blood plasma sufficient to deliver universal plasma.
	The tampliner	Imperial College London and Callaly, UK	Manufacturing of biodegradable and plastic-free tampliner.

Centre for Nanotechnology and Smart Materials (CeNTI), Portugal	Intelligent Protective VEST (iPVEST)	SCOOP Ltd, VIATEL Ltd - and CITEVE Technological Centre	The iPVEST project is aimed at research and development of innovative solutions for intelligent, multi-risk, protective clothing to increase protection, prevention and reduce the growing incidence of health and protection problems in installation and maintenance of infrastructure in the Energy and Telecommunications sectors.
	Digitisation of the textile and clothing (STV) value chain (STVgoDIGITAL)	TMG Ltd. and CITEVE	This project encompasses a set of R&D initiatives with a robust collective character that enhances the adoption and transition to the new paradigm of Industry 4.0. It is aimed to promote the digital transformation across value chains, leading to productivity and efficiency of textile companies.
Taiwan Textiles Research Institute (TTRI), Taiwan	Government Funded	Development of Flexible Electronic Textiles	The smart textile technology is based on woven fabric, through the conductive and packaged inks modification, combined with multi-layer precision coating and SMD packaging to develop flexible electronic textile, which can be applied in soft electronics, wearable and IoT related fields.
		The technology of Biological Fibre	Bio-derived natural fibres and compound fibre-based textiles were developed using alginate, chitosan, collagen, bacterial cellulose, natural cellulose, etc. The final product is biocompatible and can be widely applied in skin-friendly products and medical care.

19.4 Manufacturing and testing facilities at premier COEs

The COEs for textiles are often established to perform multiple functions which include providing leadership in research & development, offering technical consultancy services, carrying out quality evaluation of materials, facilitating new product development, prototype building, supporting pilot tests, imparting training to human resources and publishing technical books and papers. It is for this reason that COEs invest in developing excellent testing and manufacturing facilities. It is the quality and contemporariness of production and testing machines and equipment which often determines the performance outcomes of the COE thus impacting its reputation in the industry. The following table gives brief details about the manufacturing and testing facilities available in premier international COEs that have been considered for the present study:

Table 19.3: Latest Manufacturing and testing facilities available with premier international COEs		
International COE	**Manufacturing and testing facility**	**Description**
Composites Research Group, University of Nottingham, UK	KUKA six-axis Robot Bentley Room	This robot has a compact six-axis, which are designed for exceptionally high working speeds.
	Prototyping facilities for nonwoven fabrics	Manufacturing methods like spun-laid, wet-laid, drylaid, electrospinning, are available for prototyping of different nonwoven fabrics.
Nonwoven Research and Innovation Institute (NIRI), UK	X-ray Microtomography (XMT)	This is an X-ray imaging in 3D, the same method used in clinical CT scans, but on a small scale with significantly enhanced resolution.
Centre for Nanotechnology and Smart Materials (CeNTI), Portugal	Functional coatings	Functional coatings are applied using different vacuum and extrusion techniques.
	Surface mount technology	In this method, a line of electronic components is attached and connected on the board's surface using batch solder-reflow processes.
	3D printing for prototype	3D printing optimises the design step by speeding iterations through product testing. Rapid prototyping with 3D printing allows designers to produce multiple design iterations quickly and change a product design overnight.
	Fanuc M16-1 Robot	The Fanuc M-16 robot provides an intelligent automation solution for various applications such as material handling and removal, loading and unloading, assembly and even water jet cutting etc.

19.5 Knowledge dissemination by premier COEs

One of the main aims of the COEs in textiles is 'knowledge dissemination' among the professionals working in the industry in different roles and functions. The main mechanism followed for such knowledge dissemination is 'information sharing' and it is accomplished through various events and programmes such as conferences, workshops, seminars, visits, fairs, webinars and training programmes. A large part of COE activity comprises such events and programmes. Besides benefitting the industry professionals, these programmes help the COEs to develop a sustainable revenue model and build human resource capacity. In order to get a glimpse into the nature of such activities in premier international COEs, the particulars of recent knowledge dissemination activities are provided in the following table:

Table 19.4: Recent knowledge dissemination initiatives of premier international COEs

International COE	Type of programmes	Description
CLUTEX, Czech Republic	EXTRATEX – company visits	CLUTEX organises company visits as a part of the EXTRATEX project. The aim of the event is to introduce Czech partners to foreign partners, establish new foreign contacts and possible cooperation across sectors. CLUTEX is scheduled to conduct the next round between 20th – 24th September 2021. The programme will consist of company visits, company presentations and B2B meetings with partners from various European countries.
	Conference	Final online conference of TEX4IM (Textile Clusters for Industrial Modernization) was conducted during 20-22 April 2021. Lectures and webinars focused on the topics that covered the circular economy and digital transformation in the textile industry were held.
	Virtual Trade Show	BE@Smart Manufacturing Matchmaking event was held during November 18 - 20, 2020. It was a virtual business fair with a webinar and also created possibilities of individual meetings among potential partners from different countries. This event was aimed at growing and expanding market opportunities in the European Textile-clothing sector.
Composites Research Group, University of Nottingham, UK	PhD.	The centre offers facilities for fully-funded PhD opportunities in the field of composites.
Nonwoven Research and Innovation Institute (NIRI), UK	Technical & Market Intelligence Training	NIRI provides tailored training programmes to organisations depending upon their requirements.
Centre for Nanotechnology and Smart Materials (CeNTI), Portugal	Automotive Interiors Expo 2020, Virtual 'Live' exhibition	"Seamless textile sensing solutions for car seats" was the theme of this European exhibition on December 1 & 2, 2020.
	SmartEEs2: Webinar focused on Printed Electronics	CeNTI promoted a Webinar dedicated to the SmartEEs2 Project, whose theme was "Sensing Technologies and Devices in Flexible Form". The webinar, held on July 14^{th}, 2021 was aimed at innovative companies and researchers interested in working in the printed electronics areas. Smart EEs2 is a collaborative European project which aims to promote the adoption and use of "Flexible and Wearable Electronics" technologies by companies for enhancing their competitive advantage and responsiveness in the market.

	SmartEEs2: Training event	A Webinar was conducted on December 7th, 2020 by that CeNTI and TNO. The theme of the webinar was "Hybrid Printed Electronics for Flexible, Stretchable and 3D Products". The training oriented webinar, directed at professionals, entrepreneurs and researchers consisted of discussion on Printed Electronics topics, such as processing, printing, assembly and building. Some demos associated with these technologies were also presented.

19.6 Comparative analysis of premier international COEs and Indian COEs

The activities and performance of the Indian COEs have been studied, analysed and documented as part of this study. Based on the information documented about Indian COEs and its comparison with the information about practices of premier international COEs, the following inferences can be drawn to formulate suggestions to improve the functioning of COEs in India:

i. The Indian CoEs have a relatively weaker international research contacts, expertise, and research training capacity than the premier international COEs. Indian COEs will have to improve significantly in these aspects so that they can compete in the global scenario and play an instrumental role in developing research, innovation, and higher education in technical textiles in India.

ii. Indian COEs earn relatively lesser part of their revenue from projects as compared to premier international COEs whose primary activity is carrying out projects. Most Indian COEs fail to undertake important research projects due to lack of funds. There is enough scope for improvement for Indian COEs in this regard. The challenge mentioned above can be resolved by sponsoring and facilitating funds for R&D projects, infrastructure, start-ups, incubation activities by government and industry.

iii. Indian COEs are constrained to work in an environment of low customer and enterprise level awareness. Therefore, knowledge dissemination and information sharing efforts by Indian COEs have to be much greater than these are at present. Indian COEs can study the high levels of such activities by premier international COEs and adapt their practices and approach to Indian conditions.

iv. In case of India, there is a lack of uniformity in processes and standards used for testing textile products. Many COEs use a different mix of Indian and international standards. Such lack of standardisation in product specifications leads to more deviations being permitted during testing and finalising results. COEs require significant support from the government to formulate and implement new standards. The premier international COEs do not face any such challenge and instead are instrumental in formulating and updating the standards.

v. Most Indian COEs have not expanded their operations outside India. This is in stark contrast with international COEs who have their clients in many countries. This situation can be remedied by exploring and encouraging Indian COEs to collaborate with other global COEs, participate in different nonwoven and technical textiles trade fairs and exhibitions at international level. International visibility can also be created by promoting joint R&D projects with international COEs.

20. Technical Textiles Education in India

Universities and academic institutions are important instruments for dissemination of relevant knowledge and for encouraging new ideas and innovation in any field, and technical textiles is no exception. A primary survey of all the academic institutions and universities which offer textile-related programmes and courses in India was conducted by IIT Delhi. The responses to the survey have then been documented and analysed to serve as inputs for policy makers. This may help in formulating better policy interventions for supporting technical textiles industry in India.

Alongside the primary survey, an attempt has been made to identify the best practices of premier institutes across the globe so as to identify areas of changes needed in Indian institutions to reinforce their strengths.

20.1 Methodology

All academic institutions and universities of the country which offer programmes in textiles at different levels (undergraduate, postgraduate, and Ph.D.) were identified for the study. A semi-structured questionnaire targeted at Heads of Institutions/Heads of Textile Departments was developed by the experts at Indian Institute of Technology (IIT) Delhi. The content of the questionnaire covered among other things, institution level data about the textile-based programmes and courses being offered, curriculum, faculty resources, machines and equipment installed, number of students, research conducted, projects and consultancy assignments, challenges being faced and future areas likely to be pursued for growth.

20.2 Findings from the Primary Survey of Academic Institutions in India

Textile related programmes offered by academic institutions and universities in India

Government of India has identified technical textiles as a sector that needs to be put on an accelerated growth path to unlock India's potential and to harness opportunities in domestic and international markets. There is a need to develop a pool of human resources that are trained for specialised skills and knowledge of technical textiles so that they can undertake new developments and innovations. However, in India, most of the courses related to technical textiles are offered as part of textile discipline.

We identified and contacted all the academic institutions/university departments which offer technology programmes in textiles in India. A total of 31 academic institutions and universities participated in the survey.

Table 20.1: Textiles related programmes offered, sanctioned strength and number of students passed out				
S. No.	**Name of Programme**	**No. of institutions & universities offering the programme**	**Total sanctioned strength**	**Total number of students who passed out (2019)**
1	B.Tech. / B. Sc.	31	2134	1747
2	M.Tech.	16	375	120
3	Ph. D.	9	243	18
	Total	**31**	**2752**	**1885**

Source: Primary Survey conducted by IIT Delhi

Textile-related programmes are taught at four levels – Diploma, Bachelor's (B.Tech.), Master's (M.Tech.) and Doctoral (Ph.D.). The colleges/institutes offering diploma courses are outside the scope of the present study's primary survey but list of all such institutions has been provided in Annexure 28 of this report. These institutes/colleges/ university departments offer Bachelor's and Master's programmes in:

i. Textile Technology
ii. Textile Engineering
iii. Carpet and Textile Technology
iv. Textile Chemistry
v. Jute and Fibre Technology

Even though most of these programmes have an elective (optional) course related to technical textiles, none of the institutions reported offering a complete specialised programme on technical textiles.

All the 31 respondent institutions/universities offer Bachelor's degree programmes. Master's and Doctoral programmes are offered by 16 and 9 institutions respectively.

- Bachelor's programmes comprise of 78% of the total sanctioned strength for all programmes.
- More than half the seats remain vacant in programmes other than the Bachelor's programme (as per 2019 data).
- There are 9 respondent institutions that offer PhD. programme in textiles. The names of the institutions and their respective sanctioned student intake are presented in the following table:

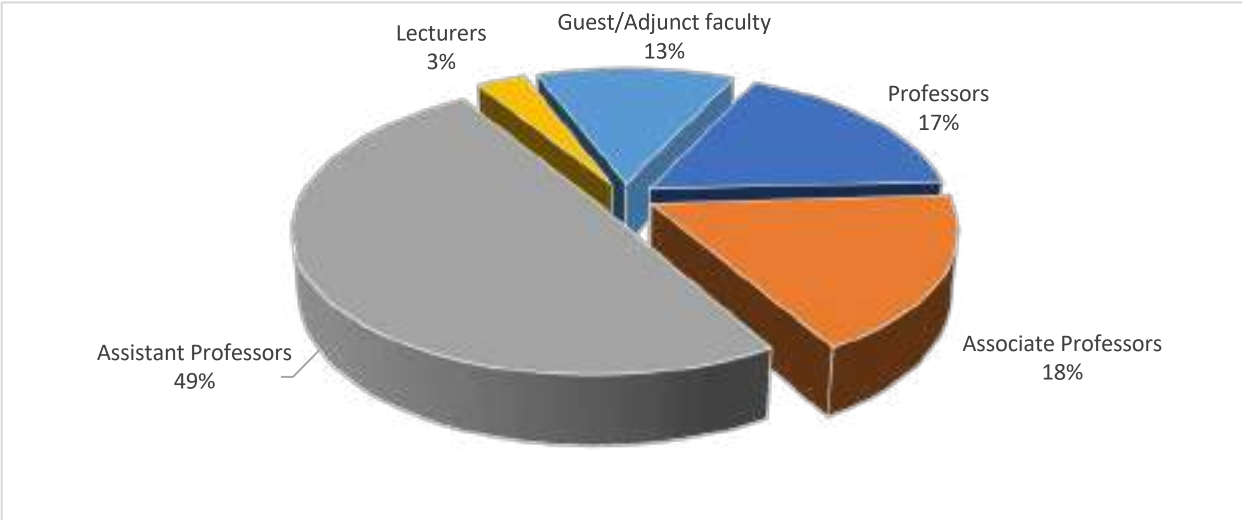
Table 20.2: Institutions/ Universities offering Ph.D. programmes in textiles (2019)			
S. No.	**Name of Institutions/Universities**	**Sanctioned strength**	**Students who passed out in 2019**
1	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	8	0
2	DKTE Textile & Engineering Institute, Kolhapur	Open	3
3	Kumaraguru College of Technology, Coimbatore	Open	2
4	MLV Textile and Engineering College, Bhilwara	8	0
5	University of Calcutta, Department of Jute and Fibre Technology (erstwhile-Institute of Jute Technology)	12	3
6	Uttar Pradesh Textile Technology Institute, Kanpur	14	0
7	The Maharaja Sayajirao University of Baroda, Vadodara	34	2

8	Anna University, Chennai	Open	3
9	IIT Delhi	120	11
Total		**196**	**24**

Source: Primary Survey conducted by IIT Delhi

20.2.1 Faculty strength and its break-up

Figure 20.1: Distribution of faculty placed in various positions



Source: Primary Survey conducted by IIT Delhi

Of the 380 faculty members across 31 institutions, 188 are Assistant Professors, 67 are Associate Professors, 65 are Professors, 12 are Lecturers and 48 are Guest/Adjunct faculty.

20.2.2 Faculty resources

The faculty resources are an important indicator of adequacy of required number of learning resources available to the students. The following table presents the ratio of number of students per faculty in 2019. The data highlights that there was one teacher (including guest/adjunct faculty) for every 27 students and one teacher (excluding guest/adjunct faculty) for every 31 students.

The All India Council for Technical Education (AICTE) has fixed 1:15 faculty-student ratio for deemed universities, autonomous colleges and accredited engineering colleges.

Table 20.3: Faculty resources (2019)

	Total faculty strength	**Total sanctioned number of students**
Total Number	380	10258
Number of students per faculty (including guest/adjunct faculty): 27		
Number of students per faculty (excluding guest/adjunct faculty): 31		

Calculation is based on sanctioned student strength as follows: (2134 x 4) + (375 x 2) + (243 x 4) divided by 380.

20.2.3 Library resources

Books, journals, research reports and other resources of the library play a key role in knowledge conservation and dissemination. The following table gives an aggregate view of the library resources of the participating institutions.

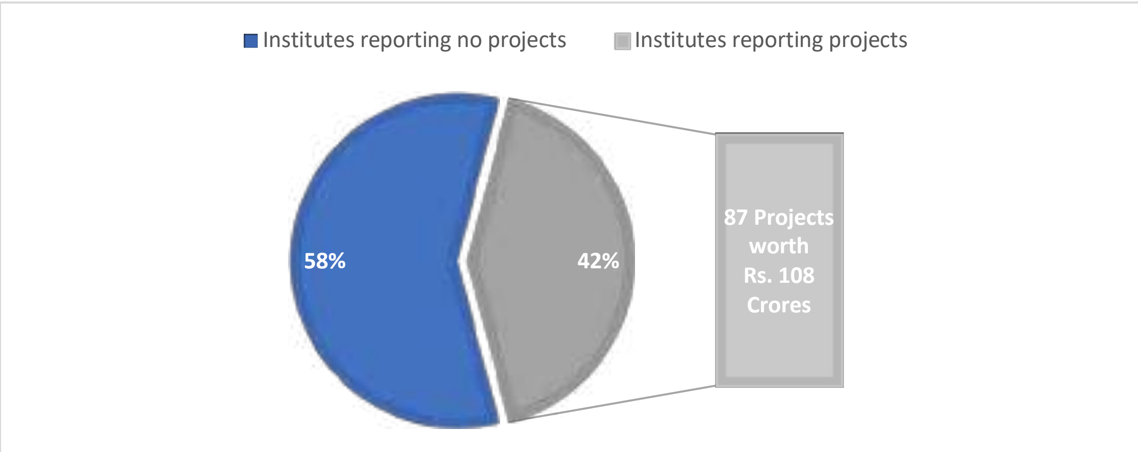
Table 20.4: Library Resources

	Number of books	Number of international journals subscriptions	Number of national journal subscriptions
Total number	146949	2164	477

Source: Primary Survey conducted by IIT Delhi

20.2.4 Funded/Sponsored Projects (2015-2020)

Figure 20.2: Funded / sponsored projects undertaken by Academic Institutions (2015-2020)



Source: Primary Survey conducted by IIT Delhi

It was observed that 13 (42%) out of 31 academic institutions were involved in funded/sponsored projects during 2015-2020. The names of such institutions and the titles of the funded/sponsored projects are presented in Table 20.5. The total number of projects (top ten in terms of value) undertaken by these 13 universities is 87, and the project funding for these amounts to Rs. 108 Crores.

Table 20.5: Funded/sponsored projects reported by Academic Institutions (2015-2020)

S. No.	Name of Academic Institution/ University Department	Important projects undertaken
1	College of Engineering and Technology, Bhubaneswar	Enhancing light fastness of dyed Nomex Fabric by Nano-Dyeing
2	Institute of Chemical Technology (ICT), Mumbai	Modification of synthetic fibres and their colouration
		Development of mosquito repellent textiles
		Product development through wet processing

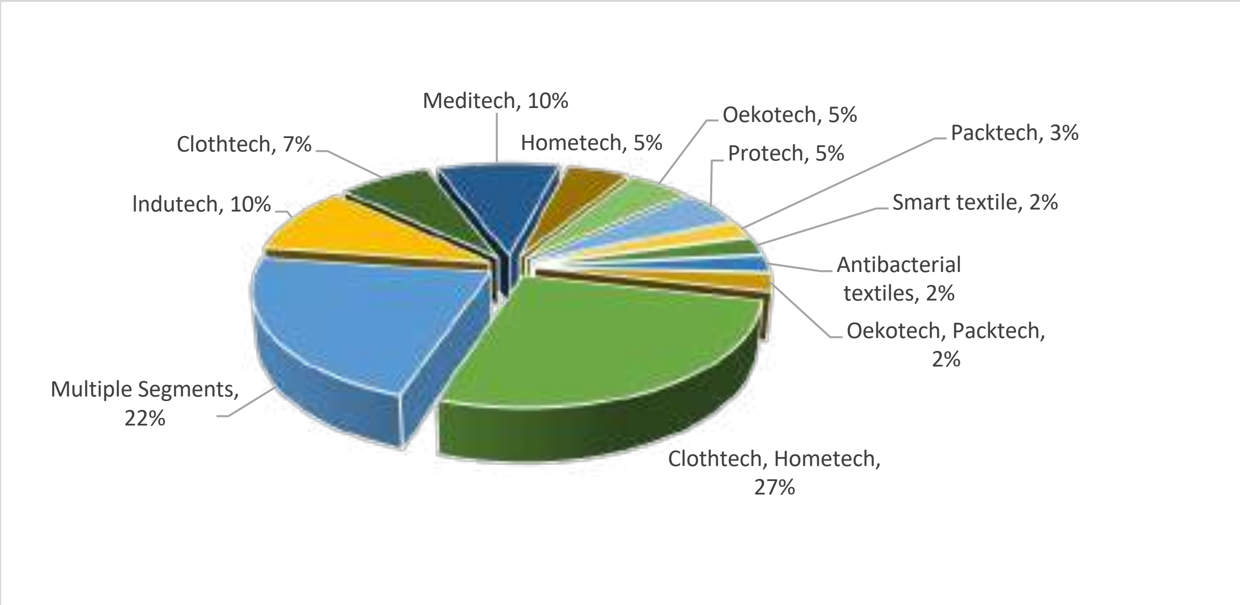
		Covalently coupled pentacene dimers: novel materials for organic photovoltaics
		Biodegradable flame retardants
		Phenanthroline-ly coupled tetracene dimers: novel materials for organic electronics
		Novel reactive dye system based on diazonium salts
		Development of triple-layered nanofibrous bandages as a wound dressing material
		Development of new generation high-performance auto responsive green textile through renewable energy resources
		Singlet fission via extended aromaticity of azacenes: (sfeaa) novel material for potential solar cell applications
		Product development through wet processing
		Evaluation of the efficiency of natural dye formulation as hair dye
		Development of specialty chemicals
		Research & development of specialty chemicals using biotechnology
3	Kumaraguru College of Technology, Coimbatore	Development of characterisation of banana peel protease-based wound dressing material for genital warts
		Development of flame retardant home textiles with self-cleaning and antibacterial properties
		Design and fabrication of computerised dynamic knittability tester for hosiery yarns
		Development of self-cleaning finish in home textile material
4	Indian Institute of Carpet Technology, Bhadohi	Development of woven carpets in terry pile structure loom in hand made carpet perspective
		Application of jute material in hand-made carpets
		Promotion of handmade carpet through improved and predictable wear performance of handmade woolen carpets
		Promotion of handmade carpet through incorporation of tug reed mechanism in handloom
		Promotion of handmade carpet through optimum utilisation of Indian wool in hand made carpets
		Promotion of handmade carpet through development of vertical mechanised durry loom
		Promotion of handmade carpet through incorporation of jacquard mechanism for designing of pile carpet
		Promotion of handmade carpet through development of continuous tufting system
		Promotion of handmade carpet through survey-based database and studies on process standardisation for woolen/semi-worsted yarn manufacturing
		Studies on silk carpets
5	DKTE Textile & Engineering Institute, Kolhapur	Cluster Management Technical Agency (CMTA) for power loom mega cluster scheme
		Centre of excellence in nonwovens
		MODROB - Development of textile chemistry laboratory
		Focus Incubation Centre in coated technical textiles
		Entrepreneurship Development Cell (EDC)
		Research & Development project – Development of spinning waste

		linen fibre-based nonwovens for technical textiles applications
		Research promotion scheme-study of lubricants used in textile machines
		MODROB-procurement of wet spinning machine
		Development of textile chemistry laboratory-upgradation of textile chemical processing laboratory
6	Uttar Pradesh Textile Technology Institute, Kanpur	Wastewater effluent treatment by using PPy (polypyrrole) based nano-clay composites
		Insulating materials development and evaluation
		Development of antimicrobial textiles using biowaste: synthesis and characterisation
7	Dr. B. R. Ambedkar National Institute of Technology, Jalandhar	Design of fabric tensile impact testing machine
		Optimisation of pulse cleaning parameters for achieving high-level performance of filter media during industrial pollution control
		Designing of wet abrasion tester
		Design of pulse jet filtration
8	K. S. Rangasamy College of Technology, Namakkal	Design and development of anti-diabetic herbal medical suture
9	NITRA Technical Campus, Ghaziabad	Development of electronic drape meter based on image analysis technique
		Development of fabric smoothness tester
		Development of smart protective textiles for firefighters, soldiers and old-age people
		Development of protective work-wear for cement porters
		Development of multi-layered flame & thermal resistant fabric for firefighter clothing
		Development of value-added product from different fibres in Himalayan region
		Development of improved version of body protector used for riots control
		Development of air cleaner home textiles to reduce indoor air pollution
		Development of technical textiles products in the field of feminine hygiene
10	IIT Delhi	Development of soft body armour using shear thickening fluids
		Development of multi-layered coated and laminated fabric for aerostat hull material
		Design and development of laminated fabric for high altitude airship
		Design and development of extreme heat protective clothing
		Extreme cold weather clothing for defence personnel
		Direct 3D bio-printing strategies to study articular cartilage development, degeneration and regeneration
11	Anna University, Chennai	Development of centrifugal spinning machine prototype for production of nanofibres and its application in tissue engineering
		Fabrication of biomimetic nerve guide by a facile ultrafine fibre spinning method
		Design and development of novel microfibre spinning assembly for health care application
		Development of aerosol filters using silica aerogel and textile composites

		Bulk scale sustainable salt-free exhaust dyeing on cationized cotton knit fabrics
12	University of Calcutta, Department of Jute and Fibre Technology (Erstwhile-Institute of Jute Technology, Kolkata	Coating/finishing of textile, based on jute and other natural fibres for technical applications
		Development of eco-friendly natural fibre-based textile (Oekotech products) with simultaneous natural dyeing and natural finishing and to establish natural dye /finish mark
		Design and development of jute-cotton blend based nonwoven fabrics for potential uses as surgical disposable (SD), medical packaging (MP) and medical disposable baggage (MDB) materials
		Development of products from Himalayan Indian nettle
		Standardisation of fire-retardant finish for jute fabric
		Design and engineering of industrial wipes for potential application in fluid absorption
		Development of bags made from jute fabric aluminum foil laminate for packaging of tea
		Design and engineering of jute and jute blended combined fabrics and its suitable after-treatment to develop Geomembrane and tarfelt for potential use
		Designing, engineering and application of jute based Agrotextiles: a bio-engineering measure for soil and water conservation and fertility enhancement of the barren and baid lands of Purulia, West Bengal, India
13	Department of Textile Technology, PSG College of Technology, Coimbatore	Centre for excellence for Industrial Textiles (Indutech)
		Focus Incubation Centre (FIC)
		Development of jute/jute blended fibrous mat for effluent filtration applications
		Recycling of textile industrial waste as value added composite materials
		Design & development of electro-active sensor fabrics (body kinematics and vital signs)
		Development of antimicrobial suture using PLLA fibres spun (dry-jet-wet spinning)
		MODROB in textile chemical processing laboratory
		Development of durable antimicrobial face mask using natural fungal extract
		Development of active sportswear using bi-layer knitted fabrics
		Development of antimicrobial silk suture materials
		Development of oil sorption and sound absorption pad using natural fibre based non-wovens textiles for sustainability

The following chart presents segment-wise distribution of the projects undertaken by the academic institutions:

Figure 20.3: Segment–wise distribution of 87 funded / sponsored projects in last six years (2015-2020)



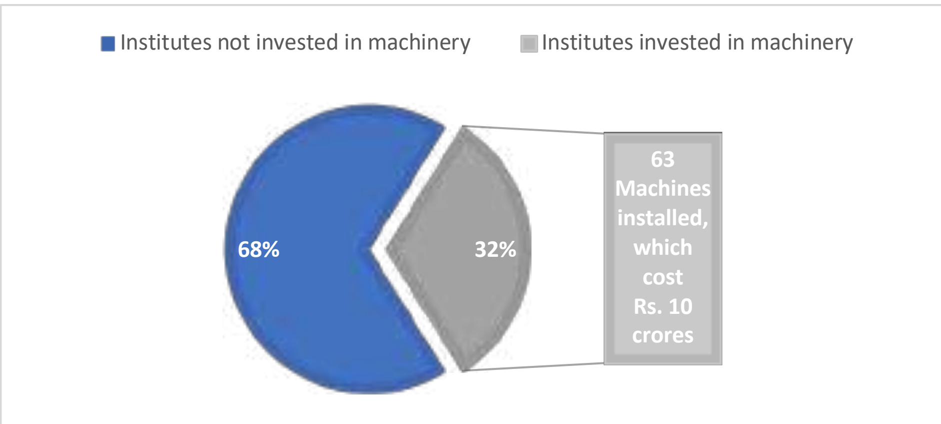
Source: Primary Survey conducted by IIT Delhi

The above figure shows that the highest number (16) of projects are in Hometech segment with a total project value of Rs. 7.50 Crores. Other major segments with such projects are Protech at 15%, Meditech at 14%, Indutech at 13% and Clothtech at 12%.

In four segments – Agrotech, Buildtech, Geotech and Sportech, the academic institutions reported one funded project each during the period 2015-2020.

20.2.5 Machines and equipment worth more than Rs. 5 Lakhs each, installed in last three years (2017-2020)

Figure 20.4: Machines and equipment installed in the years 2017-2020



Source: Primary Survey conducted by IIT Delhi

There are 10 academic institutions that reported having installed 63 machines and equipment worth more than Rs. 5 lakh each related to technical textiles in the years 2017-2020.

The total cost of all the machines and equipment installed is around Rs. 10 Crores.

20.2.6 Placement of Students

Number of students placed in the industry over the past five years is as follows:

Table 20.6: Number of students placed in conventional textiles and technical textiles sector (2015- 2019)

Year	Total number of students placed in conventional textiles industry (A)	Total number of students placed in technical textiles industry (B)	Total no. of students placed each year (C = A +B)	Percentage of students placed in technical textiles
2015	992	41	1033	3.9
2016	902	34	936	3.6
2017	943	43	987	4.4
2018	864	67	931	7.2
2019	834	41	875	4.7
Total	**4535**	**226**	**4762**	**4.7**

Source: Primary Survey conducted by IIT Delhi

Based on the responses received during the survey, over the past five years the number of students pursuing technology and engineering programmes in the field of textiles has declined. Only one in 25 students was placed in the technical textiles industry. Approximately 48% students got jobs through campus placements in 2019.

20.2.7 Patents Granted

Information furnished by the academic institutions with respect to patents applied for and granted is summarised in the following table:

Table 20.7: Patents related to technical textiles products/ machinery/ raw materials for the period 2015-2020

S. No.	Category	National	International	Total
1	Patents applied for and under consideration	32	7	39
2	Patents granted	14	3	17
	Total	**46**	**10**	**56**

Source: Primary Survey conducted by IIT Delhi

With respect to patents applied for, a greater number of patents have been applied for domestically as compared to those with international agencies. Domestic patents as a percentage of total applications were 82.05%, whereas international patents as a percentage of total applications are 17.94 percent.

20.2.8 Number of publications (2015-2020)

Table 20.8: Number of publications (2015-2020)							
S. No.	**Type of publications**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
1	Journal articles	216	208	314	242	222	227
2	Research reports	3	6	8	10	7	2
3	Books	5	9	5	5	8	5
4	Others (Book chapters, Working papers, etc.)	27	11	22	42	38	20
	Total	**251**	**234**	**349**	**299**	**275**	**254**

Source: Primary Survey conducted by IIT Delhi

20.2.9 Start-ups in technical textiles supported by Academic Institutions/University Departments

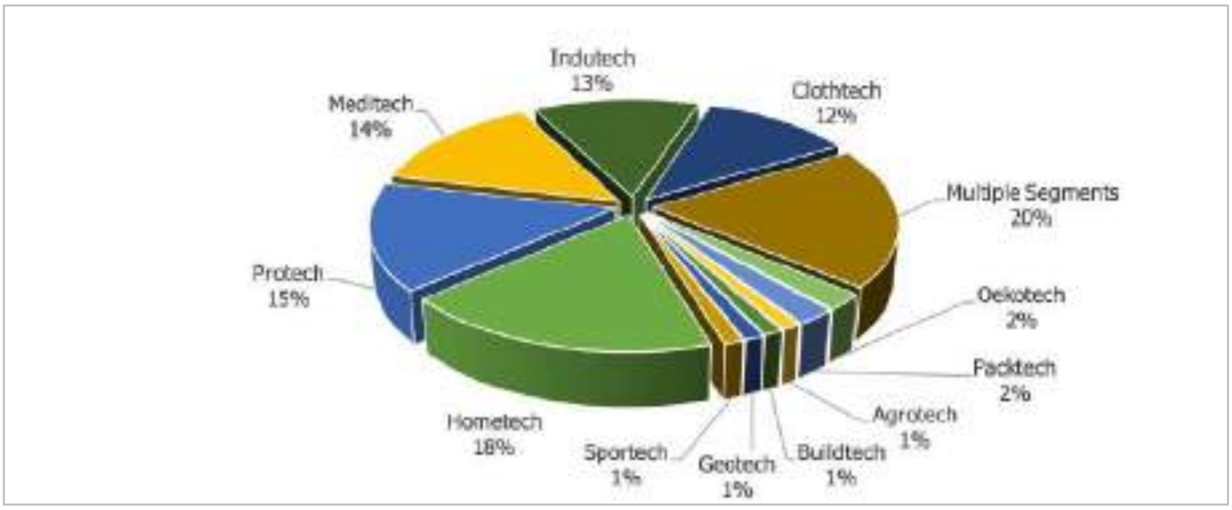
To encourage entrepreneurs and to promote innovations in technical textiles, many academic institutions are supporting start-ups. These efforts are summarised as follows:

Table 20.9: Products of the start-ups reported by respondent institutions (segment-wise)	
Segment(s)	**Products of the start-ups**
Indutech	Industrial export fabric manufacturing, warp preparation unit for specialised fabrics, patterning & garment stitching, manufacturing of utilities for textiles
Meditech	Medical textiles, compression measurement device for bandages, facemask and antibacterial water container
Oekotech	Technical sorbent sheet, eco-friendly bags
Packtech	Water resistant biodegradable cotton/jute bag for shopping and other purposes, Bag based on jute fabric aluminum foil laminate for distribution of Prasadam at Devasthanam of Tirupati, Tirumala Trust
Protech	Textile mobile application, Intelligent parking solution
Clothtech, Hometech	Woven fabric, knitted garments, printing of fashionable fabric required for apparels, garment washing with value added finishes, body shape garments, waste recycling unit, manufacturing of single end sizing, novelty embroidery designs, reed cleaning equipment for loom, manufacturing of compact warp patterning device, water governance equipment, garment finishes, kids wear, household textiles
Smart textiles	Posture monitoring device
Various Segments	Modification of plain power loom in to shuttle less technology, manufacturing of sample weaving machine, fabric manufacturing, manufacturing of innovative flexible rapier weaving Machine " Wayan", manufacturing of warp connect technology, warp preparation and welding device, modification of plain power loom into shuttle-less technology, geographical patent provider, control systems

Source: Primary Survey conducted by IIT Delhi

Note: The information presented above is based on data provided by Kumaraguru College of Technology Coimbatore, Jawahar Lal Nehru Government Engineering College, Sundernagar, Guru Nanak Dev University, Amritsar, DKTE Textile & Engineering Institute, Kolhapur, IIT Delhi, University of Calcutta, Department of Jute and Fibre Technology, and PSG College of Technology, Coimbatore

Figure 20.5: Segment-wise bifurcation of technical textiles-related start-ups



Source: Primary Survey conducted by IIT Delhi

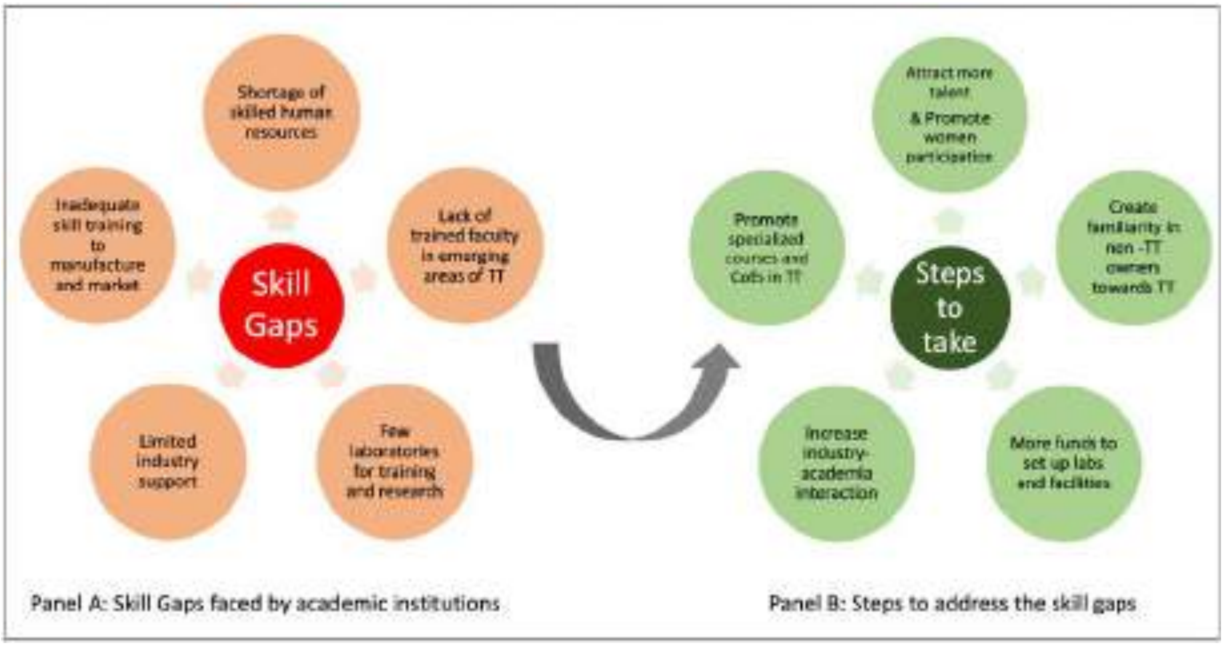
There are 7 institutions which provided details of the start-ups being supported by them. Total number of start-ups reported is 41 out of which 11 start-ups are from Clothtech and Hometech combined.

There was one start-up each in the domain of smart textiles and antibacterial textiles.

20.2.10 Skill gaps in technical textiles education in India

The primary survey also tried to capture skill gaps prevalent in the technical textiles sector. Listed below are some skill gaps identified by the respondent institutions.

Figure 20.6: Major skill gaps in textile education and ways to address them as reported by respondents



Source: Primary Survey conducted by IIT Delhi

Major skill gaps

Related to industry interaction:

- There is very limited collaborative industry-academia interaction as evidenced by small number of industry-oriented projects, few opportunities for students and faculty for practical exposure to industry and lack of significant financial support by industry to academia for R&D
- Lack of technical textiles machine development projects

Related to research and manufacturing:

- When compared with those in other countries, technical textiles workforce in India has received very little skill training for manufacturing and marketing technical textiles. Less than 5% of employees in technical textiles industry have attended any formal training compared to similar employees in other nations (UK: 68%, Germany: 75%, USA: 52%, Japan: 80% and South Korea: 96%)
- Lack of training and encouragement for developing prototypes
- Limited practical knowledge about technical textiles, the associated processes and reverse engineering of products
- Lack of awareness of recent developments in technology and manufacturing equipment

Related to new talent in the industry:

- Shortage of trained faculty
- Inadequate knowledge exposure about recent products and applications of technical textiles

Methods to address the skill gaps

The following steps were suggested by the respondents to fill the skill gaps:

Related to industry interaction:

- More effective formal mechanisms to improve the opportunities and quality of interaction between industry and academia must be established
- Frequent and more productive visits of students and faculty members to manufacturing plants/ research facilities must be ensured so as to provide them with greater exposure to the industry
- Number of funded/industry sponsored projects need to be increased
- Technical textiles associations and other industry bodies should increase their engagement with academic institutions

Related to research and manufacturing:

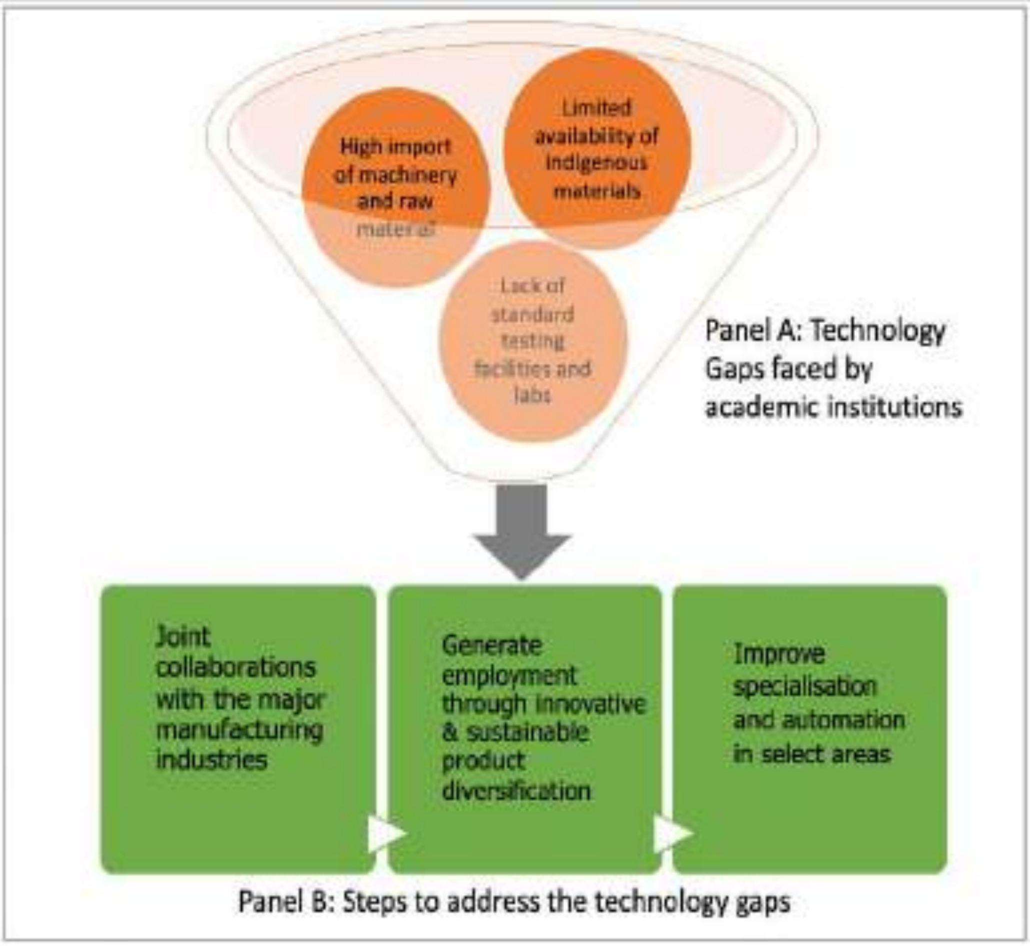
- Promote industry to sponsor research in academic institutions
- Provide government support for development of prototypes
- Promote inter-disciplinary research in academic institutions for design and development of machinery useful for production of technical textiles products

Related to new talent in the industry:

- Offer specialisation in technical textiles at the UG/PG level with adequate number of choice of subjects in the curriculum
- Setup more COEs and improve the research ecosystem
- Conduct more industrial training programmes for students in technical textiles companies
- Conduct training programmes incorporating industry training for faculty for updating their knowledge and skills

20.2.11 Technology gaps in textile education in India

Figure 20.7: Technology gaps in textile education and ways to address them as reported by respondents



Source: Primary Survey conducted by IIT Delhi

In the context of technology gaps in textile education, the following suggestions were made:

Related to high dependence on imports:

- Machinery: At present, most of the machinery that is used to manufacture technical textiles products is not available in India and has to be imported. The R&D institutions have been unable to make a significant contribution towards designing and developing machines and equipment locally. This has placed Indian technical textiles manufacturers at a relative competitive disadvantage vis-à-vis manufacturers of technical textiles from other countries
- Raw material: India relies heavily on imported specialty fibres, which are raw materials for technical textiles. The technical institutions have been unable to help Indian industry in developing specialty fibres indigenously

Related to promotion of innovation:

- Natural fibres such as bamboo, jute, sabai grass, coir and banana fibres, are commonly available in many parts of India but these have still not been used for developing innovative products
- There is lack of adequate number and capacity of testing laboratories. This compromises the capability of disseminating and ensuring globally acceptable standards for Indian products and processes
- There is lack of inter-disciplinary collaboration for developing smart textiles for various applications

Methods to address the technological gaps:

Related to high dependence on imports:

- Machinery: TMMA must work with GoI to formulate special schemes that can be launched to encourage manufacturing of machinery in India to substitute imports
- Raw material: Incentivising collaboration between interested Indian manufacturer-entrepreneurs and international manufacturers of high-performance speciality fibres. This can create manufacturing capabilities locally and reduce dependence on imported raw material for technical textiles

Related to Innovative Applications:

- Vested groups must be constituted to catalyse the development of technology and processes for using natural fibres such as bamboo, jute, sabai grass, coir and banana fibres, for developing innovative technical textiles products
- Additional investment must be encouraged in public, private or joint sector to augment the number and capacity of testing laboratories to help in adoption of globally acceptable standards
- Groups must be facilitated by GoI so as to promote inter-disciplinary working for developing innovative textiles for various applications such as wearable electronic textiles, textiles for energy storage, flexible displays antenna, super-capacitors, super-absorbent, super repellents, universal antiviral mask/ PPEs and indigenous FR textiles

20.2.12 Emerging areas identified by academic institutions

Heads of most of the respondent institutions identified Meditech as the most promising area in technical textiles, followed by Geotech. The responses about the emerging areas in the order of priority are presented in the table below:

Table 20.10: Emerging areas in global technical textiles education where Indian Institutes / Universities must focus

S. No.	Upcoming areas
1	Developments in implantable and extracorporeal devices
2	Smart/Intelligent textiles
3	Developments in advanced and new textiles (spacer/3D fabrics) for applications in technical textiles
4	Developments in varieties of composite materials
5	Quick Curve Ruler (QCR) Textiles, SpaceTech, Clothtech, Oekotech, e-textile, Nano fibre technology, Disposable Technical textiles, Sustainable products and processes
6	Developments in specialty finishes to be required for different end-use applications
7	Waste management, Use of Internet of Things (IoT), Filtration Technology, Performance Textiles, Marine textiles, Coating and lamination, 3D printing, Machine and product design, Inkjet printing

Source: Primary Survey conducted by IIT Delhi

Potential areas for enhancing technical textiles education in India:

- Education about products in protective textiles
- Education about innovative Smart textiles/intelligent textiles is going to gain prominence over the next few decades.
- Multi-disciplinary education, collaborative research, research to develop flexible electronic substrates and components that would allow integration and maintain the natural flexibility of fabrics
- Education and research about cost-effective manufacturing techniques and processes

Methods to promote education in upcoming areas of technical textiles:

- Support efforts that promote better collaboration between academic institutions and TRAs, other research associations, especially for advanced nonwovens
- Establish centres for electronic textiles with financial investment by GoI along with active participation of leading industrialists and research and training institutes
- Provide adequate training to our technocrats for better understanding and appreciation of manufacturing. This will improve our country's capability to utilise facilities to manufacture different types of textile material

20.2.13 Challenges faced by academic institutions and universities in imparting education related to technical textiles

Academic institutions face certain challenges in imparting education related to technical textiles. These challenges are presented in the following table:

Table 20.11: Challenges faced by Indian academic institutions in imparting technical textiles education

S. No.	Parameter	Challenges
1	Workforce	Scarcity of competent and trained faculty
		Lack of expertise about latest developments in the field among faculty members
		Shortage of qualified support staff
2	Laboratory	Scarcity of competent and trained faculty
		Lack of laboratory facilities for imparting appropriate education about technical textiles
		Lack of modernisation of facilities (Specialty equipment & characterisation instruments, miniature technical textiles machines)
		Shortage of laboratory technicians to impart practical training related to technical textiles
3	Collaboration	Inadequacy of Industry-Academia partnerships
4	Funds	Financial constraints
5	Resources	Lack of latest machinery and instruments
		Resources (books, library journal subscriptions, software, prototypes) are limited
		Absence of a robust R&D eco-system, infrastructure, and funding avenues
6	Courses	Lack of courses being offered in technical textiles, significant obstacles faced while changing the curriculum as approval process is cumbersome
7	Jobs	Shortage of recruiters from the field of technical textiles
8	Awareness	Lack of awareness among prospective students and their parents about technical textiles

Source: Primary Survey conducted by IIT Delhi

The institutions have suggested following methods to overcome the challenges in imparting education related to technical textiles:

<u>Related to support required from the Government:</u>

- Support acquisition of latest machines and instruments for technical textiles
- Support increased collaboration between industries with institutes
- Support training of faculty members and technicians in latest knowledge and practices in the field of technical textiles
- Support funding of research projects so as to improve capabilities of development of machinery and material related to technical textiles
- AICTE and UGC need to be sensitised about the need of academic institutions to have a revised curriculum that has courses related to latest developments in technical textiles
- Incentivise entrepreneurs to establish and expand production capacities of technical textiles

- Organise exhibitions, conferences and seminars with stakeholder participation from the global technical textiles value chain

Related to institutions:

- Introduce changes in curriculum towards specialisation in technical textiles
- Share faculty and laboratory technicians to temporarily mitigate shortages
- Incentivise faculty members for taking up research or international teaching assignments
- Encourage better exposure of faculty through exchange programmes with world's leading institutes
- Enhance competencies for design and development of machinery and raw material usage
- Encourage collaboration of institutes for testing facilities, research projects, online sharing of e-journals and books to address institute level shortages

Related to industry-academia interaction:

- Encourage collaboration between industry and academia for application-oriented projects
- Establish good laboratories in Public-Private-Partnership (PPP) mode
- Encourage industry to host visits, involve students and faculty in live projects, training and internship of the students and faculty members

20.2.14 New programmes and courses related to technical textiles that academic institutions and universities must offer in the coming future

Table 20.12: New programmes related to technical textiles that Indian Institutes / Universities must offer in future

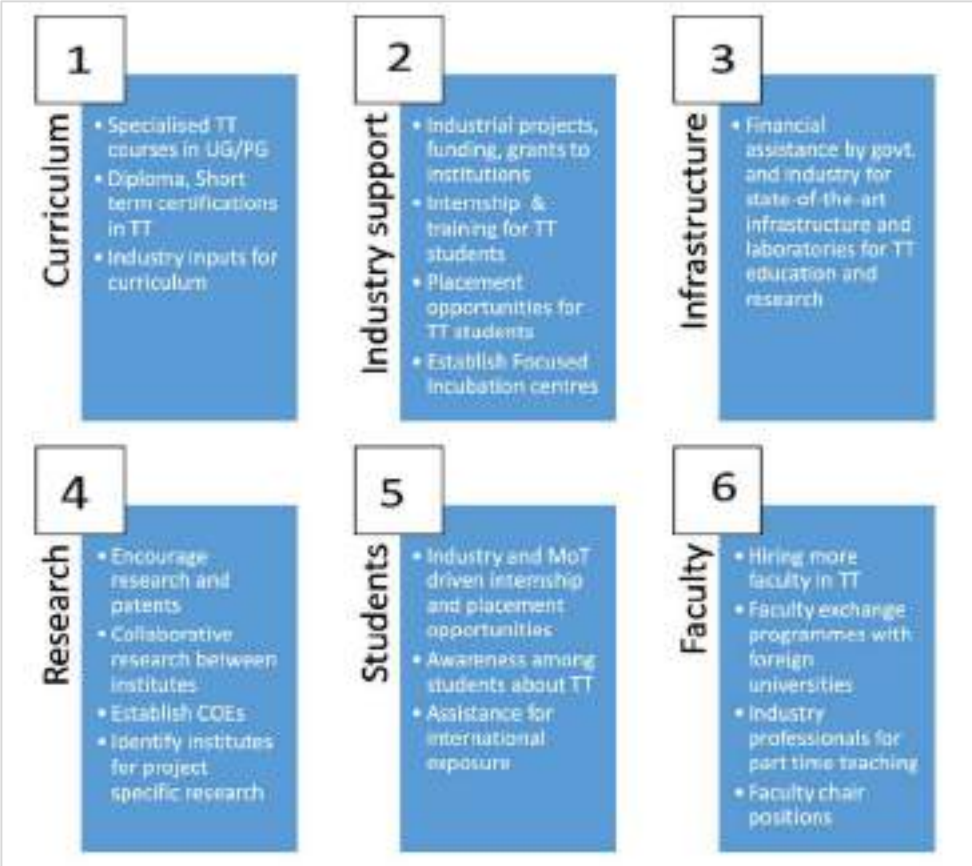
Programme	Background	Courses
B.Tech. in Textile engineering/ textile technology/textile chemistry/ man-made fibre technology with specialisation in technical textiles	Students will complete the basic textile subjects till the sixth semester. The final two semesters will focus on technical textiles subjects	**15-20 credits from this basket** 1. High performance and functional fibres 2. Advanced finishing & nanotechnology 3. Protective textiles 4. Medical textiles 5. Industrial textiles 6. Geotech and agro textiles 7. Fibre-reinforced composites 8. Functional and Smart textiles 9. Testing and characterisation of technical textiles 10. Standards and specifications of technical textiles 11. Project on technical textiles

M.Tech. in Textile engineering/ Fibre Science/ Textile chemical processing with specialisation in technical textiles	Students will pursue M.Tech. level courses of respective stream and they can earn certain number of credits (12-15) as electives to get a specialisation in technical textiles	**12-15 credits from this basket** 1. High performance and functional fibres 2. New materials and innovations in technical textiles 3. Coating and lamination 4. Advanced finishing 5. Nanotechnology 6. Protective textiles 7. Medical textiles 8. Industrial textiles 9. Geotech and agrotextiles 10. Fibre-reinforced composites 11. Functional and Smart textiles 12. Advanced testing and characterisation of technical textiles 13. Standards and specifications of technical textiles 14. Project on technical textiles
M.Tech. in Technical textiles	An interdisciplinary M.Tech. programme open to students with undergraduate degree in textile/ polymer/mechanical/ chemical/ materials science	1. High performance and functional fibres 2. New materials and innovations in technical textiles 3. Advanced nonwovens and knitting 4. Design of technical textiles 5. Coating and lamination 6. Advanced finishing 7. Nanotechnology 8. Protective textiles 9. Medical textiles 10. Industrial textiles 11. Geotech and agro textiles 12. Home and Sportech textiles 13. Fibre-reinforced composites 14. Functional and Smart textiles 15. Advanced testing and characterisation of technical textiles 16. Standards and specifications of technical textiles 17. Project on technical textiles

Source: Primary Survey conducted by IIT Delhi

20.2.15 Suggestions to strengthen technical textiles education

Figure 20.8: Mechanisms to strengthen technical textiles education



Source: Primary Survey conducted by IIT Delhi

Key Findings:

<u>Related to programmes and curriculum:</u>

- Introduce more courses related to technical textiles at Diploma, Undergraduate and Postgraduate levels
- Incorporate industry-oriented practical/ project work with the help of industry professionals

<u>Related to industry support:</u>

- Inclusion of personnel from the industry as essential stakeholders in academic institutions right from guest faculty level to course advisors to board members
- Sponsor Focused Incubation Centres for technical textiles related fields
- Introduce industry-sponsored faculty chair positions

Related to infrastructure requirements:

- Augment funds to modernise and upgrade current laboratories and workshop facilities in institutions
- Set up machines with very high capital investment with complete GoI assistance
- Establish special laboratories for smart and innovative textile materials
- Establish centralised laboratory facilities that can be utilised by research scholars against payment of fees

Related to research:

- Incentivise high quality application-based research and get these published in reputed research publications
- Encourage filing of patents in high priority technical textiles areas
- Encourage collaborative research projects among CoEs, IITs, NITs, and other research organisations
- Encourage sharing of e-journals, books and research work among institutes

Related to students:

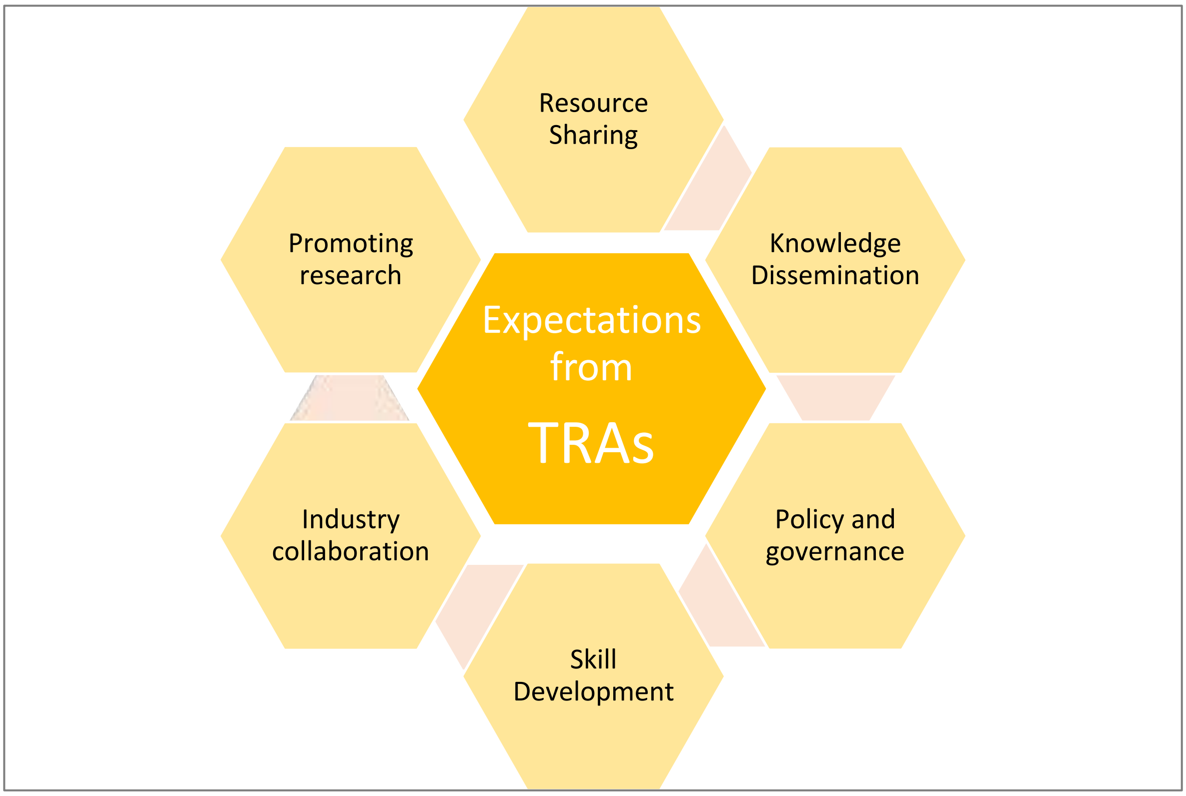
- Promote student exchange programmes with reputed international institutions
- Promote international exposure by providing GoI assistance for participation in international events like DOMOTEX, ITMA and exchange programmes with foreign universities

Related to faculty:

- Recruit faculty with relevant industry experience
- Provide hands-on industry experience to interested faculty at reputed technical textiles industries
- Encourage faculty training and exchange programmes with foreign universities
- Conduct short-term Faculty Development Programmes (FDPs) in technical textiles
- Engagement of industry professionals to augment in-class teaching

20.2.16 Support from TRAs

Figure 20.9: Expectations from TRAs by academic institutions



Source: Primary Survey conducted by IIT Delhi

Expectations from TRAs by academic institutions

Related to resources-sharing:

- Sharing of testing, production, evaluation facilities at TRAs with institutes at nominal charges
- Establish an online platform that can help researchers access pan-Indian TRA resources
- Develop and share segment-specific case studies to teach students

Related to knowledge-dissemination:

- Incentivise and hold mandatory industrial training programmes
- Provide technical know-how of products and technology to users
- Share information on new products and their development with user industries
- Publish regular periodicals about progress and challenges faced by Indian technical textiles sector
- Create awareness about technical textiles development and related government policies
- Provide support through regular market surveys and statistics
- Conduct workshops, conferences and trainings on various fields of technical textiles

- Encourage students by providing structured training, sponsoring projects and organising seminars, conferences and competitions
- Organise international events and exhibitions
- Share research work in the area of technical textiles with institutes/research scholars
- Play a key role in motivating faculty members and students

Related to policy and governance:

- Sign MoUs among industry-government and institutions with clear deliverables
- Create awareness about technical textiles development and related government policies

Related to skill development:

- Permit internships in technical textiles for UG and PG students
- Encourage visits to TRAs
- Allow teaching staff/ research staff from institutions to work in production, testing, marketing in technical textiles during academic breaks
- Co-guide interns/ PG students along with faculty supervisors
- Encourage collaborative research and projects with institutes in the area of technical textiles

Related to industry-collaboration:

- Create and maintain strong linkages with industry for identifying research areas and solutions
- Promote industry-sponsored research
- Collaborate with industries to design and develop textile machinery to produce quality products
- Encourage industry practitioners to take up part-time/guest teaching at academic institutions

Related to promoting research:

- Establish Incubation Centres
- Encourage collaboration with foreign institutes/laboratories

20.3 Best Practises of Premier International Universities

The findings from the primary survey of Indian Academic institutions offering textile engineering and technology related programmes reveals their strengths as well as areas of improvements. An examination of best practices of premier universities in this field globally can offer some ideas about what changes can be introduced to address the areas of improvement and to reinforce the strengths.

For this purpose, the following five premier foreign universities offering textile engineering and technology related programmes were identified based on inputs from faculty experts at IIT Delhi:

- Donghua University, China
- Leeds University, UK
- North Carolina State University (NCSU), USA
- RWTH Aachen University, Germany
- Technical University of Liberec (TUL), Czech Republic

Information was gathered from multiple secondary sources and analysed to identify the best practices. The findings of and an account of the best practices is presented in the following paragraphs.

20.3.1 Design of Courses

Premier universities where education in textile engineering and technology is imparted permit their students a high degree of flexibility in selecting the subjects that they wish to study. Students can design the curriculum that they wish to pursue. For example, in North Carolina State University (NCSU), USA, students can pursue a specialisation in any of the areas in technical textiles even at the undergraduate level. The mandatory subjects that the students have to pursue also include many subjects from the field of technical textiles apart from conventional textiles. The following table lists the subjects from the field of technical textiles that are offered in some of the world's premier universities in textile engineering and technology.

Table 20.13: Courses in subjects related to technical textiles offered in world's premier universities

S. No.	Premier University	Courses related to technical textiles
1	Donghua University, China	• Bio-medical materials • Industrial textiles • Composite materials • Textile physics
2	Leeds University, UK	• Research methods • Advanced textile technology • Advanced composites • Technical and biomedical textiles
3	North Carolina State University (NCSU), USA	• Medical textiles • Technical textiles • Textile supply chain operations
4	RWTH Aachen University, Germany	• Composites • Factory planning • Technical textiles

20.3.2 Research projects by students

Courses at these premier universities are relatively more focused on research, internships, industry experiences and design projects. Some of the examples are artificial blood vessel development, design of novel water filtration units for remote villages and design of structures to protect astronauts from radiation while on the moon. The students work closely in peer groups, access expert guidance from faculty from across the world, as well as interact with relevant professionals in science and technology. The exposure that the students get prepares them better for designing and producing innovative solutions in the field of technical textiles. The table below presents some of the application-based research projects undertaken as part of student education in NCSU.

Table 20.14: Indicative list of research projects by students at NCSU

University	Sponsor of summer project	Project title
NCSU (North Carolina State University), USA	Lear Corp.	Natural FibreFibre Wovens for Automotives
	NuFabrx	New frontiers for drug delivery using textile drug delivery
	Gildan Activewear Inc.	Cool socks for athletes
	Carpe	On-the-Go Sweat Towel

20.3.3 Industry-Academia collaboration

In most of the developed countries of the world, formal technical education has a large component of industrial training. Premier universities themselves own businesses as well as incubate businesses. These universities also enter into formal agreements to collaborate with industrial organisations. All such initiatives offer several opportunities to students to undergo practical training and develop their skills for actual hands-on work that prepares them for a future in engineering and technology. The following table lists some such prominent industry-academia collaborative arrangements at these universities.

Table 20.15: Some recent industry-academia collaboration arrangements in premier universities

S. No.	University	Company/University in collaboration	Description
1	Donghua University China	Uster Technologies	Every year, two students of the Masters programme have an opportunity to work with specialists at USTER to gain practical knowledge and experience to improve the research part of their Masters thesis
		Sino-Japan Medical textile forum	Share information on textile medical fibres, textile-based medical devices, anti-coronavirus nano materials, high-performance mask production technology, medical textiles repair materials and other topics
2	North Carolina State University, USA	Avery Dennison	To explore introducing technology as part of their capability enhancement, students at the university were asked to explore various print methods, specifically with regard to Avery Dennison's Printed Fabric Label (PFL) division

			for incorporating greater stretch into the fabrics
		Gildan Activewear Inc.	To create measurably cooler athletic socks with long lasting cooling properties to help keep the wearers cool and dry, thereby improving their athletic performance. As of today, there are no true cooling socks on the market, and this may be attributed to a couple of challenges this study serves to address
3	Leeds University, UK	Stockholm University	Greener approaches for waterproof clothing
		Royal College of Art, Burberry Wools of New Zealand, Abraham Moon and Sons, Textile Centre of Excellence Camira	Many projects to give a boost to creative innovation in the textile and fashion industry are being spearheaded by the University of Leeds
4	RWTH Aachen University, Germany	Carl Weiske GmbH & Co. KG. HUESKER Synthetic GmbH	BioBase project with an aim to establish bio-based polymers in the textile industry and to demonstrate their full potential
		Atlan-tec Systems GmbH, Willich	AutoNoM – Automated model building and analysis of nonwoven production by using machine learning
		Philadelphia University, USA	Projects on new generation " 4D-textiles".
		Aachen-Maastricht Institute for Biobased Materials and BioTex	Projects on Implantable medical textiles
		Korea Institute of Industrial Technology (KITECH)	Projects on Smart living product with Internet of Things (IoT),' 'Textile fashion with wearable technique'.

20.3.4 Establishment and effective working of innovation centres

University of Leeds has 3D Weaving Innovation Centre which is part-funded by the European Regional Development Fund. It aims to expand research in the area of textile technology by developing advanced 3D woven structure prototypes for a wide range of sectors from fashion, healthcare to aerospace. As a result of this innovation centre, the School of Design at Leeds University has become a leader in 3D Weaving technology, design, and production. Similarly, other premier universities also have innovation centres that not only foster research and innovation but also provide opportunities to students for participation in workshops, training programmes and seminars. The information provided in the following table offers a list of some such innovation centres.

Table 20.16: Innovation centres in premier universities

S. No.	Premier University	Innovation centre
1	Donghua University, China	• Technological Development Center of Agricultural Textile • Technology Development Center of Textile Material for Biomedicine
2	Leeds University, UK	• 3D innovation centre
3	North Carolina State University (NCSU), USA	• Textile Protection and Comfort Center (TPACC)

		• Zeis Textile Extension
4	RWTH Aachen University, Germany	• Carbon reinforced concrete collaborative research centre

20.3.5 Scholarships

North Carolina State University (NCSU) in USA has the highest percentage of students participating in its scholarship programmes and more than 50 percent of all textile engineering students receive scholarship support. The following table contains information on some of the scholarships.

Table 20.17: Scholarships in premier universities

S. No.	Premier University	Scholarships
1	Leeds University, UK	• Manchester Alumni Scholarship Scheme • GREAT scholarship • Equity and merit scholarship • Global Futures scholarship
2	North Carolina State University (NCSU), USA	• Engineer your programme • Gilman Scholarship • Jackson Rigney Scholarship • Ralphe and Ree Edward Scholarship • Donor scholarship
3	Technical University of Liberec (TUL), Czech Republic	• Social Scholarship • Accommodation scholarship • Merit scholarship

20.3.6 Exchange programmes

Strong emphasis is placed on collaborations and partnerships with other leading universities for better student and academic staff mobility and exposure. Short and long duration faculty and student exchange with other well-known international universities is an important practice followed by premier universities. This practice allows university students and members of the faculty to learn from good practices of their partner universities and apply the appropriate practices for development of their own university.

20.3.7 Quality assurance from external sources

Premier universities ensure that they follow high standards and best practices by taking the help of external auditors and quality consultants such as professionals, statutory, and regulatory bodies. These external agencies conduct peer-reviewed audits and subject-based reviews, based on the needs of the respective university. The following table contains information that offers a few examples of such external mechanisms for monitoring and evaluation.

Table 20.18: External mechanisms for monitoring and evaluation			
S No.	**Premier University**	**Monitoring and evaluation panel members**	**Objectives of Evaluation Panel**
1	Leeds University, UK	Ed Anderson, CEO, Leeds Bradford airport. Liz Barber, CEO, Yorkshire Water Tom Clark, Chief Tech Officer, Lowell group	The council takes care of the University as a receipt of public funds and keeps a track of institutional and executive performance
2	Technical University of Liberec (TUL), Czech Republic	Dr. Helen Mallison, UK Prof. Matthias Ziegenhorn, Germany Prof. Yardan Kyosev, Germany Prof. Markus Westener, Rasenburg	"The International Evaluation Panel" is set up for the purpose of evaluation of the university according to the Methodology for Evaluating Research Organisations

20.3.8 Student to faculty ratio

Student to faculty ratio is a parameter often used for assessment of quality of an educational intitution. Premier universities for textile engineering and technology education identified for the present study often have sufficient number of faculty members which ensures a small and easily manageable class size so that faculty members can give personal attention to each student.

Table 20.19: Faculty student ratio in premier universities		
S. No.	**Premier University**	**Student to faculty ratio**
1.	Donghua University, China	18:1
2.	Leeds University, UK	11:1
3.	North Carolina State University (NCSU), USA	12:1
4.	RWTH Aachen University, Germany	19:1
5.	Technical University of Liberec (TUL) Czech Republic	10:1

Source: Based on data available on websites of respective universities

20.4 Summary of main findings

India has a number of academic institutions and universities offering undergraduate and postgraduate programmes related to different areas of textiles. Of the 39 colleges that were contacted for the survey, 31 responded. While all of them offer UG programme(s) in textiles, 16 of them also offer M.Tech. programme(s) and 9 of them offer Doctoral degrees. Their total sanctioned strength is 2750 students.

Universities and academic institutions are important instruments for dissemination of knowledge and for encouraging new ideas and innovation. With good exposure to Technical Textile courses during their programmes and meaningful industry-aligned projects, students can become invaluable assets in the development of technical textiles industry in India. It is therefore vital that their opinion and feedback is factored in while making significant decisions, so that they are industry-ready and can play their part in the development and growth of the technical textiles industry in India.

20.4.1 Findings related to Skill Gaps

- Limited exposure of the faculty to new emerging areas of technical textiles
- Lack of facilities for producing and testing technical textiles that are required for teaching, training and implementing projects
- There is very limited collaborative industry-academia interaction as evidenced by small number of industry-oriented projects, few opportunities for students and faculty for practical exposure to industry, and lack of significant financial support by industry to academia for R&D
- Limited exposure of faculty to TT production technologies and specialised characterisation techniques
- Shortage of trained technicians for training and operating technical textiles equipment

20.4.2 Methods suggested to address the skill gaps

- More effective formal mechanisms to improve opportunities and quality of interaction between industry and academia must be established
- Technical textiles associations and other industry bodies should increase their engagement with academic institutions
- Infrastructure development at the academic level in states in selected technologies and setting up of testing facilities should be funded
- Organise continuing education programmes for faculty, staff, and people working in the industry

20.4.3 Curriculum related steps suggested

- Encourage more and specialised courses in technical textiles at UG and PG levels
- Start M.Tech. programme in technical textiles at one or two selected institutes
- Incorporate technical textiles courses as core courses for all students at UG level
- Recruit faculty with relevant industry experience
- Provide hands-on industry experience to interested faculty at reputed technical textiles industries
- Encourage faculty training and exchange programmes with foreign universities
- Conduct short-term Faculty Development Programmes (FDPs) in technical textiles
- Encourage industry professionals to take part-time faculty assignments

The comparative analysis of practices of Indian academic institutions with premier international universities indicates significant scope for improvement of the Indian Academic Institutions across their education and training methodologies. Technical textiles, being a discipline that is rapidly evolving, will continue to require man-power that is abreast of the dynamic trends and well-trained in relevant technologies. It is only then that the academic ecosystem of India comprising academicians, trainers, students, researchers and support staff will be able to produce graduate and post-graduate professionals who are well equipped to handle the challenges of the fast-paced changes in technical textiles, and foster innovations that will place Indian technical textile industry among the global leaders.

21. Status and Contribution of Focus Incubation Centres

21.1 Background

Incubation Centres are established to nurture and assist entrepreneurs, start-ups and early-stage business groups in developing community, education, linkages, capital and mentorship in a controlled environment to help them in their initial stages. Incubation Centres provide immediate, local and practical solutions for day-to-day business problems which arise in an early-stages of business and provide transitory and facilitative assistance. Services provided by incubators to start-up ventures include access to[1]

- Physical resources
- Office support services
- Capital
- Process support
- Networking services

The world's first incubator was Batavia Industrial Centre started by a New York businessman named Joe Mancuso in 1957. He created readily accessible, short-term lease office spaces for small businesses.[2]

Incubation Centres have changed their role from time to time to reach their present state. Their evolution is as follows[3]:

1950s - 1980s: Business incubators were focused on providing low-cost working space and set of basic shared services required for a business such as secretarial services, copy and fax equipment, reception, telephone answering, meeting & conference rooms, car parking and kitchen facilities.

Mid 1980s - Mid 1990s: Along with the services offered previously, knowledge-based services such as training, coaching, mentoring from domain experts were added to help entrepreneurs start businesses and learn.

[1] Incubation in India: A Multilevel Analysis, Indian Institute of Management, Ahmedabad, March 2020

[2] A Brief History of 'Investability DNA' in Incubation and Acceleration, Alex Prather, 2018

[3] 3 The History of Business Incubation, Vasily Ryzhonkov, 2013

Mid 1990s - Present: Along with the above services, the incubation centres help new firms access networks that ease the acquisition of resources and specialised expertise, provide learning opportunities, and allow new firms to build up legitimacy faster.

Incubation as a concept found its way into India around 1991 when some of the eminent institutions for higher education started establishing these centres. The Society for Innovation and Development (Indian Institute of Science, Bengaluru) was established in 1991 and the Foundation for Innovation and Technology Transfer (IIT Delhi) was established in 1992. In 2016, Government of India launched Startup India Scheme to support entrepreneurs, building a robust startup ecosystem with a package of services to promote startups. As of 2019, there were 13 central government ministries and departments that were supporting incubators. There are 284 incubators (government supported and private) which have been identified in India.

21.2 From Incubation Centres to Focus Incubation Centres for Technical Textiles

Ministry of Textiles has setup Focus Incubation Centres (FICs) as a component of Technology Mission on Technical Textile (TMTT) to help the potential investors enter into technical textiles. Eleven Focus Incubation Centres (FICs) have been established on plug and play model at a cost of Rs. 59.35 Crores out of which five Focus Incubation Centres (FICs) have been established in the Centres of Excellence for which Rs.14.45 Crores have been sanctioned to these five Centres of Excellence. Six Focus Incubation Centres have also been approved by Empowered Committee at Indian Institute of Technologies (IITs) namely, IIT Kharagpur, Mumbai, Delhi and Kanpur with a total cost of Rs. 44.90 Crores.[4]



[4] http://texmin.nic.in/sites/default/files/Textiles-AnnualReport2018-2019%28English%29.pdf

21.3 Progress of the Focus Incubation Centres

The status of progress of the FICs is presented in the following table:

Table 21.1: Progress of the Focus Incubation Centres

S No.	Designated institute for FIC	Year of establishment	Intended support to entrepreneurs	Reported progress so far
1	Ahmedabad Textile Industry's Research Association (ATIRA), Ahmedabad	2017	- Focusing on helping incubatee enterprises in the field of composites - The products that are being developed have applications in aerospace, mass transportation, machinery parts, etc.	- ATIRA has signed an MOU with iCreate International Centre for Entrepreneurship and Technology Development of Entrepreneurs for supporting incubatees in the area of Focus Incubation in July 2017 - The institute has collaborated with various institutes including iCreate (technology business incubation centre) along with Entrepreneurship Development Institute of India (EDII), National Institute of Design (NID) and Centre for Entrepreneurship Development (CED) - ATIRA has not reported incubating any start-up so far
2	Dattajirao Kadam Technical Education (DKTE), Kolhapur	2016	- Monitoring business planning - Providing technical assistance - Providing space for services and training - Focusing on mentoring students	- 24 start-up proposals have been received by the centre of which 14 have been incubated and nine startups have successfully received funding from external sources - 16 startups have graduated from the Centre till date and have their own independent establishments - The scale of operation of the Centre was Rs. 75,82,876 for the year 2019-20 - Five mentors are actively looking after the incubation centre - Training programs organised by the centre are: Awareness programmes, Product specific programmes, Industry personnel training programmes and Students training programmes - There are around 10 corporate partnerships with industries concerned with technical textiles. - Major new product development areas are Geotextile, Filtration, Automobile,

				Carpets, Mattresses, wadding and quilting - Six technologies have been patented by the Centre as of June 2021
3	Northern India Textile Research Association (NITRA), Ghaziabad	2018	- Focusing on weaving, knitting and garmenting - Providing a facility to undertake commercial production - Providing machinery for garmenting and embroidery. These include latest cutting, fusing, sewing and embroidery machinery	- NITRA has not reported incubating any start-up so far - Machinery provided by NITRA is being used for purposes of production of prototypes and samples - NITRA also provides testing facility
4	PSG College of Technology (PSG), Coimbatore	2015	- Focusing on filtration products, coir and acoustic materials. - Promoting research, encourage industry to use the machinery installed, take up testing, impart training, and manufacture products for commercial use.	- The incubation centre is equipped with full-fledged prototyping facilities for developing various products such as industrial filters, insulation materials, coated and laminated fabrics, abrasives, natural fiber based composites, mattress ticking, ropes and cordages, brushes, etc. - The centre also imparts training to market the products in the respective markets. - The centre has not reported incubating any start-up till now.
5	South India Textile Research Association (SITRA), Coimbatore		- Focusing on medical textiles (Meditech) - Providing essential machines to carry out production. - These machines can produce sanitary napkin, face mask, wet wipes / alcohol swabs and cotton wool rolls.	- The FIC is Dormant/Inactive
6	Indian Institute of Technology (IIT), Kharagpur		- New generation product development	- Seven startups have been incubated by the Centre - The major infrastructure comprises: Graphene production facility, Microbiological Testing Facility Plant,

			- Promoting innovation and institute partnership	biological testing facility, Animal cell-based testing facility, Plantation of banana & pineapple for natural fibers for startups - Seven workshops have been conducted
7	Indian Institute of Technology (IIT), Mumbai	2018	- The Textile Focus Incubation Centre (TFIC) consists of two centres, Focus Incubation Centre in Technical Textiles - IIT Bombay (FICTT) and Advanced Fiber Reinforced Polymer Composite Development Centre (AFRPCDC)	- Incubation is yet to take off - Conducted textile leadership conclave: Theme: Emerging opportunities and markets, IIT Bombay August 23, 2018
8	Indian Institute of Technology (IIT), Delhi		- Offering facility for 3D Weaving and Structural Composites used for testing by enterprises	- Incubation is yet to take off
9	Indian Institute of Technology (IIT), Kanpur		- Supporting innovation, research, and entrepreneurial activities in technology-based areas - Providing services related to patenting and commercialisation	- No activity reported for technical textiles incubation centre
10	Synthetics & Art Silk Mills' Research Association (SASMIRA), Mumbai		- Supporting the working trials, shopfloor trials, etc. - Focusing on agriculture textiles (Agrotech)	- The FIC is Dormant/Inactive

Source: Information gathered by IIT Delhi

21.4 Challenges faced by the FICs

The secondary research followed by primary research was conducted for the present study and it shows that most of the Focus Incubation Centres (FICs) for technical textiles are yet to begin incubating the start-ups. The FICs of technical textiles can be divided into four categories as follows:

1. FICs that have commenced incubating the start-ups: DKTE, IIT Kharagpur
2. FICs that are providing support to technical textile enterprises irrespective of their being start-ups or existing businesses: PSG College, ATIRA, NITRA, IIT Delhi
3. FICs that are yet to commence active support services including incubation: IIT Bombay
4. FICs that are dormant/inactive/non-starters: SITRA, SASMIRA
5. FIC for which information could not be obtained: IIT Kanpur

It is evident from the study of functioning of FIC intervention of the Ministry of Textiles that there is a considerable scope for improvement. Ideally, an incubation centre for technical textiles in order to be effective has to offer the following services:

i. Help the entrepreneurs with basics of conducting the business
ii. Opportunities for networking with peers, experts, successful entrepreneurs from technical textiles
iii. Training followed by assistance with marketing of the products
iv. High-speed internet access
v. Assistance with accounting and financial management of the business
vi. Training for and access to bank loans, loan funds, etc.
vii. Help with presentation skills especially to investors
viii. Access to higher education resources in the field of textiles and management
ix. Connections with possible strategic partners
x. Access to angel investors or venture capital
xi. Business training programmes
xii. Technology training programmes
xiii. Testing facilities

6. The evidence available from the information gathered about existing FICs suggests that even the two FICs with maximum progress were able to offer only four services viz. High-speed internet access, access to higher education resources, technology training programmes and offering testing facilities have been extended by most of the functional COEs towards incubation of the enterprises. This leaves a vast scope for improvement even in case of the best performing FICs.

7. There are four FICs which provide non-incubatee specific services such as training programmes, participation in industry events, and permitting the use of technical facilities, machines and equipment for testing, concept development and producing prototypes at affordable charges to all entrepreneurs of this industry irrespective of whether they are start-ups or not. So, these are useful services but not specifically targeted to help incubate ventures.

A study of the guidelines for FICs as specified by the Ministry of Textiles states that the following requirements must be met by the FICs:

i. Industrial sheds with basic infrastructure/basic machineries may be made available to the prospective entrepreneurs for setting up their units for production on commercial scale.
ii. FICs may be provided to new entrepreneurs on "Plug and Play" model with mentoring by the concerned CoE for taking up the innovation on commercial scale.
iii. Once they get established, they shall shift to their own facilities and the center will be made available to new entrepreneurs.
iv. CoEs have to establish the FICs in their area within a time period of six months.
v. There will be separate line of equipment for each entrepreneur.
vi. FICs would be run by entrepreneurs and not the CoEs.

It is apparent from the information that has been gathered that the FICs which have been established so far are yet to follow the above mentioned guidelines mandated by the Ministry of Textiles.

It is a widely prevalent practice among good incubators that they have a specifically trained and experienced incubation manager and a team of personnel who assist him. None of the present FICs have such a set of dedicated personnel in place.

The faculty/personnel of the FICs are assigned the task of mentorship as an additional charge over and above the regular workload and there is no incentive from the organisation for the extra work that is allotted. This practice often leads to lack of attention and neglect of the mentoring role. It affects incubation activity negatively.

Active partnering with technical textile industry is inadequate and this leads to poor connect of the startup entrepreneur with latest developments in the market.

22. Status and Contribution of Integrated Textile Parks

22.1 The concept of Integrated Technology Parks

The World Bank and UNCTAD place Science and Technology Parks (STPs) under the category of Special Economic Zone (SEZ). SEZs are those geographic areas which have independent business rules and which offer a variety of incentives to attract investors and businesses from a wide range of industries. The STPs are precursors of industrial and technology parks. The industrial and technology parks are based on the concept of integration of diverse functions in an identified area with a large financial turnover. The collaborative actions by firms and facility providers are leveraged to result in substantial collective gain. The introduction of technology parks in India followed a spate of industrial reforms in Asian countries in the 1980s, where rapid industrialisation was characterised by the emergence of numerous speciality cities and industrial clusters each dedicated to a particular product.

22.2 Scheme for Integrated Textile Parks in India

As per the scheme guidelines released by the Ministry of Textiles, the Scheme for Integrated Textile Parks (SITP) was launched in 2005 by merging the then existing schemes namely Scheme for Apparel Parks for Exports (APE) and the Textile Centre Infrastructure Development Scheme (TCIDS). It involves identification of appropriate locations for textile units so as to meet the geographical, social and international standards. It provides for funding to private entrepreneurs for setting up textile parks with world-class infrastructure features.

Under this scheme, Government of India (GoI) has made a provision for giving a grant of up to 40% of the project cost subject to a ceiling of Rs. 40 Crores. Each Integrated Textile Park (ITP) is proposed to have upto 50 units. However, the number of entrepreneurs and the resultant investments in each ITP can vary from project to project. The SITP is proposed to be implemented through the Special Purpose Vehicle (SPV). SPVs are to be formed with the representatives of local industry, financial institutions, State and Central Government to support the textile parks. SPVs need to be a corporate body registered under the Companies Act.

Infrastructural roadblocks	• Location of some of the textile parks outside the textile clusters came out as major roadblock
Flouting of provisions	• Special Purpose Vehicles (SPVs) flouting the SITP's guidelines by getting non-textile units into textile parks • Slow fund mobilisation which ultimately has led to slow progress
Lack of interest among industries	• Lack of marketing efforts • High rentals in some parks • No special benefits available for investors in parks • Poor accessibility • Delays in obtaining statutory clearances from the state governments

Source: Information collected by IIT Delhi

From the table above, it is evident that there is a need to improve the functioning of technical textile parks and specific recommendations have been provided in the section on recommendations in the study.

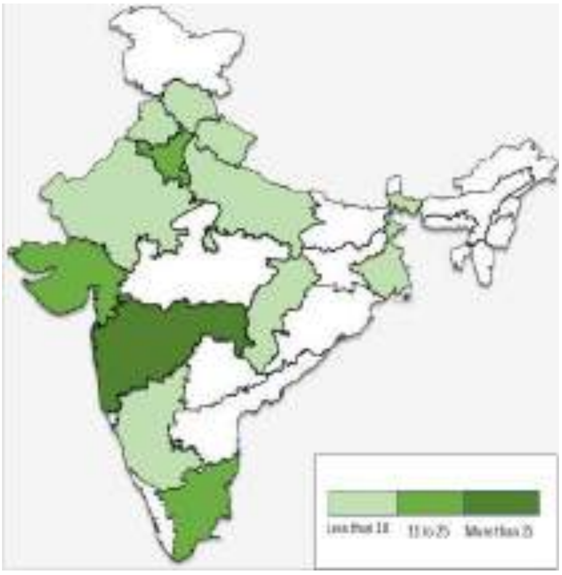
23. Technical Textiles Product Manufacturing Firms: Findings from Primary Survey

With the objective of understanding the nature, engagement, and structure of three important participant groups of technical textile industry in India viz. Product Manufacturing, Raw Material Manufacturing and Machine Manufacturing, a pan-India survey of technical textiles product manufacturing firms, machine manufacturing firms, and fibre, filament & technical yarn (raw material) manufacturing firms was carried out with the help of semi-structured questionnaires that were specific to each group. Purposive sampling method was used to identify the respondents for the survey because of wide variation in the number of firms in each of the twelve application segments of the industry. The objective was to have a fair and adequate representation of firms in all the application segments. The sample that was derived from the purposive sampling strategy, which is a nonprobability sampling method adopted for this study, is assumed as being representative of the population. A total of 114 responses were obtained from firms operating in these three categories (product manufacturing, raw material manufacturing and machinery manufacturing firms) and across the twelve application segments spread across different parts of the country. Findings from the survey of these firms operating in the technical textiles industry in India are presented below.

23.1 Technical Textiles Product Manufacturing Firms

This section captures the responses obtained from technical textile product manufacturing firms which are operating in various application segments and are spread all over India. The following figure presents the geographical spread of the respondent firms.

Figure 23.1 Geographical spread of respondent firms

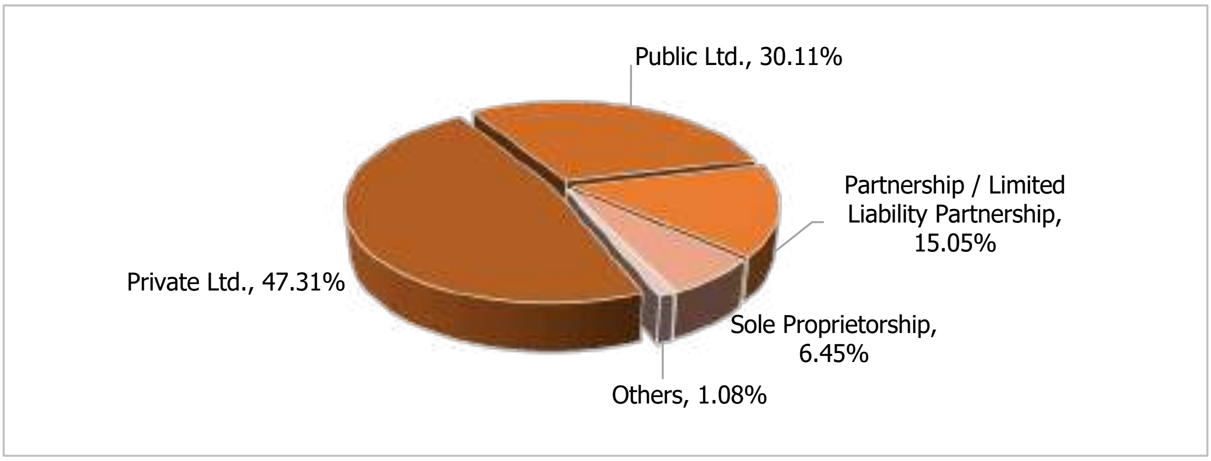


From the heat map, it can be observed that of the total firms surveyed, the largest responses were received from firms operating in Maharashtra (28 percent). A large proportion of the respondent firms were from Tamil Nadu, Gujarat, Haryana and Delhi with a similar representation between 10 and 12 percent. The other states and union territories from where responses could be obtained were West Bengal, Uttar Pradesh, Punjab, Rajasthan, Himachal Pradesh, Uttaranchal, Karnataka, Chhattisgarh and Puducherry.

23.2 Type of firms based on Ownership Structure

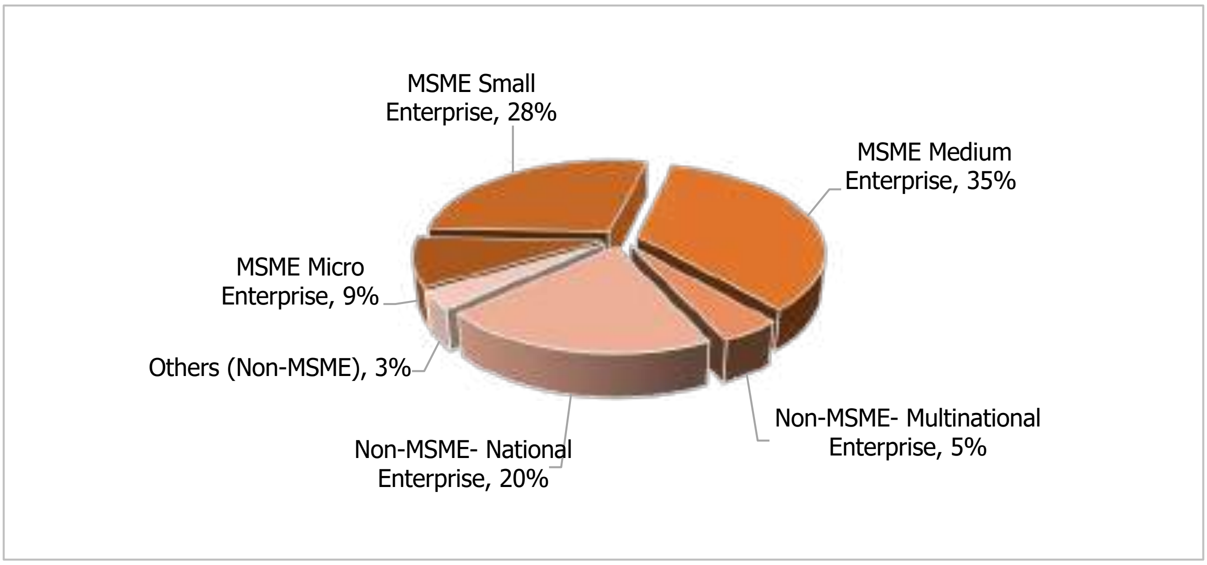
Out of the surveyed product manufacturing firms, 47 percent were Private Ltd Companies and 30 percent of were Public Ltd. Companies. Remaining 15 percent were Partnership firms/Limited Liability Partnership firms, 7 percent were sole proprietorships, and 1 percent fell in "Others" category. This indicates that a large proportion of the respondent firms are large in terms of size and operation.

Figure 23.2: Distribution of respondent firms based on Ownership



In terms of the distribution based on scale (MSMEs-Non MSMEs) and focus on exports (Export Oriented Units EOU or non-EOU), the following observation was made. Medium scale MSMEs constituted 35 percent of the respondent firms while 28 percent were in the small enterprises category; 9 percent were in micro MSME category. Around 5 percent of the respondent firms were multinational enterprises whereas 20 percent represented national enterprises from the non-MSME category.

Figure 23.3: Distribution of respondent firms (MSMEs and Non-MSMEs)



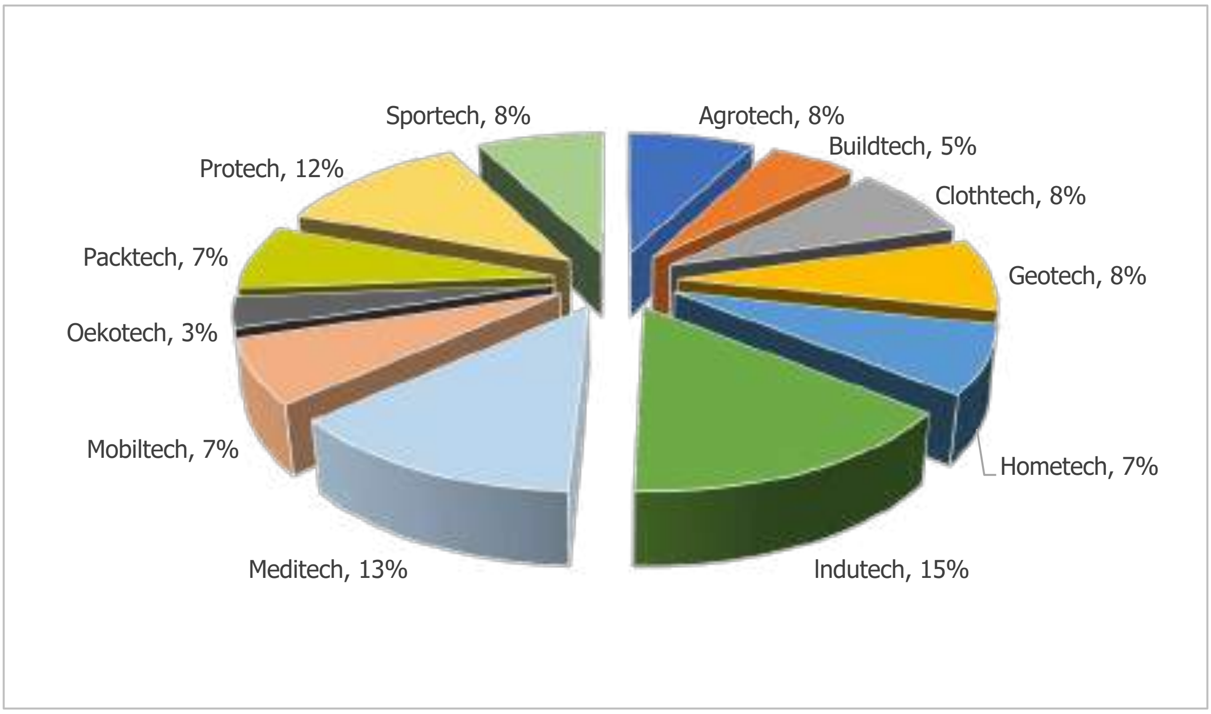
Of the total firms surveyed, 24 percent of the respondent firms were export oriented units (EOUs). Segregating the responses between MSME and non-MSME category, it was observed that this proportion remained same i.e., around a fourth of the respondent firms were export focused while the rest were primarily in the non-EOU category.

23.3 Segment wise distribution of firms and their roles

All the respondent firms who participated in our study operate in various segments of the technical textile industry. Many of these respondent firms operate in multiple segments whereas there are few that operate in a single segment. A large number of participants were operating in Meditech and Indutech segments followed by Protech, Sportech, Clothtech, Geotech and Hometech.

The figure given below presents the distribution of firms operating in various segments.

Figure 23.4 Distribution of respondent firms operating in various segments



In terms of the roles and functions performed, a large majority of the respondent firms (91 percent) are into core manufacturing. A large proportion (38 percent) of them cater to the global demand by exporting their products to various parts of the world. Around a fifth of the respondents also function as converters; 15 percent of them also import products from global markets. A very small number of firms are also engaged in providing testing facilities, manufacturing equipment and providing consultancy services.

23.4 Technical textile products manufactured by respondent firms

The table shown below presents the comprehensive list of products being manufactured by the respondent firms.

Table 23.1: List of technical textile products manufactured by respondent firms

Name of the Segment	List of products manufactured
Agrotech	Fishnet twine, nylon multifilament fishing nets, nylon monofilament fishing nets, carbo-melt fabric, twine, HDPE woven anti insect net, fishnet, woven agricultural net, shade net, tyre cord fabrics, soil saver (open mess) in, nonwoven jute, warp knitted fabric, anti-hail net, anti-bird net, ground cover, insect net, seed production cages, crop support nets, staking cord, fully assembled trawls, purse seine nets, gill nets, dole nets, pelagic nets, ropes, crop cover.

Buildtech	Tarpaulins -HDPE, LDPE sheets, awning fabric, auditorium fabric, liner fabric, outdoor fabrics, shelter fabrics, tent fabrics, PVC laminated flex, coated sheet, formwork for concrete, erosion control blankets, PVC, PU & acrylic coated fabric, & PVC coated tarpaulin and tensile fabric, & warp knitted fabric shade net, soundex (noise absorbent non-woven membrane for perforated tiles, carpet backing materials), safety nets, harnesses, lifting slings.
Clothtech	Garment elastic tapes, cotton fabric, functional yarn, coated interlinings, military fabrics, workwear, uniforms, high altitude, NBC clothing, tactical vests, interlinings for coat, jackets, shirts and bags, interlining for apparels, embroidery backings, over the back for embroidery, hook and loop tape fasteners, coated fabric.
Geotech	Nonwoven geotextiles (used for filtration in infra industries), opan fibre, para aramid fibre (twaron), high strength polyester, woven geotextile, geotube, geobag, pet geogrid and HDPE geocell, geotextiles 100 csm-724 gsm, nonwoven needlepunch geotextile, geo composite, formwork for concrete, erosion control blankets, nonwoven needlepunch, liner fabrics, needlepunch felt for geobags, black out window panels, soil sever, nonwoven, leno binded wider fabrics for erosion blanket, geo fabrics, mulch mats, boulder protection, landfill liners / fabrics, polymer and steel gabions for shore protection, PP woven fabrics with different gsm & colour.
Hometech	Furnishing (artificial leather are used in upholstery for sofas, chairs, cushion-covers, bean bags etc for homes, offices, commercial establishments and hotels), leather goods and garments, carpet and other textile floor coverings, furnishing fabric, flock coated fabric, functional yarn, carpet backing cloths, nonwoven needlepunch carpet, hollow fibre pillows, cushions and comforters, nonwoven thermal bonded waddings, designer window blinds, dry wipes & kitchen wipes, hand kerchief, baby wipe, refreshing wipe, nonwoven thermally bonded, carpet yarns, various floorcovering yarns, curtains and home textile yarns, mattress pads, laminated mattress protectors, pillows, comforters & quilts, shopping bags, floor coverings, upholstery, pillow covers, wadding for home textile (comforter, mattress pad).
Indutech	Tape fabrics (nylon curing, electric cable, nuclear plant pipes), FRP composite segments (all types of glass fabrics manufacturing like multiaxial, combi being used in FRP composites manufacturing applications), opan fibre (pyromex), liner fabric, woven filter, polyamide nylon monofilament yarn, HDPE twine, nylon & HDPE fishing nets, flame retardant canvass, water repellent canvas, canvas tarpaulins, tyre cord fabrics, conveyor belting fabrics and specialty fabrics, automotive felts, functional yarn, belting fabric, polyester industrial yarn coated sheet, laminated tarpaulin, nonwoven jute felt, filter fabrics, speaker fabrics, automotive felts, pultrusion (outer surface for reinforced fibre composite), backing cloth for artificial leather & coating, water and oil filtration, dry wipes, dry cut wipes, refreshing single wipes, banquet napkins, cocktail napkins, textile tapes, peel ply fabrics, belting fabrics, hydraulic and silicone hoses, liner fabrics, automotive hoses, refreshing wipe for railway/airlines, wipe for pharma and hygiene industry, inflatable floats & boats for defence, impression fabrics, specialized fabrics for the marine industry, phenolic lamination industry, type write ribbon cloth, abrasives cloth, phenolic laminates sheet /blocks etc manufacturing, PVC, PU & acrylic coated fabric, nylon tyre cord fabric (NTCF), automotive yarns for seat cover, car mats and under-roof, marine yarns for cruise ships, sewing threads, covers waterproof, industrial ropes, mooring ropes for shipping, high tenacity poly propylene, multifilament yarn, twine, stitching thread, transport ropes, industrial filter fabric, liquid filter fabric, HVAC, automotive filter fabric, fabric for composites, for filtration nonwoven fabric.
Meditech	PE film plain & laminated, surgical gown PPE coverall, drapes, bed sheet, medical apron, CTG belts and medical mask tapes, spun-bond fabric, melt-blown fabrics, carbo-melt fabric,

	needlepunch fabric, reusable masks, reusable PPEs, scrub suits, anti-microbial fabrics, non-surgical facemask, community mask, medical PPE, bleached open weave and leno weave gauze rolls-for export, surgical swabs and pads-for local and export markets, medical bandages-for local and export markets, AB cotton (absorbent bleached cotton), cotton hydroentangled nonwoven roll goods, finished good (cotton balls, pleat & wool roll cotton pad, round, square, oval, rectangle), synthetic non absorbable sutures, synesthetic non absorbable hernia mesh, hospital clean room garments/sterile products, drapes, gowns etc., protection garments, cap mask, antistatic garments etc., safety wears, coverall, dangri, lab coats, dust malts, functional yarn, medical wear in 100 percent cotton and 100 percent synthetic fabric for type 6b garments, surgical gowns, medical gowns, protective gowns, drapes, isopropyl alcohol swabs, gauze swabs, O.T. towels, under pads, disposable hospital bed sheets, mayo table cover, draw sheets, arm board covers, eye pad, combined dressings, abdominal sponges, mortuary bags magic coin tissues, disposable pool towels, N95 masks-NIOSH approved, surgical masks, medicated dressings, surgical tapes, blood pressure cuffs, fabrics for stretchers, inflatable mattress/pillow, sanitizing wipe, PVC, PU & acrylic coated fabric, adult diaper, adult pant, baby diaper, baby pant, underpad, surgical- adhesive tape cloth, flannel cloth, dust mask & respirators, 3 ply surgical mask & hygiene disposables, solid woven, fire resistant, antistatic PVC conveyor belts for conveying of coal / minerals / potash in underground mines & industrial applications, 25-150 gsm hydroentangled fabric for different applications (cleaning, medical, cosmetic), surgical drapes, protections kits.
Mobiltech	Tarpaulin, truck covers, luggage, packing bags, automotive textiles, railway fabric, 100 percent polyester warpknits, grey rayon tyre yarn, grey rayon cord, grey rayon tyre cord fabric, dipped rayon tyre cord fabric, dipped nylon chafer fabric (multi / multi-wicking type / non-wicking type) dipped nylon chafer fabric (mono / mono), nylon high tenacity yarn, nylon tyre cord fabric - greige fabric, nylon tyre cord fabric - dipped fabric, polyester tyre cord fabric, component binding layer for headliners, chafer fabrics for tyres, brake diaphragm fabrics, cycle tyre cord fabrics, specialized fabrics for auto component industries, PVC, PU & acrylic coated fabric, nylon tyre cord fabric (NTCF), truck canopy.
Oekotech	Nonwoven thermally bonded different types of adsorbent media for removal of VOCs and chemical agents, landfill solutions.
Packtech	Packtech FIBC, laminated fabric, HDPE woven mesh for vegetable packing, flexible intermediate bulk containers, PP woven sacks, PP woven fabric, hook and loop tape, hessian fabric, hessian bags, sacking bags & shopping bag, D cut bags, V cut bags, handle bags, nonwoven for shopping bags, nonwoven for packaging, nonwoven for interlinings, hydrocarbon free food grade bags (various capacities), gunny bags, tea bags, stitching thread, FIBC bags, nonwoven fabric of packing bags and rice bags, laminated fabric.
Protech	High altitude low temp protective clothing for defence forces, tent (labour, army, advertising canopy, men's rain coat, waterproof canvas), high visibility garments, anti-static garments, chemical resistant, UV resistant, bullet proof jacket, helmets and other safety items, inherent flame retardant fabric, waterproof & breathable fabric, flame retardant coveralls, workwear, military & tactical wear, products for medical mattress for hospital beds, functional yarn, electric static discharge tapes made for safety shoes and work shoes for electronic assembly industries, treated and inherent flame retardant fabrics, chemical resistant suits type 6, disposable masks, military fabrics, ballistic fabrics, workwear, nonwoven for PPE kit, PVC, PU & acrylic coated fabric, head to toe solutions of protective wear, flame retardant textiles for tents, tentage fabrics, bitumen & wax coated fabrics, bio gas balloon, camouflage nets, thermal liner for fire and safety, bags, rainwear.

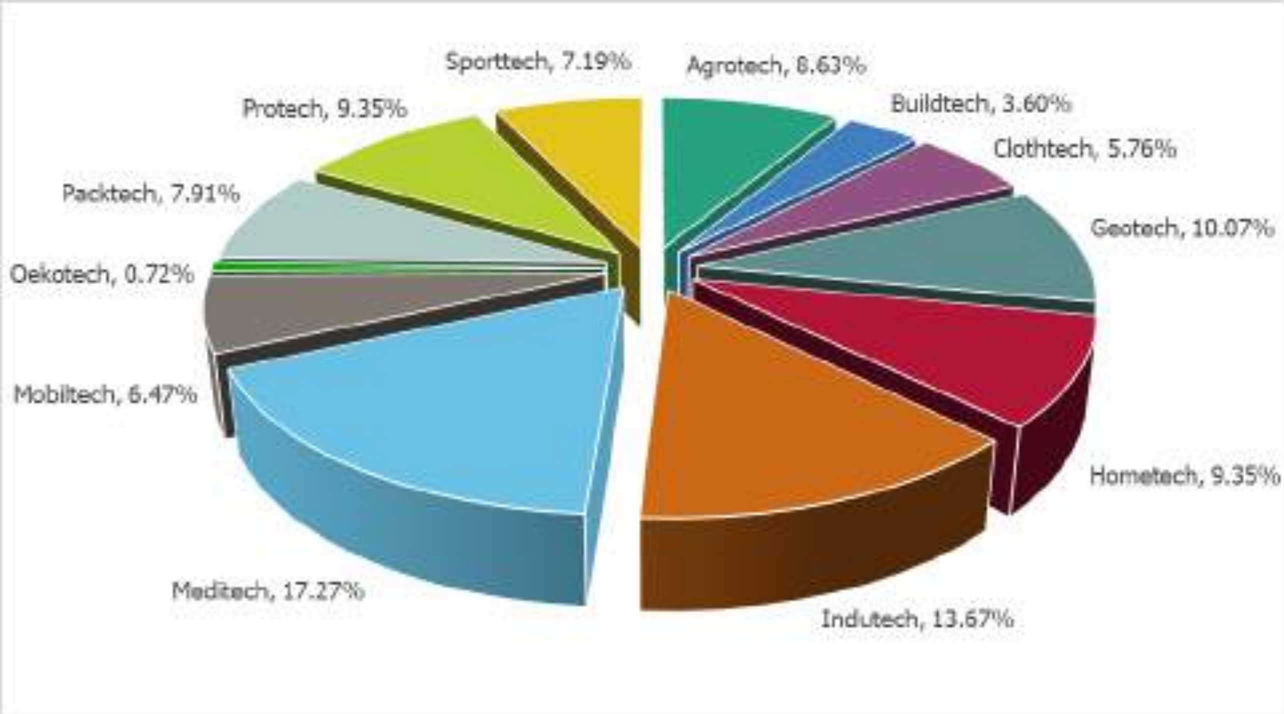
Sportech	Moisture management fabric, products for sports shoe upper, handbags and fashion shoes, 100 percent polyester and 100 percent nylon woven and warp knits, canvas tarpaulins, shoelaces for sports shoes and other shoes like school shoes, trekking boots etc. cordage for climbing ropes, sportswear, 100 percent synthetic fabric for manufacture of sports apparel with special finishes, shoetech-waterproof shoes with visibility, football, rugby ball, basketball, punching bags, volley ball, breathable fabric for sports jacket, umbrella awnings, active wear, bag pack, high altitude clothing, PVC, PU & acrylic coated fabric, toe puff, shoe components, yarns for sportswear, yarns for sports shoes, cricket net, soccer nets, volley ball net, tennis net, golf nets etc. all types of sports nets and accessories.

While many manufacturers indicated different functionalities of their products, none of them reported manufacturing any smart, intelligent or e-textiles except one firm who indicated that they manufacture medical textile products with sensors.

23.5 Production of technical textile products by Indian manufacturers

This section presents an overview of the revenue and production of the technical textile products manufactured by the respondent firms. Segment-wise representation of firms who responded to this question is given in the figure below:

Figure 23.5: Segment-wise representation of respondent firms



Total revenue of respondent firms

Total revenue of the respondent firms in all segments of technical textiles has increased at a CAGR of 10.03 percent, from Rs. 5,295.82 Crores in 2017-18 to Rs. 6,410.97 crores in 2019-20. Over this period, domestic revenue has increased by a CAGR of 10.72 percent, while revenue from international markets has increased by a CAGR of 7.75 percent. The domestic revenue has been three times more than the international revenue consistently for the past three financial years.

The sales revenue generated by the respondent firms in the last three years (domestic and international) and segment-wise composition of sales revenue of the respondent firms is presented in the figure below:

Figure 23.6: Total revenue of the respondent firms (Rs. Crores)

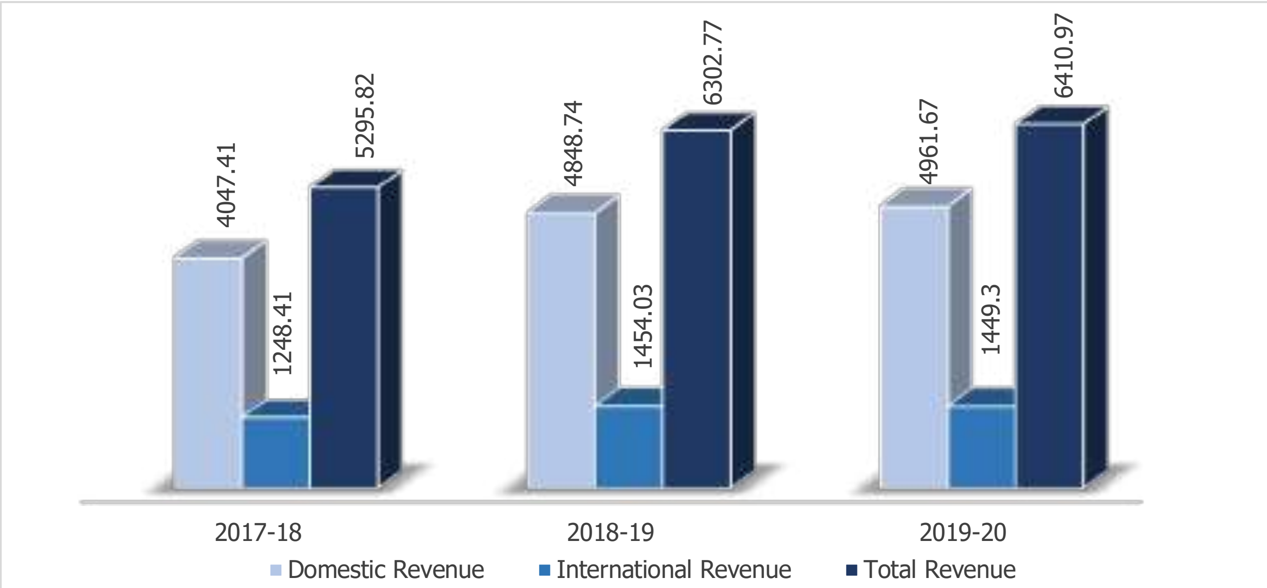
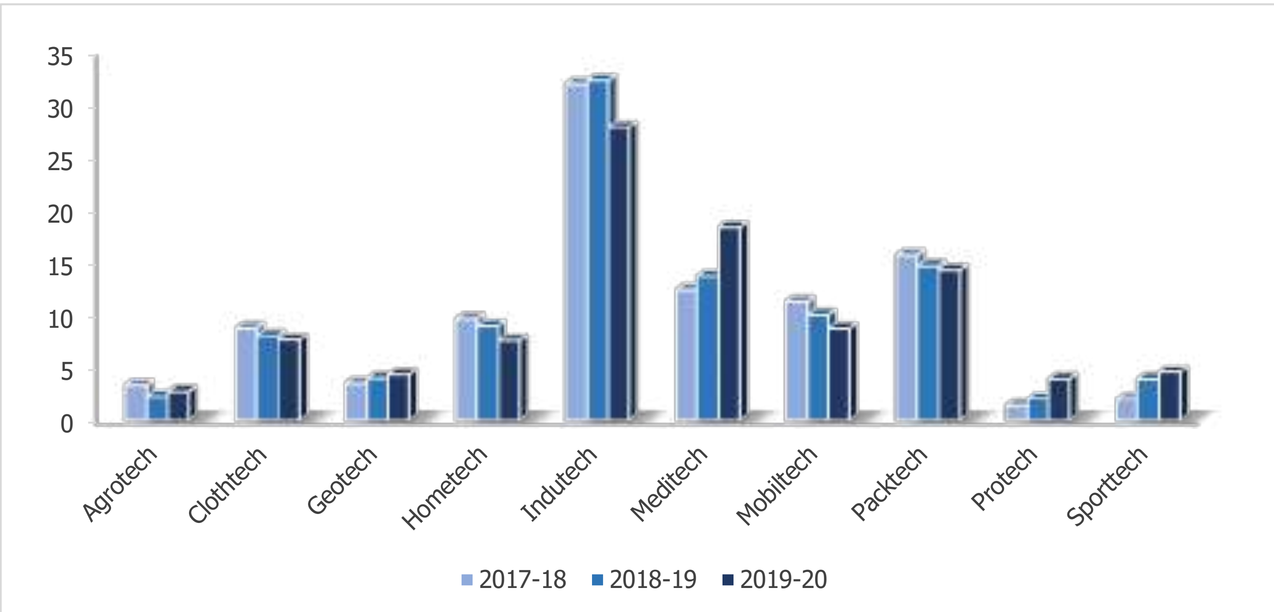


Figure 23.7: Contribution of each segment to total revenue (percent)



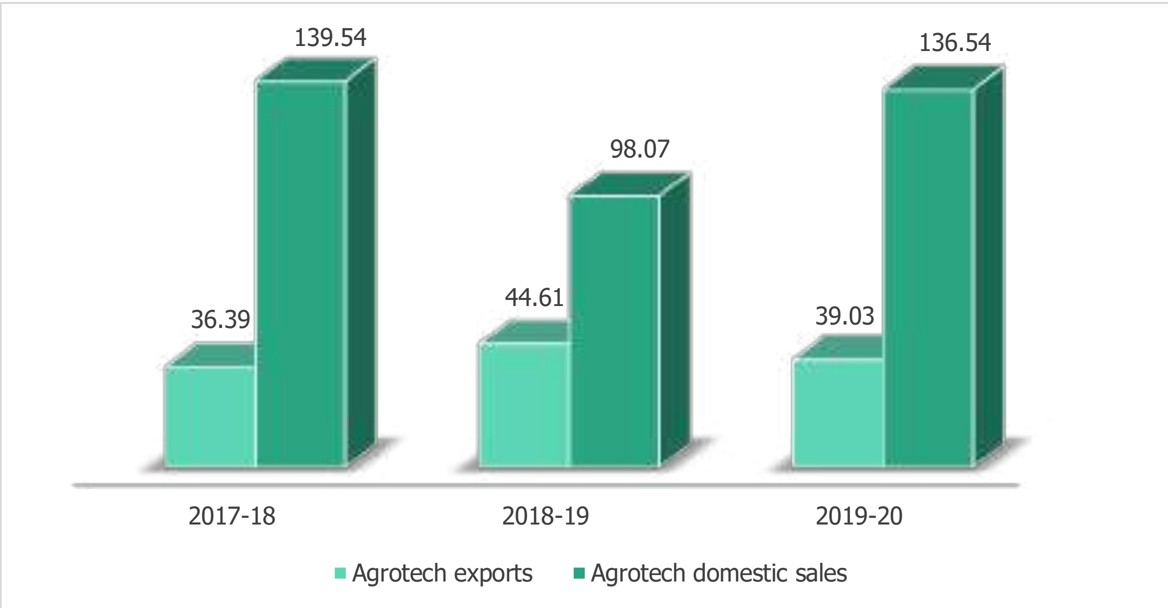
23.6 Segment-wise analysis of sales revenue and production

The following section presents a segment-wise analysis of the revenue and production by respondent firms in various application segments of technical textiles.

23.6.1 Agrotech

Respondent firms in the Agrotech segment account for 8.63 percent of the sample and they reported manufacturing anti-hail nets, anti-insect nets, anti-bird nets, crop covers, fishnet twines, fishing nets, ground covers, nonwoven jute, shade nets, spunbond fabrics, soil saver (open mesh), twisted twines, warp knitted fabrics and shade, and woven agricultural nets. The sales revenue of the Agrotech segment contributed 2 to 3 percent of the total sales of all segments in the sample between 2017-18 and 2019-20. Within the segment, domestic sales contributed between 68 to 79 percent of the total sales during 2017-18 to 2019-20, while exports ranged between 20 to 31 percent. Crop covers, fishnet twines, twisted twines, and fishing nets accounted for almost 86 percent of the segment's revenue in 2019-20. The utilisation of the production capacity, measured as quantity produced as a percent of total production capacity, averaged between 65.83 to 75.33 percent during 2017-18 to 2019-20. The production capacity has remained constant during this time, suggesting an overall increase in the actual production of Agrotech products during this period.

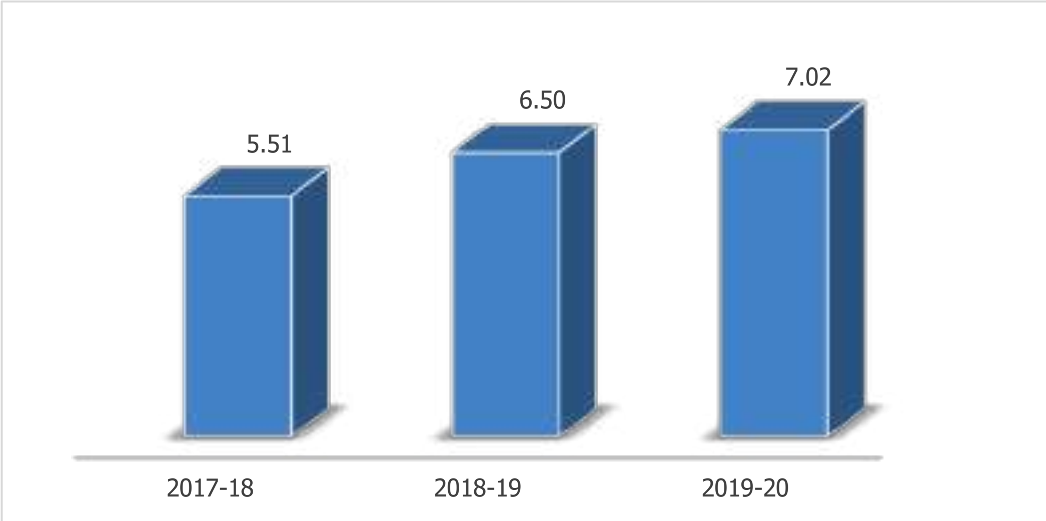
Figure 23.8: Domestic sales and exports under Agrotech segment (Rs. Crores)



23.6.2 Buildtech

Respondent firms in the Buildtech segment account for 3.6 percent of the sample and they reported manufacturing formwork for concrete, nonwoven needlepunch fabrics, nonwoven thermally bonded through air, spun-bond fabrics, and soundtex. The segment represents approximately 0.1 percent each year to the total revenue of the sample during 2017-18 to 2019-20. As per the respondent firms, the entire revenue of the segment has come from domestic sales i.e., no international sales have been reported during 2017-18 to 2019-20. The revenue has grown at a CAGR of 12.87 percent during this period. Soundtex product accounts for the majority of sales revenue of the segment, with its share increasing from 70.8 percent in 2017-18 to 84.05 percent in 2019-20. The Buildtech segment has reported a high average utilisation of its production capacity that ranges between 77.68 percent and 87.50 percent. The production capacity of the respondent firms has remained constant in the past three years, with actual production rising in 2018-19 from 2017-18 levels and then falling again in 2019-20.

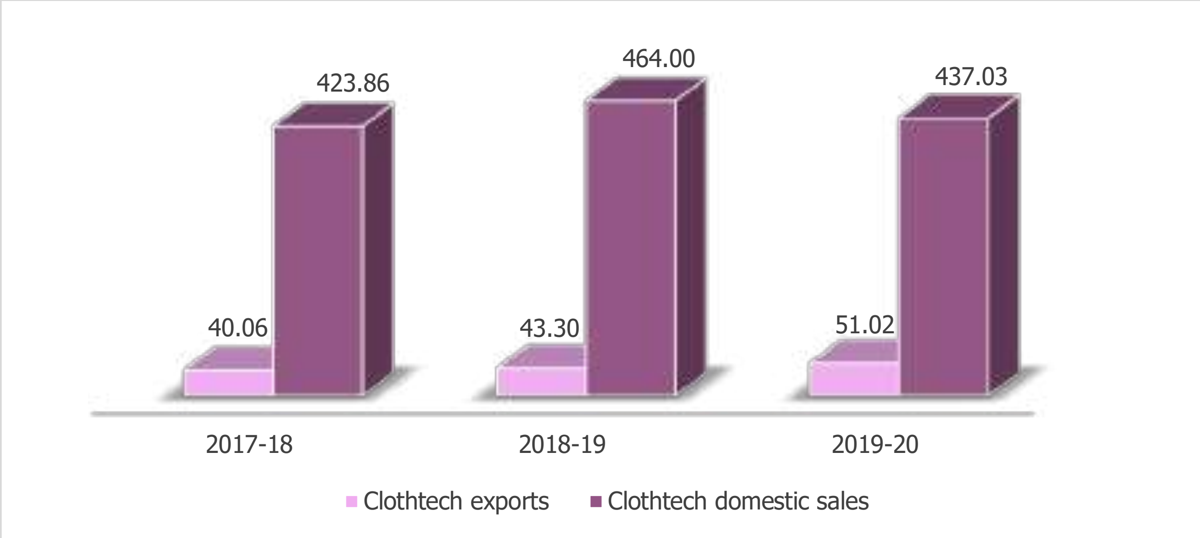
Figure 23.9: Domestic sales under Buildtech segment (Rs. Crores)



23.6.3 Clothtech

Respondent firms in the Clothtech segment account for 5.76 percent of the sample and they reported manufacturing garment elastic tapes, coated interlinings, footwear, and hook and loop tape fasteners. The total revenue of the segment grew at a CAGR of 2.57 percent even though the share of segment in total revenue of the sample declined from 8.76 percent in 2017-18 to 7.6 percent in 2019-20. Domestic sales account for 89-92 percent of the total revenue of the segment during 2017-18 to 2019-20. Footwear, interlinings, hook and loop tape fasteners contributed 83.4 percent, 78.18 percent, and 74.17 percent of the total revenue in the segment in 2017-18, 2018-19, and 2019-20, respectively. The average utilisation of the production capacity of the respondent firms has increased from 63.04 percent in 2017-18 to 75.54 percent in 2019-20.

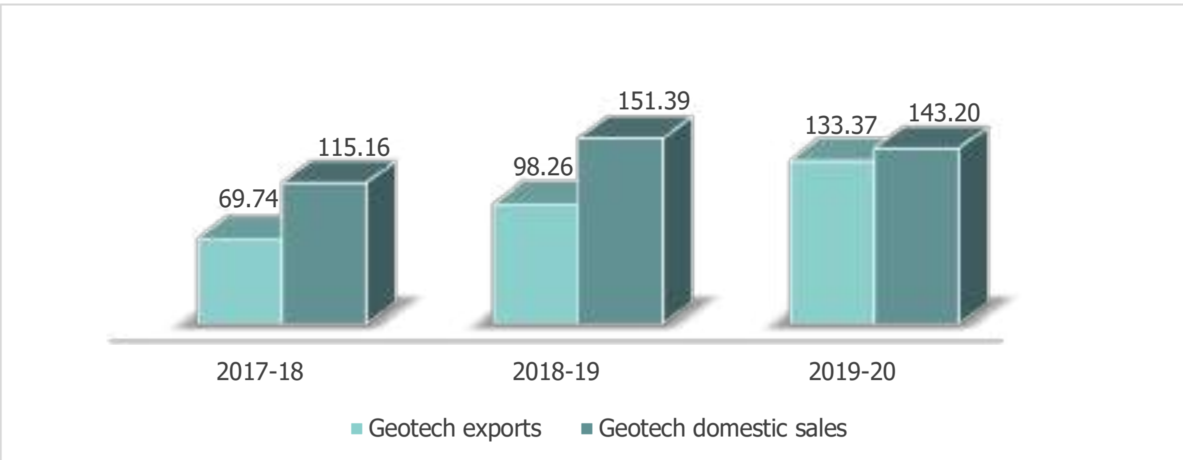
Figure 23.10: Domestic sales and exports under Clothtech segment (Rs. Crores)



23.6.4 Geotech

Respondent firms in the Geotech segment account for 10.07 percent of the sample, and they reported manufacturing jute geotextiles, erosion control, woven and nonwoven geotextiles, geo bags, PET geogrid, HDPE geocell, needlepunch felt, geo tubes, paving fabric, intelligent textile products, and soil savers. The Geotech segment has grown at a CAGR of 22.30 percent between 2017-18 and 2019-20 and contributes 3.5-4.5 percent of the total revenue of the sample. Within the segment, the share of domestic sales has dropped from 62.28 percent in 2017-18 to 51.78 percent in 2019-20, witnessing an increase in international sales from 37.72 percent to 48.22 percent. PP woven fabrics account for the highest share in total revenue of the segment, followed by PET geogrid, and HDPE geocell. On the production side, the average utilisation of the production capacity has increased from 68.14 percent in FY 2017-18 to 73.13 percent in FY 2019-20. Production capacity has remained constant for most products except PET geogrid which has increased by 150 percent. The actual production of jute geotextiles, erosion control, and needlepunch has dropped in 2019-20 relative to the 2017-18 levels while that of PP woven fabrics and PET geogrid have increased during this period.

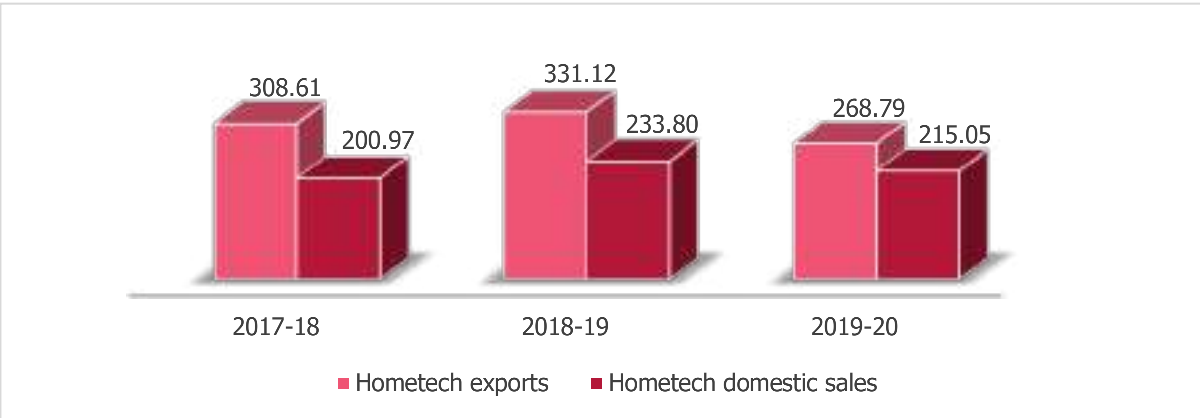
Figure 23.11: Domestic sales and exports under Geotech segment (Rs. Crores)



23.6.5 Hometech

The respondents in Hometech segment account for 9.35 percent of the sample, and they have reported manufacturing carpet yarns and other floor covering yarns, carpet backing cloth, curtains, woven, knitted, and flock fabrics, nonwoven thermal bonded waddings, baby wipes and refreshing wipes, furnishing, pillows, quilts, cushions and comforters, mattress pads, laminated mattress protectors, and black-out window panels. The share of the Hometech segment in total revenues has decreased from 9.62 percent in 2017-18 to 8.96 percent and 7.55 percent in 2018-19 and 2019-20 respectively. In contrast to other segments, international sales have contributed more than 55 percent of the total revenues of this segment i.e. international sales dominate the Hometech segment for the respondent firms. Carpets, flock fabrics, woven and knitted fabrics have contributed the highest revenue in this segment. The average utilisation of the production capacity in the Hometech segment has increased from 63.02 percent in FY 2017-18 to 68.09 percent in FY 2019-20. Production capacity of baby wipes, refreshing wipes, shopping bags, floor coverings, comforters and quilts increased during 2017-18 to 2019-20, while it remained constant for other products.

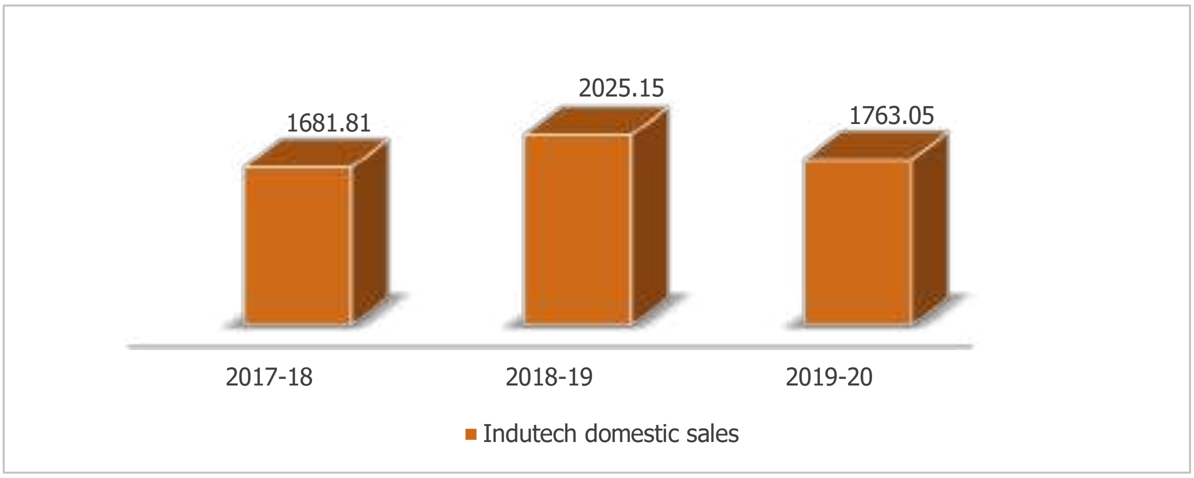
Figure 23.12: Domestic sales and exports under Hometech segment (Rs. Crores)



23.6.6 Indutech

Around 14 percent of the respondent firms are engaged in production and sale of Indutech products. Respondent firms in this sample reported manufacturing formwork for tyre cord fabrics, conveyor belting fabrics, speciality fabrics, dipped fabric. The segment contributed approximately 28 to 32 percent each year to the total revenue of the sample during FY 2017-18 to FY 2019-20. The Indutech segment has grown at a CAGR of 2.68 percent between 2017-18 and 2019-20. Furthermore, more than 98.5 percent of revenue of the segment has come from domestic sales during this period; less than 1.5 percent of international sales have been made during 2017-18 to 2019-20. Tyre cord fabrics, conveyor belting fabrics, speciality fabrics products account for majority of sales revenue of the segment, with their share increasing from 44.3 percent in 2017-18 to 50.6 percent in 2019-20. However, the Indutech segment has marked relatively high average utilisation ranging from 80 percent to 91 percent of its production capacity. The actual production rose in 2018-19 from 2017-18 levels and then fell again in 2019-20.

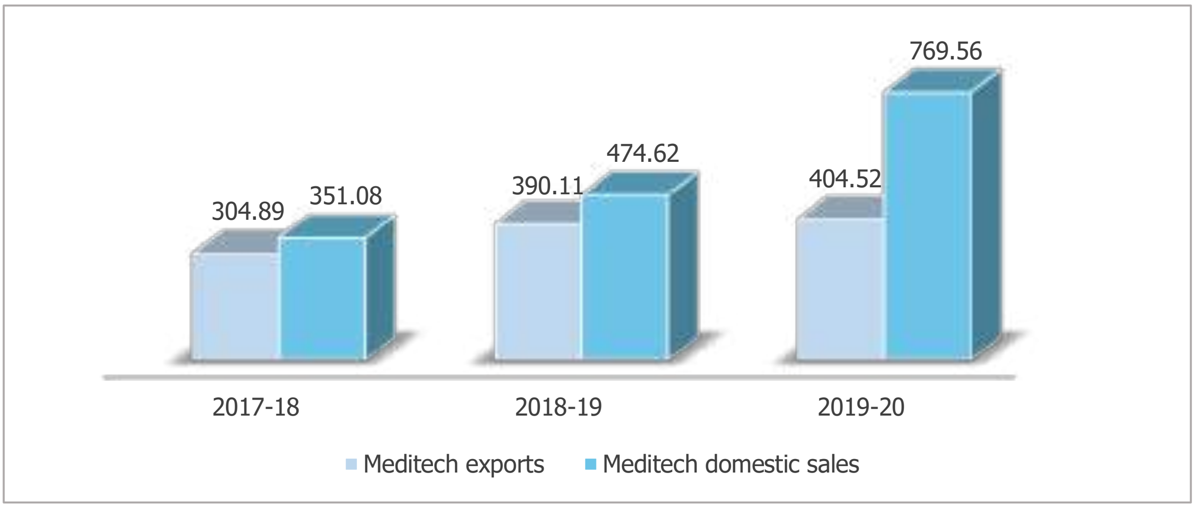
Figure 23.13: Domestic sales under Indutech segment (Rs. Crores)



23.6.7 Meditech

Approximately 17 percent of the respondent firms are engaged in production and sale of Meditech products. Respondent firms in this segment reported manufacturing of baby pants, adult diapers, N95 masks, PPE suits, wipes, medical bandages, etc. The segment has contributed approximately 12 to 18 percent to the annual revenue of the sample during 2017-18 to 2019-20. This segment has grown at a CAGR of 33.78 percent between 2017-18 and 2019-20. Furthermore, more than half the revenue of the segment has come from domestic sales during this period. International sales share has hovered between 34 percent and 45 percent during 2017-18 to 2019-20. It is higher than overall share of exports. Baby pants account for majority of sales revenue of the segment, with its share increasing from 11.5 percent in 2017-18 to 15.1 percent in 2019-20. However, the Meditech segment has marked relatively moderate average utilisation ranging from 60 - 68 percent of its production capacity. The actual production has consistently risen since 2018-19 till 2019-20.

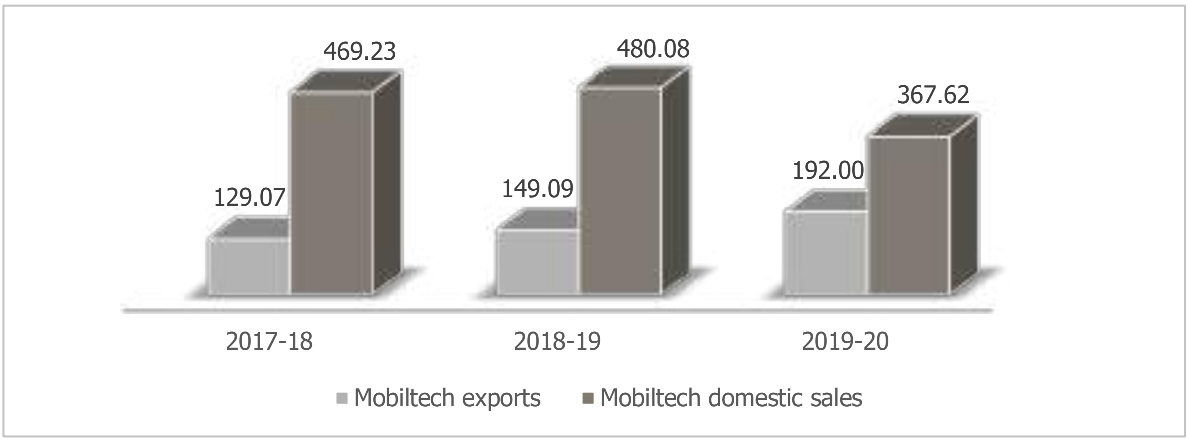
Figure 23.14: Domestic sales and exports under Meditech segment (Rs. Crores)



23.6.8 Mobiltech

A total of six percent of respondent firms are engaged in production and sale of Mobiltech products. Respondent firms in this segment reported manufacturing of automotive components, conveyer belts, luggage fabric, etc. The segment contributed approximately 9 to 11 percent each year to the total revenue of the sample during FY 2017-18 to FY 2019-20. Furthermore, more than 60 percent of the revenue of the segment has come from domestic sales during this period. More than 20 percent sales have come from exports during 2017-18 to 2019-20. Automotive components account for majority of sales revenue of the segment, with the share increasing from 46.8 percent in 2017-18 to 49.5 percent in 2019-20. The segment has marked relatively high average capacity utilisation ranging between 88 percent to full production capacity. The actual production rose from 2017-18 levels to 2018-19 and then fell in 2019-20.

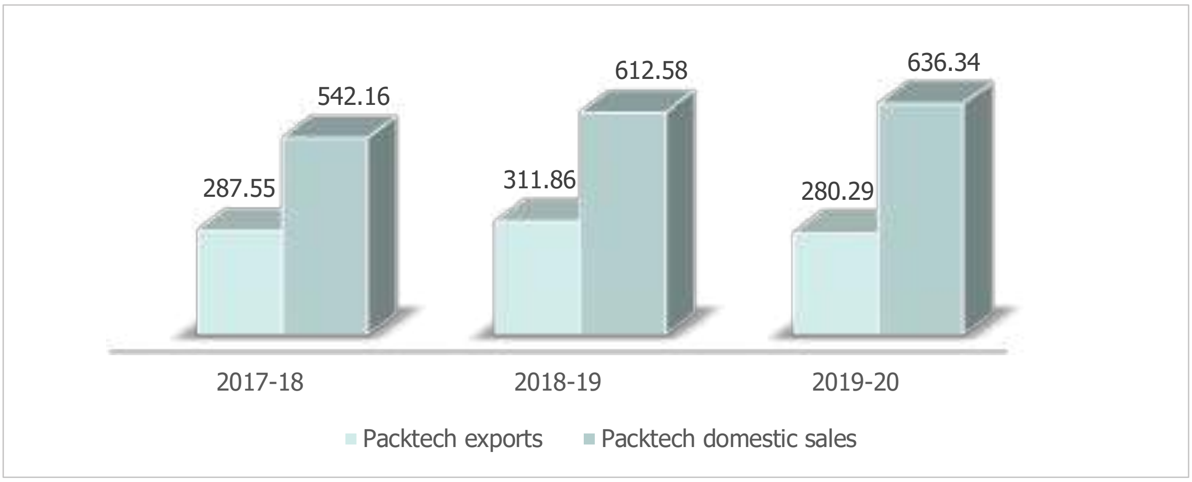
Figure 23.15: Domestic sales and exports under Mobiltech segment (Rs. Crores)



23.6.9 Packtech

A total of eight percent of respondent firms are engaged in production and sale of Packtech products. Respondent firms in this segment reported manufacturing of hessian fabric, hessian bags, sacking bags, shopping bags, etc. The segment contributed approximately 14 to 16 percent each year to the total revenue of sample during 2017-18 to 2019-20. Furthermore, more than 60 percent of the revenue of the segment has come from domestic sales during this period. Share of exports ranges from 30 percent to 35 percent during 2017-18 to 2019-20. The sales revenue of respondent firms in Packtech segment has grown at a CAGR of 5.11 percent between 2017-18 and 2019-20. Furthermore, the share of domestic sales has consistently increased from 65 percent in 2017-18 to 69 percent in 2019-10. Hessian fabric, hessian bags and sacking bags, accounts for majority of sales revenue of the segment, with their share hovering from 33 percent to 35 percent. The Packtech segment has marked relatively high average capacity utilization ranging between 75 percent and 80 percent of its production capacity. The actual production rose from 2017-18 levels to 2018-19 and then fell in 2019-20.

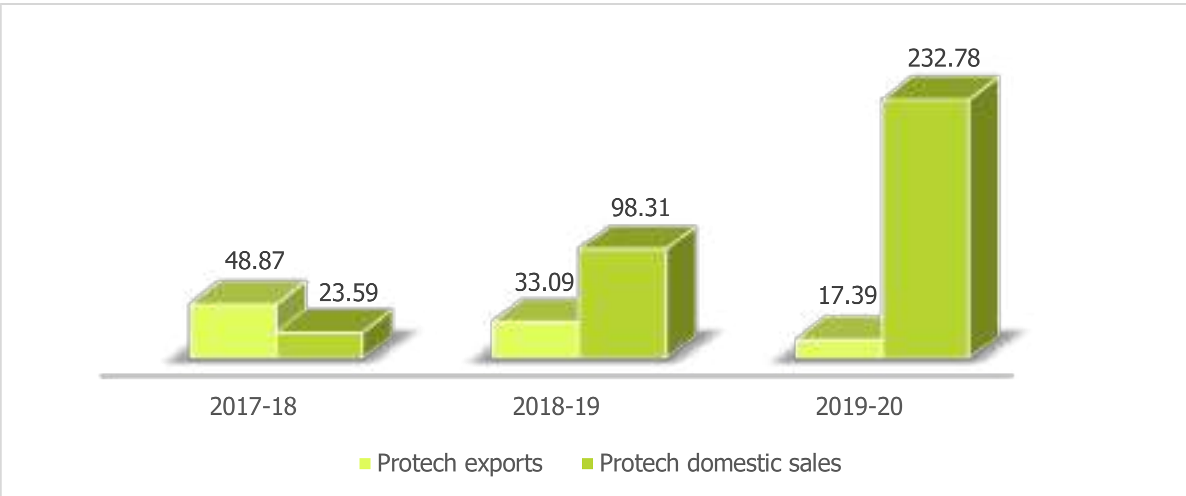
Figure 23.16: Domestic sales and exports under Packtech segment (Rs. Crores)



23.6.10 Protech

Nine percent of the respondent firms are engaged in production and sale of Protech products. Respondent firms in this segment reported manufacturing of bullet proof jackets, helmets, military FR coverall, wax coated fabrics, etc. The segment contributed approximately 1 to 4 percent each year to the total revenue of the sample during 2017-18 to 2019-20. The Protech segment has grown at a CAGR of 85.81 percent between 2017-18 and 2019-20. Furthermore, more than 90 percent of revenue of the segment has come from domestic sales during 2019-20 i.e., less than 10 percent international sales have been made during 2019-20. The share of domestic sales has consistently increased from 33 percent in 2017-18 to 93 percent in 2019-10. Bullet proof jackets and helmets account for majority of sales revenue of the segment, with the share hovering from 56 percent to 87 percent. The segment has marked relatively moderate average utilisation ranging between 59 percent and 84 percent of its production capacity. The actual production has consistently risen from 2017-18 to 2019-20.

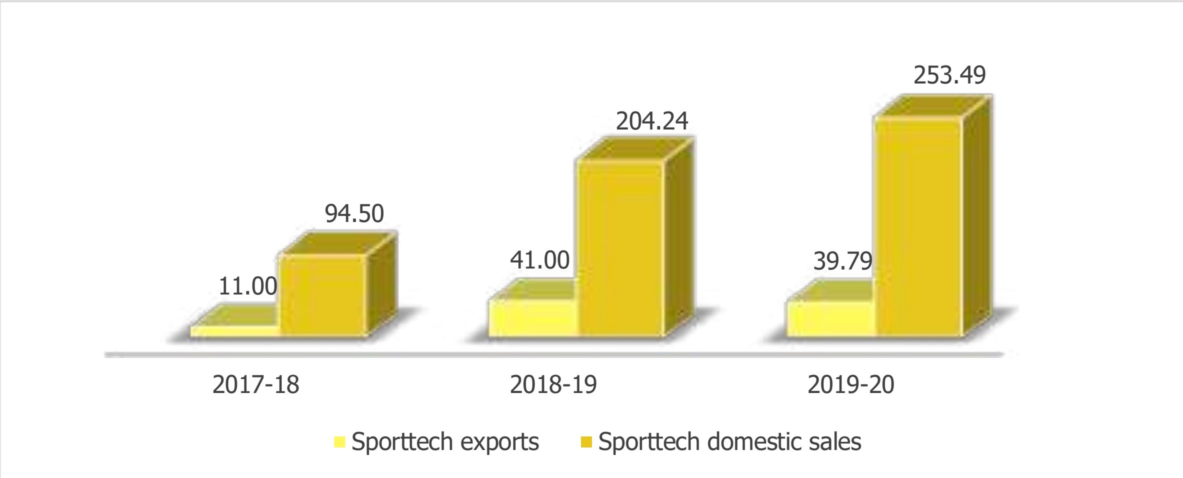
Figure 23.17: Domestic sales and exports under Protech segment (Rs. Crores)



23.6.11 Sportech

Seven percent of the respondent firms are engaged in production and sale of Sportech products. Respondent firms in this sample reported manufacturing of sports shoes, sportswear, shoelaces, sports jackets etc. The segment contributed approximately 2 to 5 percent each year to the total revenue of the sample during 2017-18 to 2019-20. The Sportech segment has grown at a CAGR of 19.58 percent between 2017-18 and 2019-20. Moreover, more than 10 percent of revenue of the segment has come from exports during this period. Sports shoes and sportswear accounts for majority of sales revenue of the segment, with their share hovering from 60-80 percent. The average utilisation of the production capacity in the Sportech segment has increased from 60 percent in 2017-18 to 87 percent in 2019-20. The actual production has consistently risen from 2017-18 to 2019-20.

Figure 23.18: Domestic sales and exports under Sportech segment (Rs. Crores)

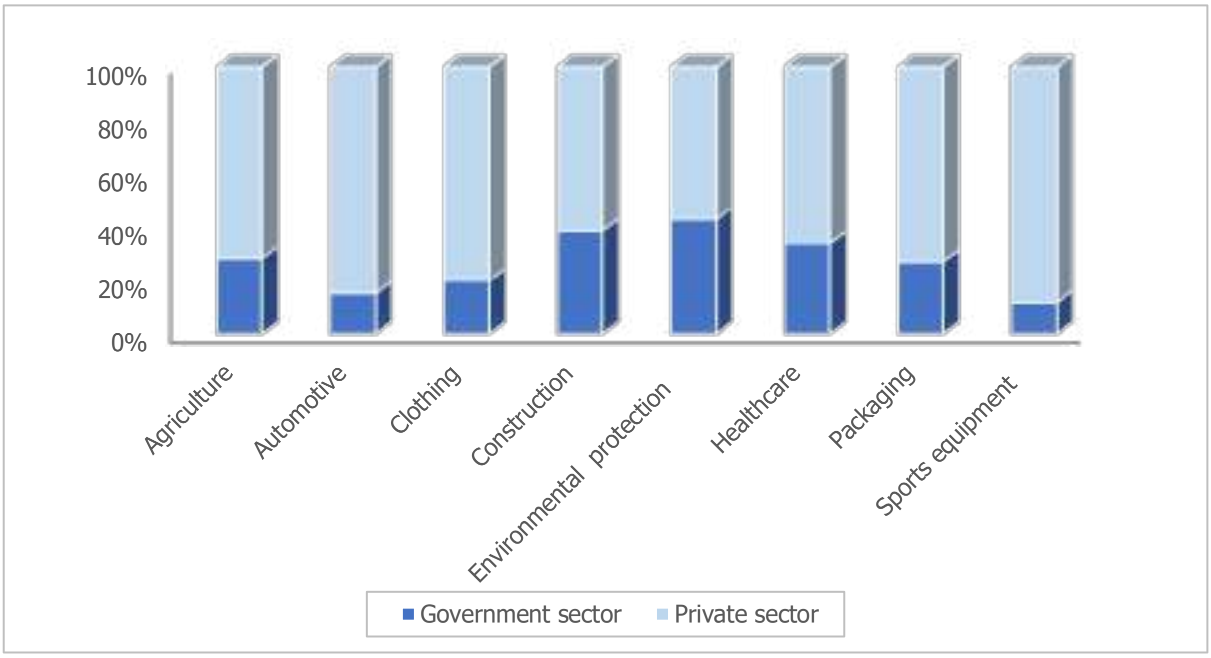


There has been a trend towards increase in total revenue of the respondent firms in the technical textiles industry, with Meditech experiencing the highest rate of revenue growth at 35.77 percent in 2019-20. Indutech continues to dominate the revenue share from 2017-18 to 2019-20 even though there has been a fall in its revenues in 2019-20. Meditech and Packtech contribute the second and third largest share to the total revenue pool of the respondent firms. In terms of CAGR, Protech, Meditech, and Geotech segments emerge as the fastest growing segments. The CAGR for each segment has been estimated based on complete responses of firms across the three years. It can also be noted that the domestic sales account for 100 percent of revenue in Buildtech. Additionally, domestic sales contribute a majority share of total revenue in all other segments except Hometech. In Hometech, revenue from exports exceeds 55 percent in the last three years. From a production point of view, on an average, Buildtech, Indutech, and Mobiltech have relatively higher utilisation of production capacity for the three periods. Meditech and Hometech segments seem to have capacity utilisation on relatively lower side for all three periods as compared to other segments.

23.7 User industries of technical textile products

The consumption pattern of the technical textile products by various user industries can be gauged from the figure below. It is clearly visible that the private sector, by and large, dominates the consumption market. In the government sector, consumption can be seen to be more in environment, construction, and healthcare sectors and lesser in sports equipment, automotive and clothing sectors. Among the private players, consumption of technical textile products is more in sports equipment, automotive and healthcare sectors. The consumption gap between the government and private players is more pronounced in automotive, sports and clothing sector.

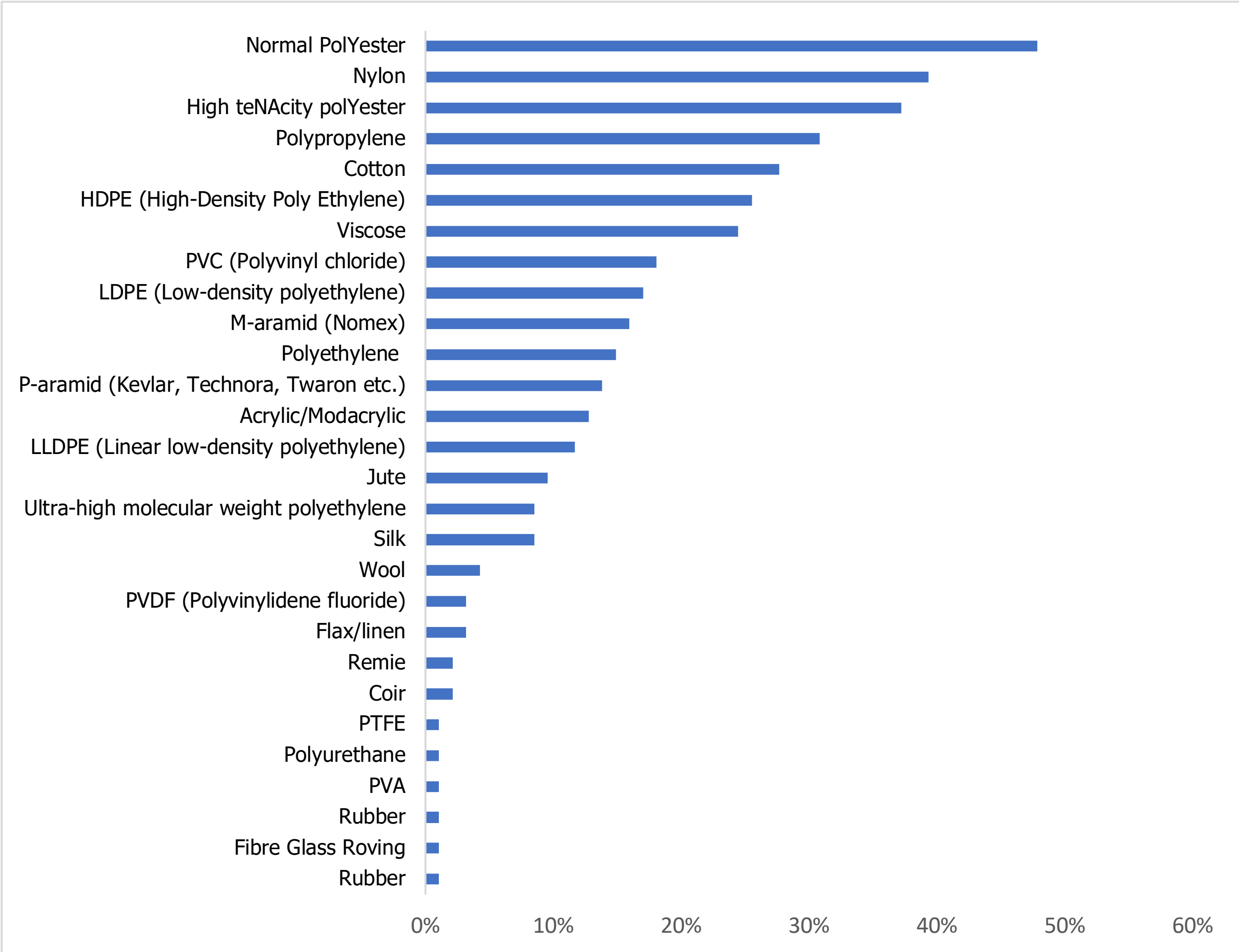
Figure 23.19: Consumption of technical textile products by different user industries



23.8 Raw materials (RM) used in the production of technical textile products

The technical textile industry consumes a wide variety of raw materials. The information about the use of various kinds of raw materials by the respondent technical textile product manufacturing firms operating in India is presented in the following figure:

Figure 23.20: Raw material used by technical textile product manufacturing firms



Polyester is the most commonly used raw material by the respondent firms operating in the Indian technical textile Industry. High tenacity and durability make it appropriate for production of clothing. Polyester is a strong fibre and it can withstand strong and repetitive movements. Manmade raw materials are being used much more as compared to natural raw materials.

23.8.1 Segment-wise consumption of various raw materials

The table below presents a summary of the percentage of firms consuming raw materials in different segments.

Table 23.2 Raw material used by technical textile product manufacturing firms (percentage of respondents)

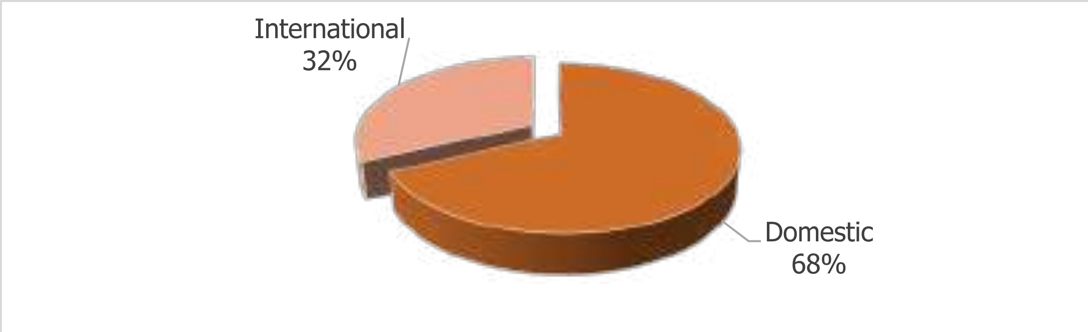
Raw materials	Agro	Build	Cloth	Geo	Home	Indu	Medi	Mobil	Pack	Pro	Sport	Oeko
Cotton	10.5	16.7	36.8	10.5	38.9	24.3	29.0	29.4	18.8	27.6	45.0	
Jute	10.5	33.3	10.5	31.6	16.7	8.1		5.9	18.8	3.5	10.0	50.0
Silk	5.3	8.3	10.5	10.5	5.6	5.4	6.5	5.9	6.3	10.3	5.0	17.0
Coir	10.5	8.3		10.5		2.7		5.9	6.3	3.5	5.0	33.0
Flax/linen			10.5			2.7				3.5	5.0	
Remie		16.7		10.5		2.7						17.0

Raw materials	Agro	Build	Cloth	Geo	Home	Indu	Medi	Mobil	Pack	Pro	Sport	Oeko
Wool			5.3		5.6		3.2			3.5		
Rubber											5.0	
Viscose	10.5	16.7	26.3	10.5	44.4	24.3	32.3	23.5	12.5	37.9	20.0	17.0
Normal Polyester	26.3	41.7	73.7	36.8	77.8	54.1	51.6	58.8	43.8	65.5	85.0	33.0
High tenacity polyester	31.6	25.0	42.1	36.8	44.4	37.8	38.7	52.9	37.5	48.3	45.0	
Nylon	31.6	16.7	57.9	21.1	50.0	48.7	45.2	52.9	25.0	51.7	60.0	17.0
Acrylic/Modacrylic		8.3	21.1	5.3	16.7	10.8	16.1	5.9		24.1	25.0	17.0
Polypropylene	21.0	25.0	15.8	42.1	27.8	32.4	38.7	23.5	37.5	44.8	35.0	33.0
Polyethylene	36.8	25.0	5.3	15.8	16.7	16.2	12.9	23.5	37.5	24.1	5.0	17.0
Ultra-high molecular weight polyethylene	5.3			10.5	11.1		9.7	17.7	6.3	24.1	10.0	17.0
P-aramid (Kevlar, TechNora, Twaron etc.)	5.3		15.8	15.8	5.6	16.2	19.4	11.8	6.3	37.9	20.0	17.0
M-aramid (Nomex)	10.5	8.3	21.0	21.1	22.2	21.6	29.0	23.5		37.9	20.0	33.0
HDPE	57.9	58.3	15.8	47.4	27.8	29.8	22.6	35.3	43.8	20.7	15.0	67.0
LLDPE	15.8	16.7	10.5	10.5	22.2	13.5	19.4	23.5	25.0	17.2	5.0	33.0
LDPE	21.1	16.7	10.5	10.5	33.3	18.9	25.8		25.0	20.7	10.0	17.0
PVC	21.1	25.0	15.8	21.1	33.3		16.1	47.1	18.8	24.1	30.0	50.0
PVDF	5.3		5.3	5.3	16.7		3.2	17.7	12.5	6.9		17.0
Fibre Glass Roving						2.7						
PVA		8.3	5.3	5.3	5.6			5.9	6.3			
Polyurethane			5.3			2.7	3.2			3.5	5.0	
PTFE					5.6	2.7	3.2	5.9		3.5		

23.8.2 Purchase of raw materials by Indian firms

Easy availability of raw material at affordable prices preferably from domestic sources is a crucial parameter for business success of the manufacturing firms. The Indian technical textile manufacturing firms source their raw material requirements from domestic and international sources. A large proportion of the number of respondent firms (69 percent) reported sourcing from the international sources, while the remaining 31 percent are sourcing from domestic sources only.

Figure 23.21: Comparative share of expenditure on raw materials (domestic and international sources)

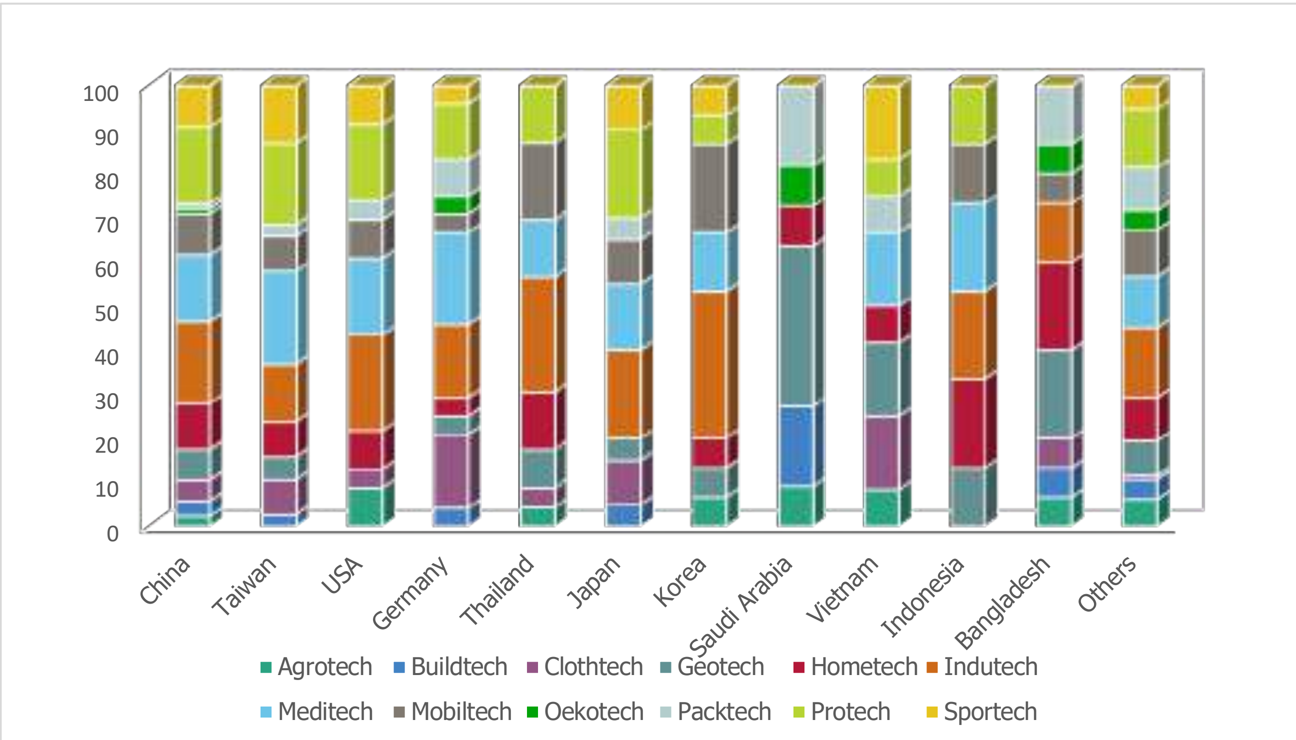


The figure above presents the average share of raw material purchased (value) from domestic and international markets. On an average, around a third (32 percent) of the total purchases come from the global markets whereas, the remaining (68 percent) is sourced from within the country.

23.8.3 Import of raw materials by Indian technical textile product manufacturing firms

The Indian technical textile product manufacturers are highly dependent on imports of many raw materials. The figure shown below captures the source-country wise analysis of these imports.

Figure 23.22: Relative consumption (segment-wise) of imported raw materials from different countries



Others include Hong Kong, Malaysia, Singapore, Switzerland, Austria, Denmark, The Netherlands, Spain, Turkey, France, Iran, Qatar, Russia, Dubai, UAE, Australia, Bahrain, Poland and regions namely Europe, UK Sea, Middle East, and Gulf countries.

China is the most dominant player among source countries of raw material imports for Indian technical textile manufacturers. About 24.2 percent of the respondents reported that they are sourcing their raw materials from China. The raw materials imported include fibre, filament or technical yarn of polyester and nylon along with other nonwoven fabrics. Major segments that import raw material from China include Indutech, Meditech, Protech and Hometech.

Taiwan emerges as the second largest (9.4 percent) supplier country for raw material. Polyester, nylon and meltblown nonwovens are the raw materials that are getting imported mainly by firms in Meditech, Protech, Indutech and Sportech segments.

USA is almost equally important source of raw material procurement as Taiwan with 9.4 percent of the firms reporting USA to be their source country. Nylon is the material that is procured the maximum; firms in Indutech, Meditech and Protech segments are the main importers from USA.

Germany is one of the largest raw material producers in Europe. Around 7.8 percent of the respondents are importing products like polypropylene mesh, stabilizer, PVC, nylon and flame retardant textiles from Germany and these firms are mainly operating in Meditech, Indutech, Clothtech and Protech segments.

Other countries from where Indian firms import raw materials for technical textiles are

- Thailand (7 percent of the respondents; raw materials imported: nylon, polyester and viscose; leading segments: Indutech, Mobiltech, Meditech, Protech and Hometech)
- Japan (5.5 percent respondents; raw material imported: aramids, polyvinyl alcohols (PVAs), polyester and resorcinol; leading segments: Protech, Indutech and Meditech)
- South Korea (5.5 percent respondents; raw material imported : caprolactam, acrylic acid and Pure MDI (adhesives) and leading segments: Indutech, Mobiltech and Protech)
- Saudi Arabia (5.5 percent respondents; key raw material: polypropylene, HDPE and polyester fibres; leading segments: Geotech, Packtech and Buildtech)
- Vietnam (key raw materials: polyester fabric/yarn and spandex; leading segments: Sportech, Clothtech, Meditech and Geotech)
- Indonesia (key raw material: viscose, polyester and nylon; leading segments: Hometech, Indutech and Meditech), Bangladesh (key raw material: Jute, leading segments: Hometech, Geotech, Packtech and Indutech).

Table 23.3: List of products imported by technical textile product manufacturers

S. No.	Source Country / Region for Import	Name of raw material
1	Australia	Foam
2	Austria	Viscose
3	Bahrain	Fibre glass roving

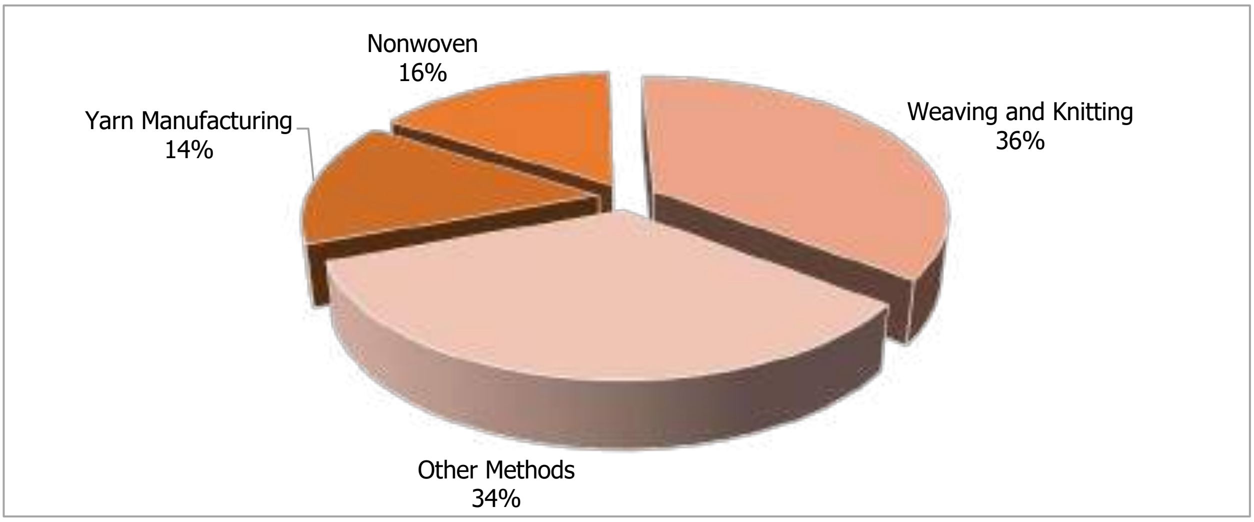
4	Bangladesh	Jute
5	China	Antistatic polyester fabric, aramids, fabric, greige fabric, adhesives and tow, fibre, flame retardant textiles, high tenacity polyester filament yarn, melt-blown filter, meta and para aramid, nylon, nylon yarn-n66 resorcinol, packing material, PE lamination film, poly-cotton woven fabric, nonwoven laminated fabric, nonwoven synthetic fabric, packing material, polyester, polyester fibre, polyester yarn, reflective tapes, synthetic fibres, uhmwpe, viscose, zippers, wrap knitted polyester fabric
6	Denmark	Bicomponent pet spunbond
7	France	Nylon
8	Germany	Activated carbon spheres, adhesive & chemicals, co-poly amides, co-poly amides, flame retardant textiles, nylon, phosphate plasticizers, PP mesh, PVC, stabilizer, stabilizer, UV stabilizer
9	Hong Kong	Packing material, viscose
10	Indonesia	Nylon, polyester, viscose
11	Iran	HDPE/LDPE
12	Japan	Aramids, caprolactam resorcinol, meta and para aramid, mod acrylic, opan (pyromex), poly vinyl alcohol (PVA), polyol + pure MDI, stabilizer, teeijinconex (mzeta aramid fibre)
13	Malaysia	Calcium carbonate power (coated), HDPE films, fibres, nonwoven synthetic fabric
14	Netherlands	Caprolactam, twaron
15	Poland	Fibre
16	Qatar	HDPE/LDPE
17	Russia	caprolactam & chips
18	Saudi Arabia	HDPE films, fibres, HDPE/LDPE, polyester fibre, polymer chips/granules, polypropylene (PP) staple fibre
19	Singapore	LDPE granules, polypropylene (PP) staple fibre, super absorbent polymer
20	South Korea	Acrylic acid, additive, drying DH 960e, caprolactam, fibre, polyol + pure MDI
21	Spain	Mod acrylic
22	Switzerland	Co-poly amides, dyes
23	Taiwan	Melt-blown filter, meta and para aramid, nylon 66, nylon chips/granules, polyester, pure adhesive, HMPSA adhesive, spunless, TPU lamination film
24	Thailand	Nylon chips/granules, plasticizer, poly vinyl chloride (PVC) resin, polyester, viscose
25	Turkey	Bicomponent pet spunbond
26	UAE	Polypropylene (PP) staple fibre, PP granules
27	USA	Aramids, caprolactam, melt-blown filter, nylon 6, nylon 66, nylon chips/granules, nylon stretchable fabric, nylon suture thread, polyester suture thread, PP suture thread, UHMWPE, wood pulp
28	Vietnam	Filler masterbatch, high tenacity polyester filament yarn, spandex, wrap knitted polyester fabric

29	UK	Viscose tow
30	Dubai	Polyester fibre, polypropylene (PP) staple fibre
31	Europe	Aramids, dyneema yarn, medical fabric, meta and para aramid, mod acrylic, UHMWPE, viscose

23.9 Manufacturing processes used by technical textile product manufacturing firms

The figure presented below depicts the distribution of processes being adopted by product manufacturing firms in technical textile industry.

Figure 23.23: Manufacturing processes used by technical textile firms in India (percentage of firms)



Around 36 percent of technical textile firms use weaving and knitting as the main process for product manufacturing. Majority of small and medium firms use cost-effective processes like stitching as indicated in the 'Others' response. Other processes used are yarn manufacturing and Nonwoven which are adopted by 14 percent and 16 percent of the firms respectively. The rest of the processes have limited use among respondent firms. It is to be noted that fibre manufacturing in the figure above also corresponds to manufacture of spun-melt nonwoven fabrics.

Fibre Manufacturing Processes

The respondent firms reported the use of three major fibre manufacturing processes viz. melt spinning, solution spinning and dry-jet wet spinning.

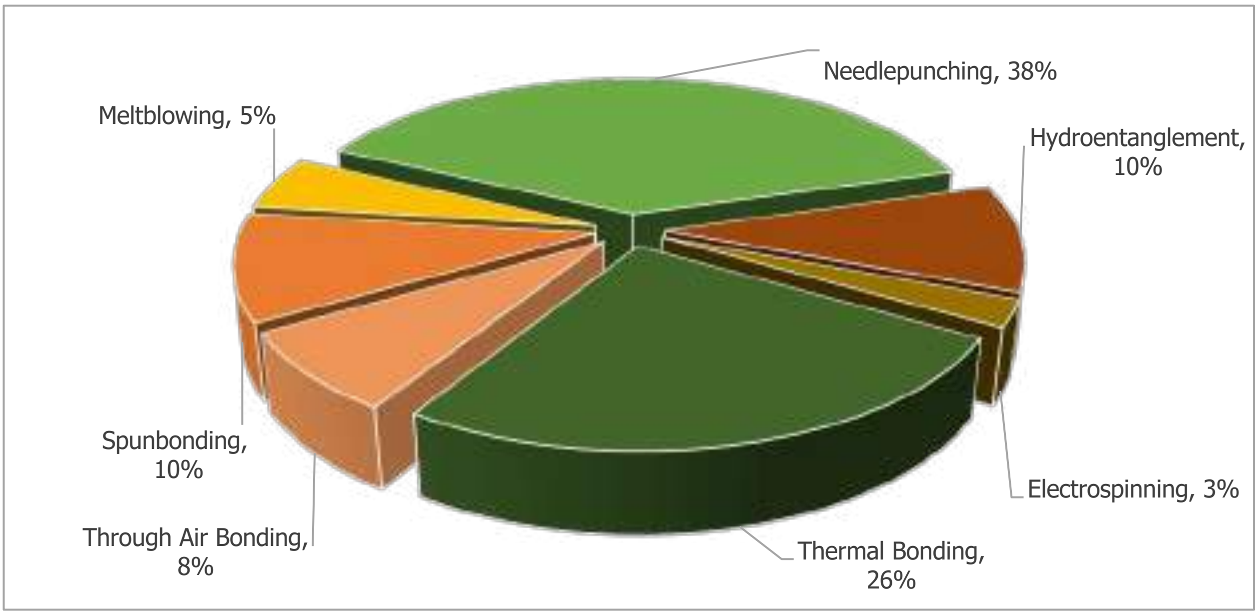
Yarn Manufacturing Processes

A majority of the respondent firms reported the use of ring spinning technique as the most widely used technique in yarn manufacturing process. Other post-spinning processes included doubling and twisting.

Nonwoven Processes

The figure presented below represents distribution of various nonwoven manufacturing processes being used by the technical textile product manufacturing firms.

Figure 23.24: Nonwoven textile manufacturing processes used by technical textile firms in India



About 38 percent of the respondent firms which use nonwoven techniques for manufacturing their products use needlepunching as their main process. Thermal bonding, including through air bonding, is the 2nd most widely used process under nonwoven category being used by 34 percent of respondent firms. Other processes include hydroentanglement (10 percent), spunbonding (10 percent), and meltblowing (5 percent). Electrospinning (3 percent) is the least commonly used process.

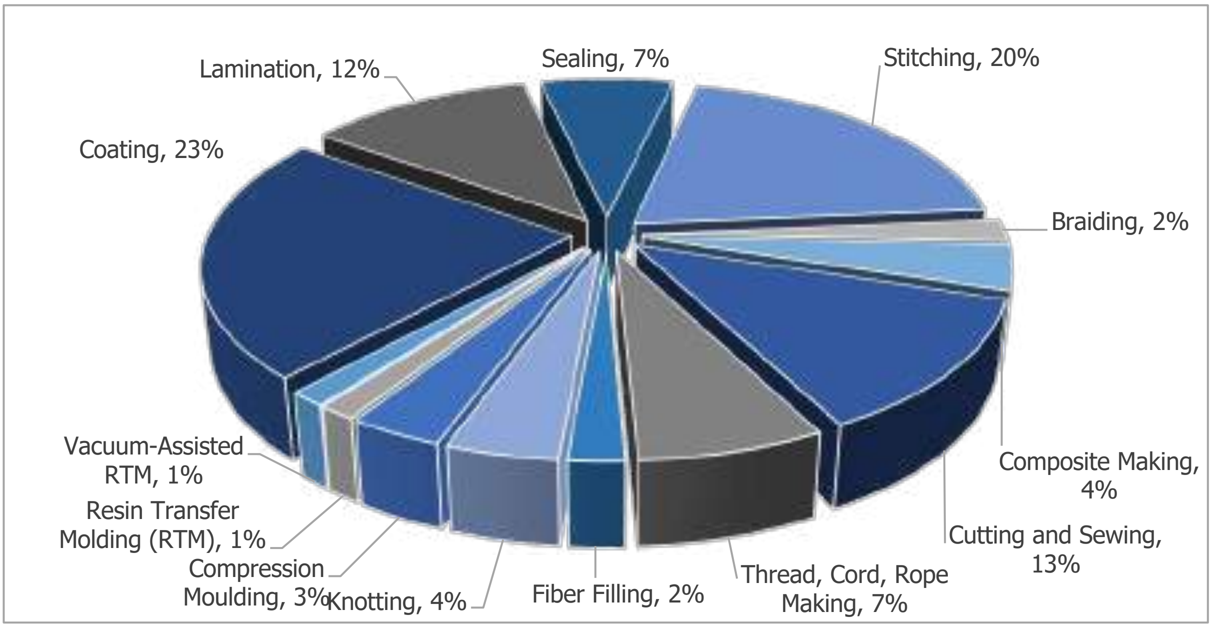
Weaving and Knitting

Almost 72 percent of the respondent firms use weaving as their main process while 28 percent reported the use of knitting as their main process.

Other Methods

The figure that is presented below shows the distribution of technical textile product manufacturing firms based on those textile manufacturing processes being used which do not fit into any of the previous categories.

Figure 23.25: Some other textile manufacturing processes used by technical textile firms in India

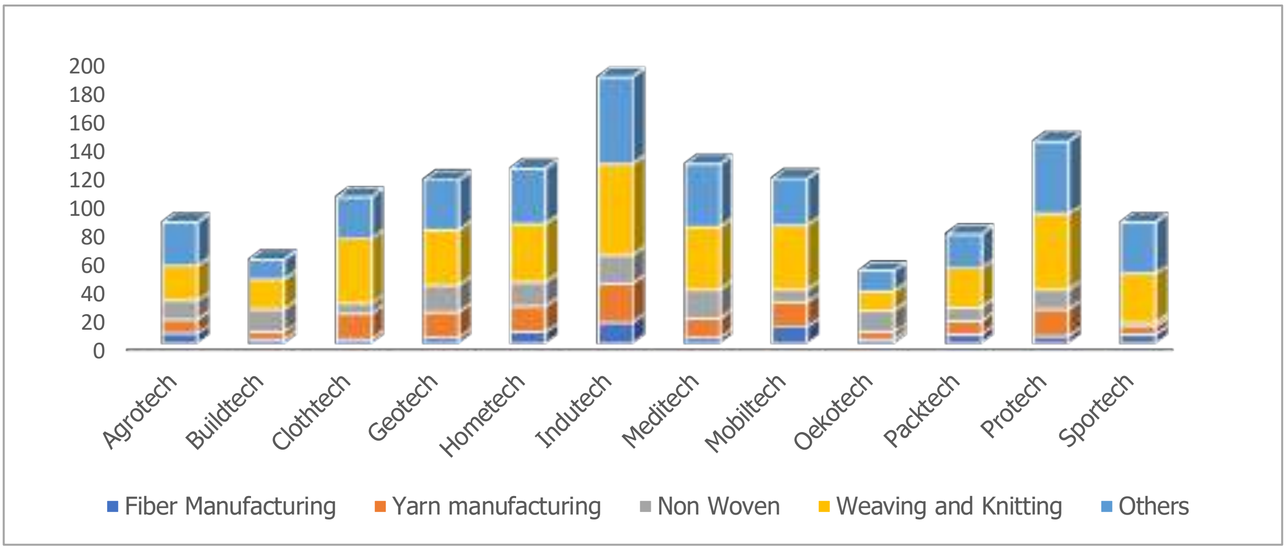


Out of the techniques that were reported, coating (23 percent) and stitching (20 percent) emerge out to be the most commonly used techniques. Other methods used are lamination (12 percent), cutting and sewing (13 percent), sealing (7 percent), and thread, cord, rope making (7 percent). Knotting (4 percent), compression moulding (3 percent), braiding (2 percent) are among the least used methods.

23.9.1 Segment-wise distribution of manufacturing processes

A segment-wise analysis was conducted to gauge the distribution and spread of technical textile manufacturing processes across 12 application segments of technical textile industry in India and the findings are recorded below:

Figure 23.26: Segment-wise distribution (relative frequency) of textile manufacturing processes used by technical textile firms in India



Most of the respondent firms operate in more than one application segment of technical textiles, with largest share of firms in Indutech, Meditech and Protech segments. Fibre manufacturing processes are used most commonly in the Indutech and Mobiltech segments. Yarn manufacturing processes are spread equally across Clothtech, Geotech, Hometech, Meditech, Mobiltech and Protech with Indutech as the highest. Nonwoven methods are most popularly used in the Geotech, Indutech and Meditech segments. Indutech is the leading segment under weaving and knitting processes followed by Protech at the second position.

Important machines installed and used in the production of technical textile products by Indian firms

The technical textile product manufacturing firms use a wide variety of machines and equipment. The table below presents a list of important machines being used by respondent firms in manufacturing products in various application segments.

Table 23.4 List of important machines installed by technical textile product manufacturing firms in India

Segment	Name of Machines
Agrotech	PP spunbond nonwoven fabric making machine, water jet looms, circular knitting looms, double dot coating machine, inspection and packing machine, warp knit insertion looms, HTHP dying machines, hot air stenter, powder dot coating machine, sectional warping machine, warping machine for warp knitting, carding machine, needlepunching machine
Clothtech	Calendar line, lamination machine
Geotech	Water jet weaving looms, warping, twisting, sizing, rolling machine, hydraulic press, autoclaves, conveyor ovens
Hometech	Warping, sizing, weaving, dyeing & processing, stitching, PVC transfer coating line, PU dry line, PU wet line machines
Indutech	PP spunbond nonwoven fabric (single beam machine), PP spunbond and meltblown nonwoven fabric (double beam machine), needlepunching machine, hydrophilic machine, looms and hot flu, lamination machine, adult diaper machine, adult pant machine, baby diaper machine, baby pant machine, underpad machine
Meditech	Needlepunching, oven, cast coating line, tabletop tufting machines, wide width tufting, weaving machines, shuttleless looms, coating machines, dyeing machines, knitting machines, multiaxial machine, stitching, maxing and compounding, printing line, embossing line, inspection machine, pigment pasting, biaxial machine
Mobiltech	Needlepunching machine, sizing, warping, looms, washing, jet dyeing, stenter, calender, coating, inspection, garmenting, welding machine
Packtech	Fishnet knitting, ring twisters, two for one twister, length stretching machine, (heat setting), dyeing machine (colouring), drilling machine, threading machine, winders, knotting (netting) machine
Protech	Projectile and airjet looms, warping machine, fibre opening line, carding, hydro-entanglement unit, winder and slitter warping machine, ring twister TFOS
Sportech	Lamination and coating machine, needlepunching machine, INA hanger system- stitching line, multi needle quilting machine, assembly winding, twisting, warping, cop making, weaving looms, paste mixing m/c, dipping (impregnation) & coating plant, fastener fixing m/c, overlock and stitching machine, suction pillow filling machine, edge binding machines, carding machine, thermal bonding machine
Various Segments	Automatic multi-layer mask manufacturing line, beaming machine, coating machine, high strength beams, universal testing machine, punching machine, ultrasonic welding machine, cutting machine, mask loop welding machines, carbon coating machine with knife on roller

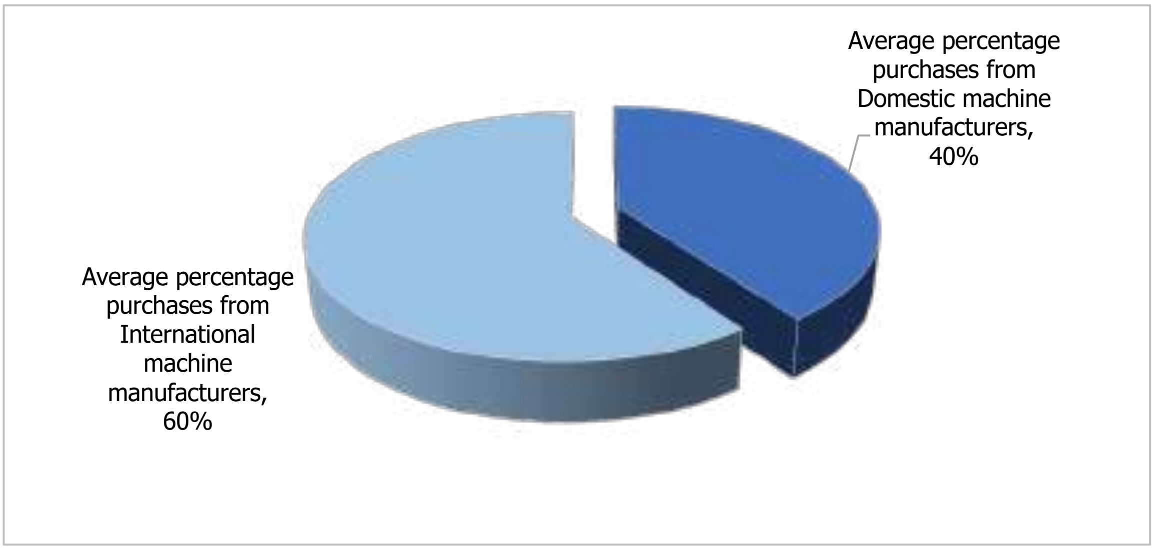
	coating head, screen for coating of adhesives and oven for curing lamination set up, electrospinning machine, printing machine, folding machine, stitching machine, quality checking machine, baling machine and generator coater, stenter, flatbed and rotary, screen printing, digital printing, arioli loop ager, soft flow dyeing machine, airoli continuous washer, duotec extrusion plant, circular weaving machine, belt weaving machine, lamination machine, fabric & belt cutting machine lamination, extruder spinning machine, cable corder, looms, dipping spinning, finishing, cutting, sewing, heat transfers, singeing cum desizing machine, continuous bleaching range machine, stenter machine, sansforizer machine, dot coating machine, coating machine, lamination machine, calendar machine, high speed braiding machines, tipping machine, high speed shuttleless narrow fabric looms, PE breathable compounding machine, PE breathable film line with embossing unit machine for slittig rolls, machine for rewinding rolls, seam seal machine rope squeezing machine, extrusion line, nylon monofilament manufacturing extruder, direct coating line, hot air sealing machine, heat sealing machine, coating machine, polymerisation reactors, solid state polymerisers, melt extruders, spin draw machines, airlay cards, jet lacing machines

The table above suggests that a range of different machines are used in the production of technical textiles.

23.9.2 Procurement of machines by Indian technical textile manufacturing firms

A significant proportion (64 percent) of the respondent firms reported that they purchase machines from international machine manufacturers incurring an average share of 60 percent of their total purchase expenditure for such purchases. This indicates a substantial dependence of Indian firms on imported machines procured from international suppliers. Out of the firms that import machines, around 60 percent of the firms reported that more than half of their total purchase was from foreign manufacturers and in some cases, the share was more than even 75 percent. This shows that Indian firms are burdened with large costs due to import of machines. Around 61 percent of the respondent firms reported that they had procured machines from domestic machine manufacturers too.

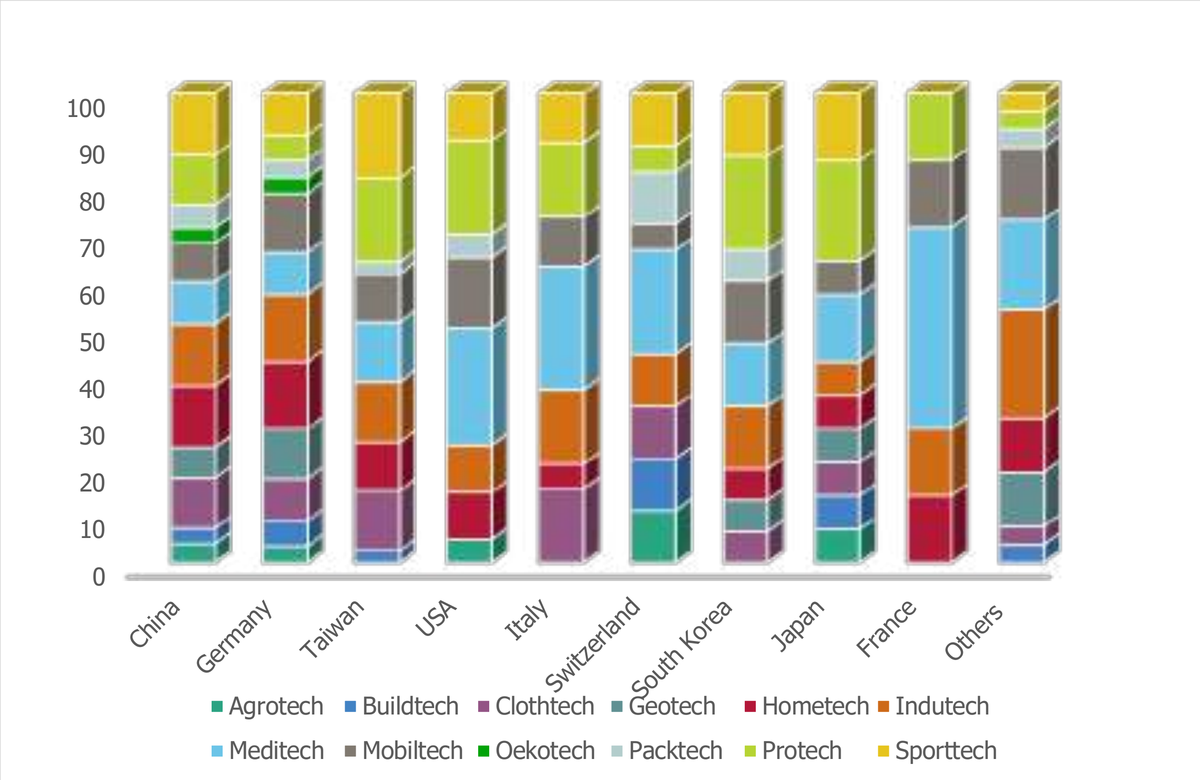
Figure 23.27: Comparison of share of costs incurred on purchase of machines from domestic and international suppliers



23.9.3 Import of machines from outside India

As already reported above, a large number of firms in India purchase imported machines. The figure given below presents the source countries of the imported machines as reported by the respondent firms.

Figure 23.28: Source countries of machines imported by Indian technical textile manufacturing firms



Others include Austria, Turkey, UK, Brazil, Belgium, Hong Kong, Netherlands, Poland and Europe as a region.

It is apparent from the figure that there are five major countries from where machines are being imported by Indian firms. These countries are China, Germany, Taiwan, USA & Italy. In addition to these countries, there are other countries viz. Switzerland, South Korea, Japan, France, Austria etc. who also act as source of supply of machines for Indian firms. China is the country from where maximum number of machines are being imported by firms from Hometech, Indutech and Sportech reporting the largest share (around 13 percent each) of purchase. Germany is the next important source of origin for machines imported by firms from Hometech (14.28 percent), Indutech (14.28 percent) and Mobiltech (12.5 percent) segments. Firms producing products belonging to Protech (12.5 percent) and Sportech (12.5 percent) segments report their largest procurement from Taiwan.

Overall, the six segments which reported large imports from various countries are Meditech (14.03 percent), Indutech (13.74 percent), Hometech (11.11 percent), Mobiltech (10.81 percent), Protech (11.69 percent), and Sportech (11.40 percent). On the contrary, the import by firms producing items of Oekotech segment was minimal (1.7 percent) and it was from China and Germany.

Around 41.7 percent of the respondents reported that they are sourcing their machines from China with major importing segments being Hometech, Indutech, and Sportech. Around 21.66 percent of the respondents reported import of machines from Germany by firms operating in Hometech and Indutech segments. A large number of firms in Protech and Sportech segments have been sourcing machines from Taiwan as well.

Table 23.5: List of Machinery imported from the various countries

Countries / Regions	Names of the machines imported
Austria	Blow room, zimmer.
Belgium	Airjet looms.
Brazil	Weaving machines (looms).
China	3 single m/c, one multi wipe machine, face mask machine, adult diaper machine, adult pant machine, baby diaper machine, baby pant machine, underpad machine, automatic mask making line and accessories, carding machines, needlepunching machines/punching machines, circular knitting, complete line of nonwoven needlepunch felts and fabric, circular knitting looms, double dot coating machine, drum building, curing, cutting, grinding, dyeing machines, extruder, fishnet knitting, fusing machines, stitching machines, high precision garment machines, high speed automatic needlepunching machines, high speed beaming machines, high speed braiding machine, tipping machine, knitting, lamination, lamination machine, hydrophilic m/c, mask making machine, melt spinning, multi excel knitting machines, coating lines etc., nonwoven manufacturing line to produce needlepunch fabric/mask manufacturing machine lines, power dot coating machine, PP spunbond-meltblown-spunbond nonwoven fabric (double beam machine), PP spunbond nonwoven fabric (single beam machine), needlepunching machine, netting machine, perforation, printing machine, PU and PVC coating machine, S4 looms, shuttleless loom, spinning machine, stenter, fabric dyeing, embossing, laser cutting, stitching machine, warp knitting machine, water jet looms, x fold, facemask, weaving machine & dyeing machine.
France	Blow room, carding, cake press, kier, dryer, ALC card, reiter card, jetlace, hydro-entanglement unit, processing & swabs making.
Germany	Berger flock cutting, blow room, carding, cake press, kier, dryer, ALC card, reiter card, jetlace, carding machines, needlepunching machines/punching machines, coating machine, coating machine's burners and machine's part, continuous dyeing / washing / stenter / bleaching, dipping machine, dornier looms, dornier machine, flame lamination, lamination machine, single needle quilting machine, looms, warp knitting, sectional warping, direct warping, needle punch line; coating and finishing machine, calendar, bale opener, slitter, hydroentanglement machines, nonwoven line, osthoff singeing, menzel CBR, monforts stenter, monforts sanforizer, dot coating, printing lines, needlepunching machine, warp knit weft insertion looms, weft insertion warp knitting machines, warp knitting machine.
Hong Kong	BFL with embossing, BFL without embossing, printing & lamination.
Italy	Adult diaper machine, baby diaper machine, blow room, carding, cake press, kier, dryer, brazzoli soft flow dyeing machine, airoli washer & loop ager, coating lines, embossing machine, fibre opening line & carding, jingye, looms, Z fold.
Japan	High precision garment machines, netting machine, knitting machines, universal testing machines, weaving machine & dyeing machine.
Netherlands	VMI machine.
Poland	Carding machine.
South Korea	Compounding, slitting recycling, high precision garment machines, finishers and coating machine, high strength beams.
Switzerland	ALC card, reiter card, jetlace, hot air sealing machine, jakob, projectile loom.

Taiwan	Circular knitting, dyeing, high speed automatic needlepunching machines, knitting, mask making machine, melt spinning, mask manufacturing machine lines, netting machine, printing, slitting, PU resin reactor's, sealing machines, sizing, weaving machine & dyeing machine.
Turkey	Fully automatic wet wipe manufacturing line, 2 flat pack m/c, 2 cross fold m/c.
USA	Fibre opening line & carding, heat sealing machine, mask testing equipment, swab making, swaging machine for suture and needle, tipping machine, bias binding making plant, tufting.
UK	Universal testing machines, weaving looms, warping machine, twisting m/c., weaving, processing, packing.
Europe	Melt spinning, BCF, cabling, heat setting, shuttles weaving loom, weaving machines (looms) & twisters.

23.10 Export of products by Indian technical textile product manufacturers

The Indian technical textile manufacturers have been exporting their products to various parts of the world. The compiled list of top five products (in value terms) being exported by the respondent firms in different segments of technical textiles are presented in the following table:

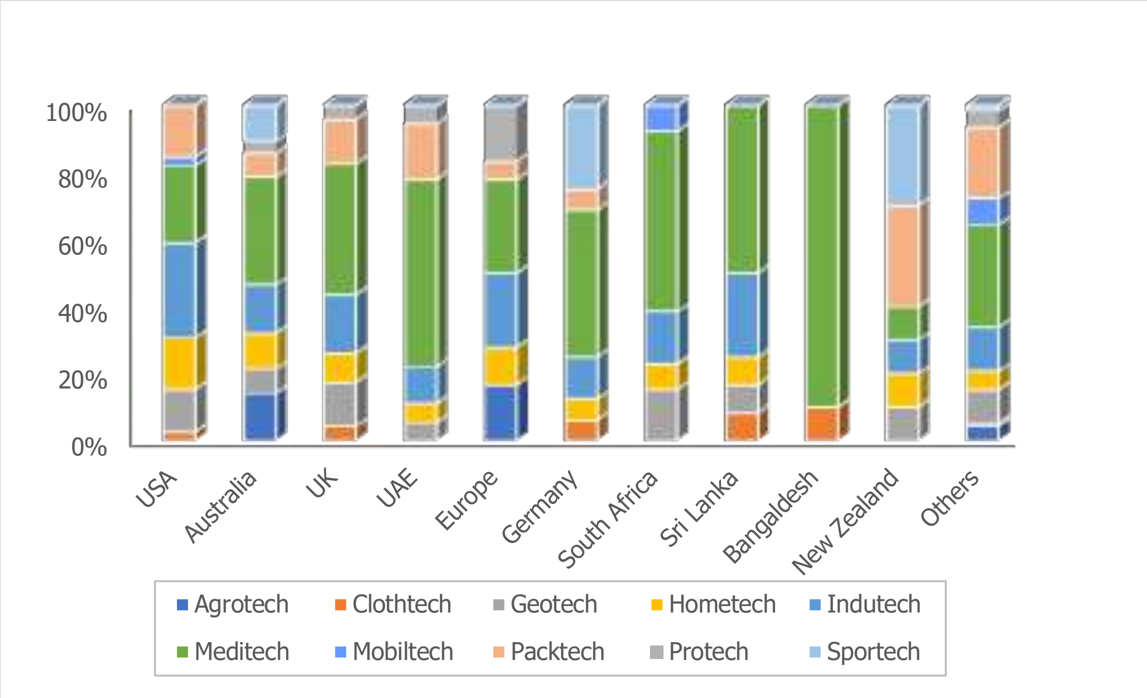
Table 23.6: Products exported by Indian technical textile manufacturing firms

Segment	Products exported	Countries and regions
Agrotech	Fishing nets, aquaculture, nonwoven for agriculture, twisted yarn	Africa, Australia, Europe, North America , South America , Tanzania
Clothtech	Hook and loop tape fasteners, interlining	Germany, Turkey, UK, USA, Bangladesh, Sri Lanka, China
Geotech	Nonwoven geotextile, HDPE geocell, PET geogrid, PP liner fabrics, soil sever, woven geotextile, geotextile, nonwoven geotextile, PP woven fabrics with different gsm & colour	Australia, Belgium, Bhutan, Brazil, France, Malaysia, Middle East, Muscat, Nepal, Netherlands, New Zealand, Norway, Philippines, Qatar, South Africa, Spain, Sri Lanka, Turkey, UAE, UK, USA
Hometech	Carpet yarns, carpets and other textile floor coverings, made ups, floor covering yarns, home furnishing products, piconol weaving loom, wet wipes	Australia, Belgium, Canada, Egypt, Europe, Germany, Japan, Middle East, Netherlands, New Zealand, Russia, South Africa, Sri Lanka, UAE, UK, USA
Indutech	Ropes & twine, coated fabric, nonwoven fabrics, nylon 6 tyre cord fabrics, solid woven, antistatic PVC conveyor belt, abrasives cloth automotive yarns, canvas, chafer/cycle tyre cord fabric, conveyor belting fabric, industrial textile, PVC laminated flex, duck cotton canvas, aeronautical textile, buff cloth, chaffer fabrics, dipped nylon tyre cord fabrics, laminated tarpaulin, marine application yarns, nylon filaments yarn, nylon tyre yarn, nylon yarn, PVC coated fabrics, tarpaulin	Africa, Asia, Australia, Belgium, Brazil, Canada, Columbia, Europe, France, Germany, Gulf countries, Iran, Japan, Kenya, Kuwait, Nepal, Netherlands, New Zealand, North America, Singapore, South Africa, South America, Sri Lanka, Thailand, Turkey, UAE, UK, USA, Vietnam

Meditech	Nylon non absorbable suture, polypropylene mesh, polypropylene non absorbable suture, polyester non absorbable, silk non absorbable suture, adult diaper, baby diaper, cotton balls, pad, pillows, under pad, adult pant, baby pant, comforter & quilts, mattress pads, nonwoven fabrics, hydroentangled fabric, bandages, swabs, 3 ply surgical mask, absorbent cotton, bleached gauze, roll, CTG belt, dust mask, hospital use disposable pillows, hospital use laminated pillows, N95 mask, pe film plain, spa disposables, surgical disposable drapes and gowns	Asia, Australia, Bahrain, Bangladesh, China, Croatia, Europe, France, Germany, Greece, Guyana, Italy, Kenya, Korea, Maldives, Mauritius, Middle East, Myanmar, Nepal, New Zealand, Oman, Romania, Saudi Arabia, South Africa, Sri Lanka, Sudan, Sweden, Tanzania, UAE, UK, Ukraine, USA
Mobiltech	Dipped rayon tyre cord fabric, automotive fabric, grey rayon tyre cord fabric, grey rayon yarn, dipped nylon chafer fabric	China, Columbia, Czech Republic, Egypt, Hungary, Indonesia, Japan, Luxembourg, Mexico, Poland, Romania, Slovakia, South Africa, Thailand, USA
Packtech	Shopping bags, FIBC, hessian bags, sacking bags, jute soil saver	Africa, Australia, Canada, China, Ethiopia, Europe, Finland, France, Germany, Guatemala, Honduras, Hong Kong, Ireland, Israel, Italy, Japan, Kenya, Korea, Lebanon, Malaysia, Mauritius, Mau Tamala, Mexico, Morocco, Netherlands, New Zealand, Peru, Singapore, Spain, Sweden, Taiwan, Tanzania, Turkey, UAE, Uganda, UK, USA
Protech	Bullet proof helmets, bullet proof jackets, flame resistant garments, bitumen & wax coated fabrics, FR coverall	Australia, Egypt, Europe, Japan, Middle East Asia, Philippines, Saudi Arabia, Southeast Asia, UAE, UK
Sportech	Football, rugby ball, volleyball, shoes fabric, shapewear	Africa, Australia, Germany, Middle East, New Zealand, Vietnam

In terms of major export destination for these products, USA emerged as the country where largest share of export of technical textile products from India was sold. The prominent technical textile products exported are from Meditech, Packtech, Indutech, Geotech, Hometech segments. The products viz. shopping bags, FIBC, hessian & sacking bags, nylon non absorbable suture, polypropylene mesh, polypropylene non absorbable suture, polyester non absorbable, silk non absorbable suture, dipped rayon tyrecord fabric, and carpet yarns are also being exported in large volumes.

Figure 23.29: Leading export destinations for technical textile products from India



Others include Africa, Asia, Bahrain, Belgium, Bhutan, Brazil, Canada, China, Columbia, Croatia, Czech Republic, Egypt, Ethiopia, Finland, France, Greece, Guatemala, Gulf countries, Guyana, Honduras, Hong Kong, Hungary, Indonesia, Iran, Ireland, Israel, Italy, Japan, Kenya, Korea, Kuwait, Lebanon, Luxembourg, Malaysia, Maldives, Mauritius, Mau Tamala, Mexico, Middle East, Middle East Asia, Morocco, Muscat, Myanmar, Nepal, Netherlands, North America, Norway, Oman, Peru, Philippines, Poland, Qatar, Romania, Russia, Saudi Arabia, Singapore, Slovakia, South America, South East Asia, Spain, Sudan, Sweden, Taiwan, Tanzania, Thailand, Turkey, Uganda, Ukraine, and Vietnam.

USA is the most significant export destination for technical textile products from India for the respondent firms (10.5 percent). Technical textile products exported to USA include FIBC, hessian bags, N95 masks, carpet yarns, industrial and defence textiles etc. Most of the products exported are from Meditech, Indutech, Hometech and Packtech segments.

Australia is also significant with 7.8 percent of the respondents exporting to Australia. The products being exported are FIBC, CTG belt, shopping bags, fishing nets, carpets and other textile floor coverings etc. The products of Meditech, Indutech, Agrotech and Hometech segments comprise majority of exports to Australia.

UK is the third largest player which imports technical textile products from India as reported by 6.2 percent of the respondents. HDPE geocell, medical pillows, canvas, shopping bags and clothing textile are some of the products being exported to UK. Products exported to UK are mainly from Meditech, Indutech, Packtech and Geotech segments.

UAE is another important export destination with HDPE geocell, medical pillows, canvas, shopping bags and clothing textile being some of the products being exported to UAE. Meditech, Indutech, Packtech and Hometech are the major segments of which technical textile products are being exported to UAE. Fishing nets, bullet proof jackets and helmets, ropes and twine are some of the products that are being exported to Germany.

23.11 Foreign Investments in technical textiles

A number of respondent firms reported foreign investments received by them for technical textiles in the past five years. These investments are not only in the form of Foreign Direct Investment (FDI) but of other types as well. The following table presents a brief summary of these foreign investments:

Table 23.7: Summary of major Foreign Investments related to Technical Textiles (2015-20)

Name of the Investing Country	Type of Investment	Segments of Investment	Investment details
Most of the respondent firms reported foreign investment from: • Germany • Singapore • Japan USA, Belgium and China were also amongst the reported countries.	Investments were made in varied forms including: • Strategic Alliance • Equity Capital Investment • FDI • Joint Venture	The technical textile segments that attracted foreign investment are as follows: • Clothtech • Geotech • Hometech • Meditech • Mobiltech • Protech	Investments reported were made in the context of: • Asset acquisition • Technology and raw material related • Capacity enhancement

The size of investments ranged between Rs. 1.60 Crores to Rs. 40 Crores with average investment size being around Rs. 11 Crores. None of the reported investments were made under any Central/State Government Schemes or plans.

23.12 Manpower and Employment

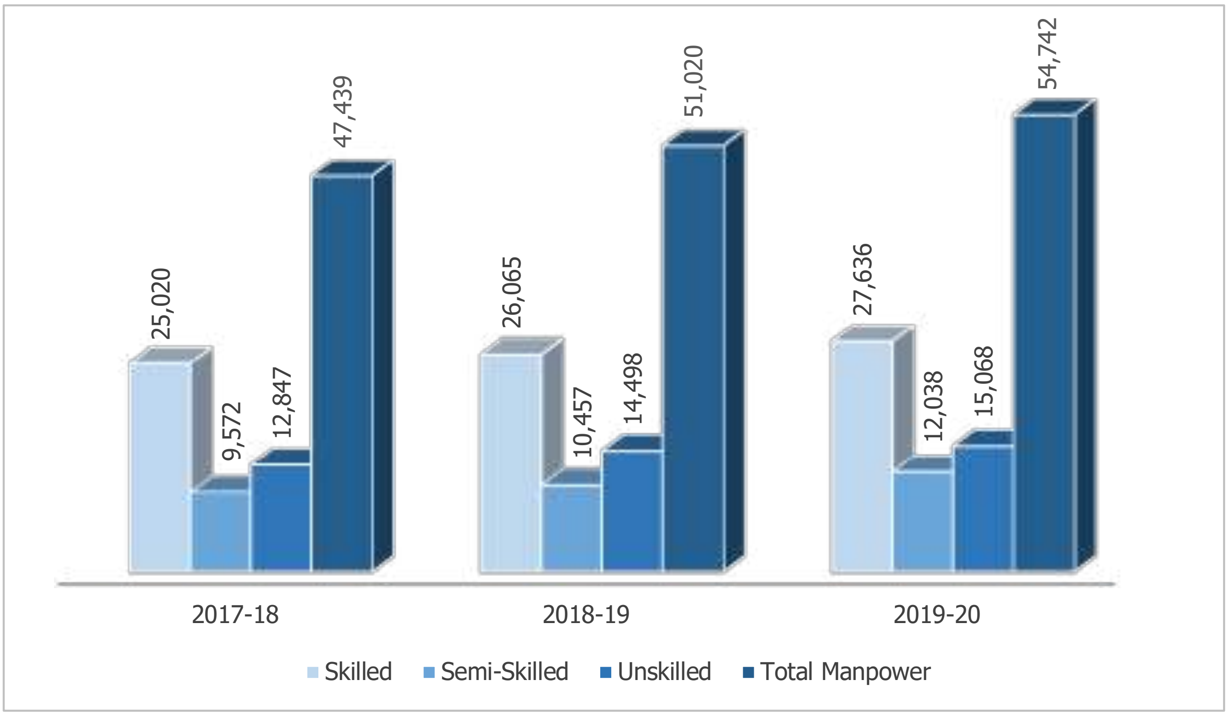
The manpower and employment status of respondent firms can be gauged from the figure and table given below. Skilled workforce is around 51 percent of the total workforce employed, semi-skilled workforce is around 21 percent and unskilled workforce 28 percent of the workforce. 37 percent of the respondent firms reported having employees with formal textile education. The numbers of such employees totalled 4,142 (2017-18), 4,294 (2018-19) and 4,893 (2019-20).

Table 23.8: Manpower and employment in the respondent firms

Financial Year	Skilled	Semi-Skilled	Unskilled	Total Manpower
2017-18	25,020	9,572	12,847	47,439
2018-19	26,065	10,457	14,498	51,020
2019-20	27,636	12,038	15,068	54,742

Source: Primary Survey conducted by IIT Delhi

Figure 23.30: Employment details: Skilled, semi-skilled and unskilled employees (Numbers)



The number of skilled people employed in the respondent firms increased from 25,020 in 2017-2018 to 27,636 in 2019-2020, showing a growth of 10.5 percent. During the same period, the total number of people employed increased from 47,439 to 54,742 implying a growth of 15.4 percent.

23.13 Employee training programmes

Different types of training programmes are conducted for the employees of technical textile product manufacturing firms to equip their employees with skills required to perform their duties more efficiently and effectively. Many training programmes are organized as workshops and seminars consisting of multiple sessions while there are also others which are spread over a larger period of time and which consist of sessions/workshops at regular intervals. Programmes are organized under multiple functional areas ranging from operations and maintenance, quality, technical, management, soft skills and legal & administration.

The information presented in the table that is shown below is a summary of the key programmes under each domain as per what has been reported by the respondent firms:

Table 23.9: Training programmes conducted for employees of Technical Textile product manufacturing firms in India

Category of training programme	Programme Details
Operations & Maintenance Training Programmes	• SOP • Inventory Management • Fire & Safety Emergency Response (Fire Mock drill) • First Aid • Waste Management • Power Saving • Machine Operation SOP Awareness Training • Hazard Identification and Risk Assessment • Department Work Instruction • Health and Safety • Use of PPE • Industrial Safety Training • Safe Start Module • Material Stacking • Flow Wrapper HMI Operation and Setting • Material Transportation • Vestibule Training • Refresher Training • Apprenticeship Training
Quality Training Programmes	• ISO o ISO 9001:2015 o EN ISO 13485:2016 o ISO 14971 o ISO 17025 o ISO 9001 o ISO 45001 o ISO 14001 o ISO 5001 o Lead Auditor for ISO Certification • GMP (Good Manufacturing Processes) • QC (Quality Control) • KAIZEN • 5S: Japanese Principles for enhancing Profitability • NABL • Operational Excellence • Product Safety & Conformity Representative Training • 1.5 S Awareness

	• Internal Auditors Course • Advanced product quality planning (APQP) • Production part approval process (PPAP) • 7 Quality Tools • 8D Analysis • Design Failure Mode and Effects Analysis • Process Failure Mode and Effects Analysis • Control Plan • DMAIC Project • Lean & Six Sigma • TQM Training • Process Control • Business social compliance initiative (BSCI) • Environmental Training • 5S Sustenance Training • Innovation and Sustainability
Management Training Programmes	• IMS (Integrated Management System) • Inventory Management • Process Management • 8D Problem Solving
Technical Training Programmes	• Technical IIP • Technical Garment Making • Technical Protective Textiles Training • On the job Training • Production training • Software training • Chemical Management/Handling • Card-feed roll metal detector • Material Pass Box
Soft Skills Training Programmes	• Time Management • Seven habits of highly effective people • Drug addiction/awareness • Ethical Training • Team Building • Personal Hygiene • 7S and Hygiene Practices

Source: Primary Survey by IIT Delhi

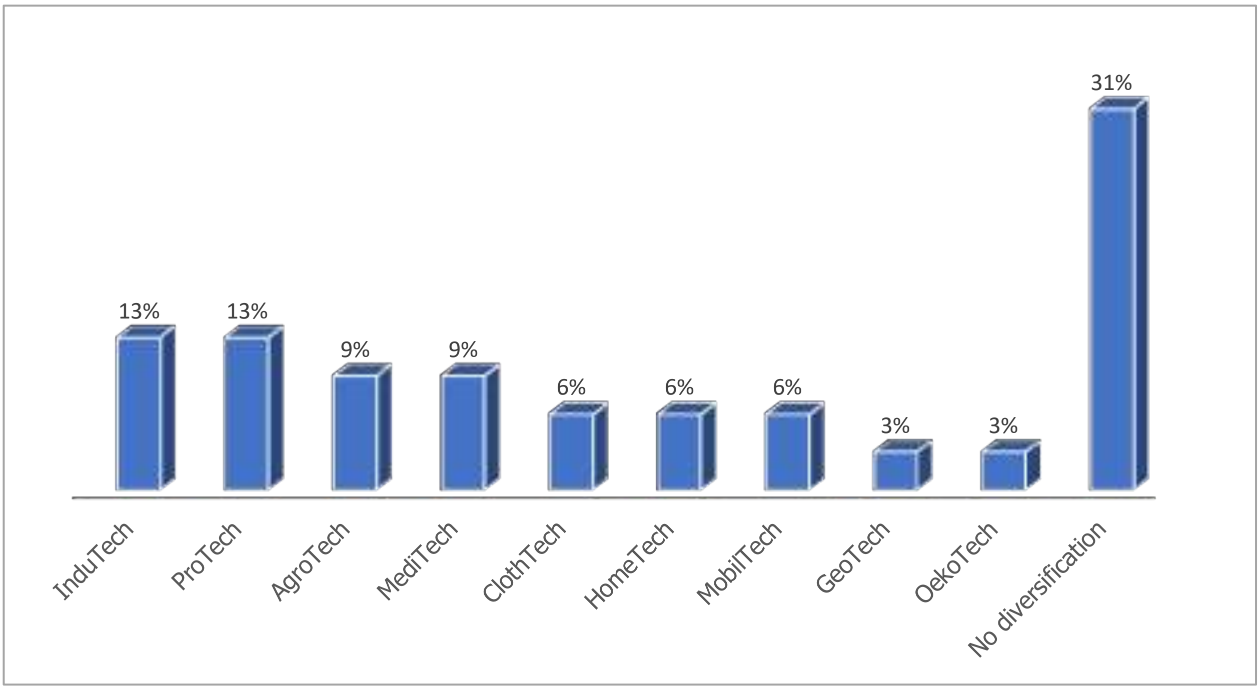
23.14 Other technical textile segments of interest

Future diversification preferences

It was observed through the findings of the primary survey that significant percentage (69 percent) of respondent firms plan to diversify their operations into newer segments of the technical textile industry in order to unlock the lucrative opportunities they perceive in those segments.

Diversification into other segments in future

Figure 23.31: Preference for future diversification (percentage respondents)



Out of the respondent firms that reported their plans for diversification into newer technical textile segments, Indutech and Protech segments emerged as the most desired option with around 13 percent of the respondent firms expressing their intent to enter those segments. The respondent firms see major growth potential and scope in these segments and are keen to diversify into these segments in the coming years. Agrotech (9 percent) and Meditech (9 percent) were the next most preferred segments for diversification, followed by Clothtech (6 percent), Hometech (6 percent) and Mobiltech (6 percent). Geotech (3 percent) and Packtech (3 percent) seemed to elicit lesser interest among the respondents.

It is also to be noted that almost 31 percent of the respondent firms reported no plans for diversification into new segments. While some firms didn't identify their sectors of diversification yet, some also reported losses in their current business as the reason for not taking up diversification so far.

Reasons for Diversification

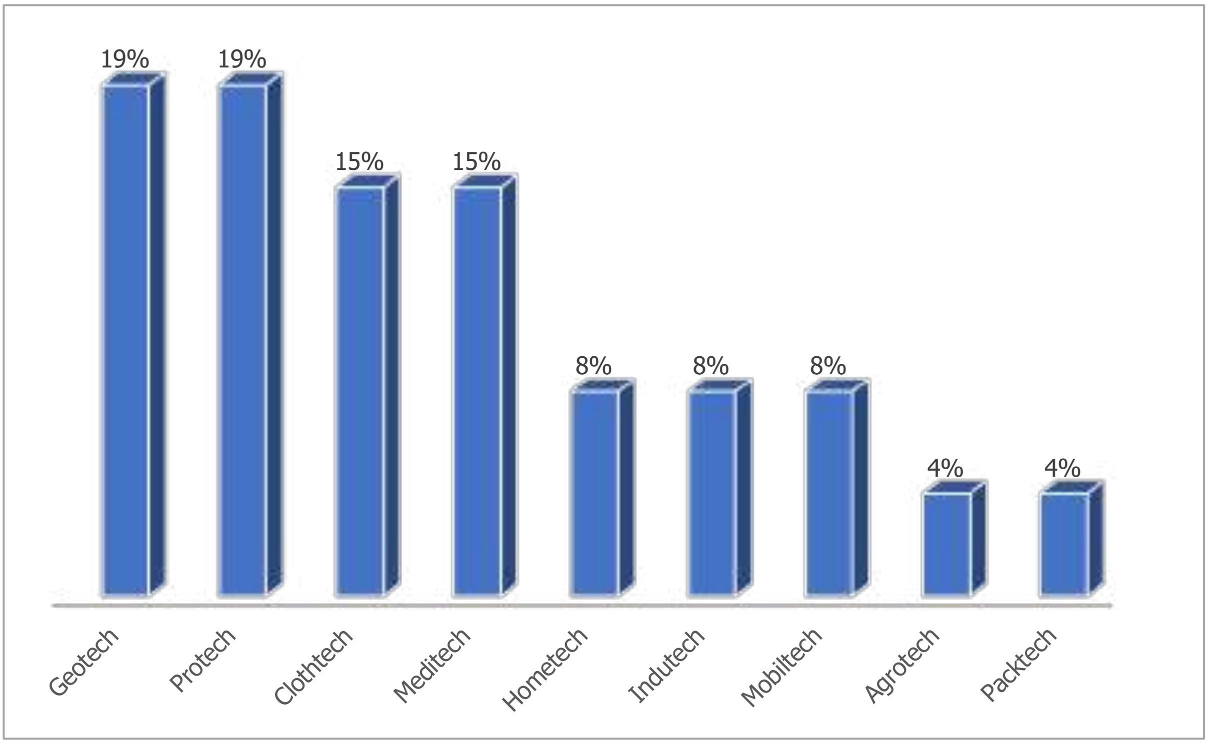
The firms mentioned the following reasons for their intent to diversify:

- Higher potential for growth in business related to the user industries (Indutech, Hometech, Meditech)
- Greater potential, and availability of specialised and research-oriented products (Clothtech, Meditech)
- Technological advancements leading to huge growth potential, safety and sustainability (Meditech, Agrotech)
- Niche markets and availability of infrastructure and manpower, hence scope for growth (Geotech, Protech)

Expansion in the current operating segment by Technical Textile product manufacturing firms

A good number of respondent firms reported their preferences for expanding their product portfolio in the technical textile segment that they are currently in. Few firms expressed their preferences for integrating backwards in their current segments i.e. producing raw materials required for production of goods in the technical textile segment in addition to the products they are currently manufacturing.

Figure 23.32: Preference for expansion in current operating segment (percentage respondents)



Out of the respondent firms which reported their intent either for expansion of product portfolio in their current segment or for backward integration, the firms operating in Geotech (19 percent) and Protech (19 percent) topped the list. In the Clothtech and Meditech segments, 15 percent of the respondent firms wanted to continue in the current segment itself. It was followed by firms in Hometech, Indutech, Mobiltech, Agrotech and Packtech.

Reasons for expansion in the current operating segment

Some of the reasons cited by the respondent firms for continuing in their current segment or integrating backwards are as follows:

- Good business performance in the current segment and in-house expertise in sales and technical acumen is available (Geotech)
- The current segment is characterised by high imports of raw material as well as finished products (Protech)

- Perceive the current technical textile segment as having a good growth potential (Clothtech)
- There is less competition in the current segment and marketing edge through better quality can be ensured through investment in product development (Agrotech)
- Producing raw materials for products might also give access to new segments in future because many raw materials are common to a number of segments (Mobiltech)

23.15 Porter’s five force analysis of technical textile product industry in India

Porter's Five Forces is one of the most popular and highly regarded business strategy tools for understanding the competitiveness of one’s business environment, and for identifying one’s strategy's potential profitability. The tool was created by Prof. Michael Porter from Harvard Business School to analyse an industry's attractiveness and likely profitability. According to the model, there are five permanent forces that are main sources of sustained competitive pressure, and these therefore constitute firm’s competitive environment in its industry as distinct from temporary factors like industry growth rates, government interventions, and technological innovations which have only a short term effect. These five forces are listed as follows:

1. Threat from New Entrants: This force is a function of the degree of ease with which new firms can enter the industry and affect the profitability of incumbent firms. It can influence the strategies that incumbent firm will follow to protect itself from the threat posed and to attempt and erect entry barriers.
2. Threat of Substitutes: It refers to the ease with which the customers can find a different method or product to satisfy the same needs that your offerings satisfy. This has an impact on customers’ response to sellers’ offerings and sellers’ flexibility of changing business strategies.
3. Bargaining Power of Buyers: Comprises of number of buyers and scale of their orders. It affects the ability of buyers to dictate their terms as well as their costs of switching from one seller to another.
4. Competitive rivalry: Consists of number and strength of competitors. It determines one’s response (aggressive or otherwise) and profitability as well as response of the customers (degree of loyalty and price sensitivity).
5. Bargaining Power of Suppliers: Comprises of number of suppliers and uniqueness of their offerings. It influences the pricing strategy of suppliers as well as one’s flexibility to switch suppliers.

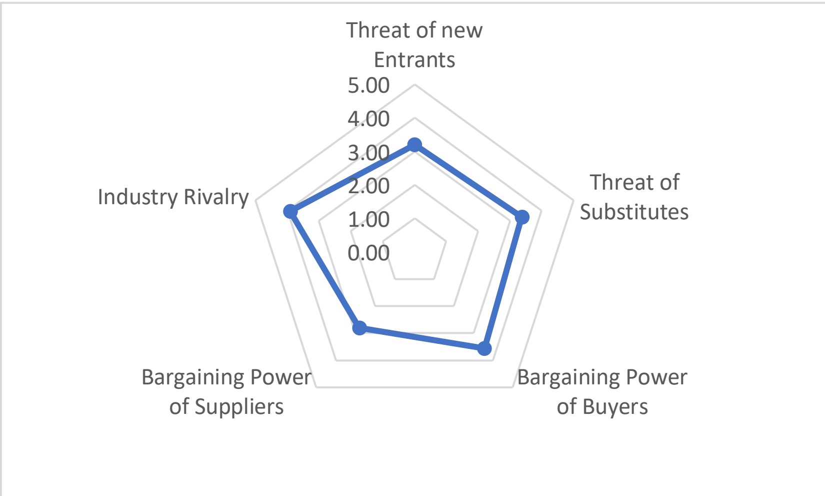
The following table and figure present the findings of the responses received from the firms on a five-point Likert scale based on their understanding of these five forces in the technical textile industry.

Table 23.10: Porter five-force score of respondent firms manufacturing technical textile products in India

S. No.	Force	Average score on a five point Likert scale
1	Threat of new Entrants	3.20
2	Threat of Substitutes	3.37
3	Bargaining Power of Buyers	3.56
4	Bargaining Power of Suppliers	2.80
5	Competitive Rivalry	3.91

Source: Primary survey of product manufacturing firms carried out by IIT Delhi

Figure 23.33: Porter's five forces in the Indian technical textile industry



The reasons, as reported by the respondent firms, regarding the presence/absence of the force as well as their associated intensity ('+' and '++' represent affirmation of the statement and their relative intensity with '+' being relatively less intense/frequent than '++'; On the other hand '–' and '- -' are negations with '-' being relatively less intensely negative than '- -') are presented in the Table below.

Table 23.11: Reasons behind the prevalence of Porter's five forces in Indian technical textile industry: Respondents views

	Porter's Five-Force	Intensity
1	**Threat of New Entrants**	
	There is increase in domestic demand due to which more firms are likely to enter this industry	+
	Reduction in imports by putting restrictions on China will provide better opportunities to domestic products. Hence, more firms are likely to enter this industry	++
	Government promoting technical textiles industry will encourage entry of new players	++
	High capital expenditure is required to enter this industry	--

	Policies of Government regarding FTA do not support this industry to be globally competitive	-
	High level of knowhow and R&D is required	--
	Demand is less compared to supply capacity due to which there are low profits	-
	Competition from cheap imports from China discourages new entrants	--
2	**Threat of Substitutes**	
	To bring down the cost of existing products, substitute products might be produced	++
	Expected shift of businesses from China to India will encourage domestic players to produce substitute products	+
	Technology change in technical textiles industry is rapid	++
	To cater to rapidly increasing demand for many of the technical textile products, substitute products may be produced	++
	Emphasis on 'Make in India' programme will promote local production	++
	There is no substitute to eliminate use of some specific products	-
	High Tech products do require high investment in R&D	--
	There is no substitute for the raw material currently in use in India	-
	India lags in access to modern technology to produce new substitute products	-
3	**Bargaining Power of Buyers**	
	There is less of domestic demand in comparison with the supply (domestic production added to imports) in some segments	+
	Cheap Chinese products are imported and are readily available in due to which the buyer expects that domestic producer should offer products at similar price levels	++
	In case of a few products, the large organisational buyers comprise bulk of demand due to which they have high bargaining power	++
	In few segments, the buyers have more choices due to more number of options	+
	In some cases, the buyers want very specific product characteristics that are achieved only by a few sellers. In cases, the buyers do not have high bargaining power	-
4	**Bargaining Power of Suppliers**	
	Due to high dependence on imports for the raw inputs, the domestic producer of technical textiles products has to compromise and adjust with the supplies from overseas supplier	++
	There is a high bargaining power of supplier in case of an input for which there is monopoly or near monopoly of the supplier	++
	In case of the customers' demand being inelastic and specific, the bargaining power of supplier is more	+
	If the input to technical textile producer is produced domestically, the bargaining power of supplier is more	++
	In a few speciality products/segments, the suppliers dominate the market	+

	In the case of some of the inputs, there are only limited sources of supply because production of input is highly capital intensive industry	--
	In case of some inputs being readily available in abundance, the bargaining power of supplier is low	-
	If the prices and extent of competition among Chinese supplier is high then the bargaining power of suppliers is low	-
	Due to domestic supplier not being able to maintain consistent quality, their bargaining power is reduced	--
	Due to huge production capacity in China which is lying spare in some cases, the bargaining power of suppliers is reduced	-
5	**Competitive Rivalry**	
	There is lower domestic demand compared to the available supply in case of some of the products in a few segments	+
	There already is intense competition in case of products that are popular and are consumed by large number of consumers	++
	Due to liberalised imports and dumping by the Chinese suppliers, there is intense competition from cheap imports	+
	Due to increased awareness and easing of availability of technical knowhow, there is an increase in the number of firms entering this industry in response to positive demand outlook.	+
	There are certain products for which competition is low	-

It is apparent from the presentation of the reasons that the 'threat of substitutes' is fairly high for the firms in this industry. This is characteristic of any industry in its early stages of development and which is true for Indian technical textile industry too. The rapid changes in technologies in the quest for better quality product substitutes available in larger quantities at ever decreasing prices makes it a constantly evolving market. The highly dynamic character of the market and technology landscape is a significant threat which Indian firms must face in this industry.

The 'bargaining power of suppliers' is another important threat that the Indian firms face. This is due to a very high dependence of product manufacturing firms of Indian technical textile industry on imported raw material. The situation is further compounded by the fact that most of the raw material comes from a single country (China) and in many cases the suppliers either have a monopoly or are part of an oligopoly.

Apart from these intense threats, there are other moderate level of threats too as evident from the responses of product manufacturing firms being processed using Porter's five force analysis frameworks. The details of each factor can be seen from the information presented in the table above.

23.16 Problems faced and suggestions offered by technical textiles manufacturing firms

Table 23.12: Machines related problems faced by technical textile manufacturing firms

Problems	Suggestions
There is a high dependence on high priced imported machinery supplied by Japanese, German and Taiwanese suppliers which results in high business costs and longer lead times	Government should provide financial and physical support for encouraging R&D that is aimed at promoting indigenous manufacturing of machines
The domestic market for technical textiles is not big enough to justify the high capital expenditure requirement and long gestation period for development of indigenous machines	Government should provide incentives focused at local, home-grown innovations in machine development as well as manufacturing within India not only for domestic market but also for exports
Less than satisfactory quality of after-sales service and support from domestic machine suppliers	Consumer Affairs department to formulate stringent laws for penalising deficient service in B2B markets

Table 23.13: Trained Staff related problems faced by technical textile manufacturing firms

Problems	Suggestions
Scarcity of trained staff	Skill India should cover training of workers for Technical Textiles sector More training capacity must be created specifically for technical textiles

Table 23.14: Technology related problems faced by technical textile manufacturing firms

Problems	Suggestions
Heavy dependence on imports from overseas partners	Government must encourage initiatives that lead to technology transfer so as to minimize the dependency on imports
The market is not big enough to justify the high capital investment and lengthy gestation period	Government must simplify the Technology Upgradation Fund (TUF) scheme to further reduce the cost of upgradation
There is a lack of information and knowledge regarding advanced technology and automation	Government should take relevant steps to enable availability of new technology at affordable price in India on large scale
Testing infrastructure in India is not robust	Government should invest in enhancement of the testing infrastructure so that the trial of new products can be conducted smoothly

Table 23.15: Government Policy related problems faced by technical textile manufacturing firms

Problems	Suggestions
Cash flow cycle has been disturbed due to difference in GST rates of raw materials (18 percent) and finished goods (5 percent)	To minimise the negative impact of differential GST rates on the cash cycle, the payment of GST refund to firms should be quickened and simplified by the Government

Even as medical facilities in urban areas are using disposable apparels / drapes, hospitals, the health facilities in rural areas are yet to adopt disposable products compelling them to use washable linen	Government must make it mandatory to use disposable apparel, drapes and linen in health facilities to the extent possible
There are several masks available in the market which do not have proper government certification	Government should make it mandatory to use only those masks that have proper government certification
Fabric imports are hurting local manufacturing primarily due to absence of anti-dumping duty	Government should impose Anti-dumping duty on fabrics imported from China, Bangladesh Nepal and UAE
The export process is highly cumbersome due to heavy dependency on offline procedures	Government should provide assistance in the form of making procedure online to ease the process. Easy online application and training videos should be disseminated for maximum adoption of online process
Current government schemes such as TUFS and PLI are not user friendly	Government must provide TUFS/ PLIs on on-going basis and quick processing to realize the benefit
Very low demand of products manufactured in India	Government must carry out periodic review of incentives so that they are effective in promotion of quality products and standards to improve the quality as well as the output

Table 23.16: Other problems faced by technical textile manufacturing firms

Problems	**Suggestions**
Delay in issuance of license and certificate due to inefficient online portal	The overall efficiency of the portal should be improved
Non-acceptance of test reports of Indian laboratories by overseas customers	Appropriate bilateral trade agreements should be signed Indian recognised test houses should acquire accreditation for testing as per the standards accepted in importing countries

24. Fibre, Filament and Technical Yarn Manufacturing Firms:

Findings from Primary Survey

Responses received from firms who produce and supply raw materials (fibres, filament and technical yarns) to technical textiles product manufacturing firms in India are presented in this section.

24.1 Types and forms of fibres, filaments and technical yarns produced by Indian raw material manufacturing firms

The different types of raw material (polyester-based, acrylic-based, and others) manufactured by the respondent firms are listed in the following table:

Table 24.1: Type and forms of fibres, filaments and technical yarns manufactured in India

Type of fibre, filament or technical yarn type	Form of fibre, filament or technical yarn manufactured
Polyester-based	• Polyester staple fibre o Solid, hollow and dyed o Reinforcement fibre o Pet flakes/pet chips/nonwoven fire retardant o Anti-bacterial • Polyester industrial filament yarn
Acrylic-based	• Staple fibre o Tow o Yarn o Tops
Others	• Mono-filaments and multi-filaments of Nylon6 and Nylon66 • HDPE • Polypropylene stable fibre • Co polyamides • Polypropylene fibre

Source: Primary Survey by IIT Delhi

Most of the respondent firms reported manufacture of polyester-based raw materials; within that, staple fibre and filament yarn are the most prominent materials. In case of acrylic-based material, a large number of respondent firms produce staple fibre in the form of yarn, tops and tow. Some manufacturers also produce mono-filament and multi-filament yarn of Nylon along with HDPE and co-polyamides.

24.2 Segment-wise supply of fibre, filament, and technical yarns by raw material manufacturers in India

The supply of raw materials to different segments of technical textiles in India by the respondent firms is presented in the following table:

Table 24.2: Segment-wise raw materials supplied by raw material manufacturers in India

Segment	Raw Materials Supplied
Agrotech	Recycled polyester staple fibre/ polypropylene staple fibre Nylon 6, co polyamides, polyester and HDPE monofilament and nylon 6 multifilament, and twines
Buildtech	HDPE monofilaments Polyester industrial filament yarn
Clothtech	Polyester staple fibre, PP fibre
Geotech	Recycled polyester staple fibre/ polypropylene staple fibre Polyester industrial filament yarn
Hometech	Recycled polyester staple fibre/ polypropylene staple fibre
Indutech	Recycled polyester staple fibre/ polypropylene staple fibre Polyester industrial filament yarn
Meditech	Recycled polyester staple fibre/ polypropylene staple fibre Nylon 6 and nylon 66, polyester, PP, HDPE, PBT monofilaments, and nylon 6 and nylon 66 multifilament
Packtech	Recycled polyester staple fibre/ polypropylene staple fibre
Mobiltech	Recycled polyester staple fibre/ polypropylene staple fibre Nylon 6, nylon 66 and PP monofilaments

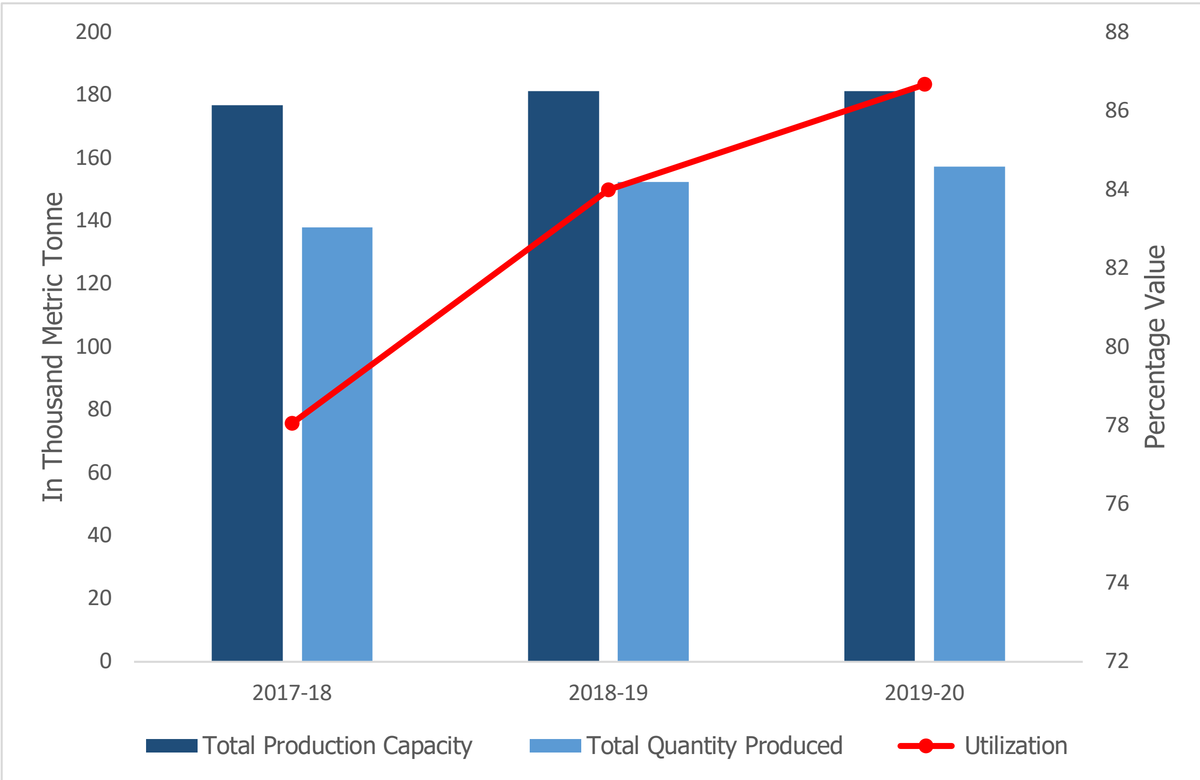
Source: Primary Survey by IIT Delhi

24.3 Production of fibre, filament, and technical yarn manufacturers

The total production capacity and output varies across respondent firms. Although, the cumulative production capacity of respondent firms has remained stable around 180 thousand MT over last three years, there has been a growth of 1.26% in the production capacity. At this growth rate, the projected production capacity for the years 2020-21 and 2021-22 can be around 184 thousand MT and 186 thousand MT respectively.

The cumulative quantity produced by them has increased every year from around 140 thousand MT to 160 thousand MT in the last three years, which is likely to be in response to an increasing demand for raw materials. The data shows a growth of 6.7% in quantity produced and an estimated value of 170 thousand MT and 180 thousand MT respectively for the years 2020-21 and 2021-22. The capacity utilization has consistently increased from 78.3% to 86.7% for the respondent firms during the stated period indicating better utilisation of resources by the firms.

Figure 24.1: Production capacity and quantity produced by respondent raw material manufacturing firms in India



Source: Primary Survey , IIT Delhi

In terms of supply of raw materials to the domestic and global markets, most of the respondent firms supply most of their output to the domestic market whereas a few respondent firms also reported supplying around 60% to 80% in the domestic market and the balance to export market. The United States, UAE and Brazil were reported as the leading markets for Indian manmade fibre and polyester fabrics.

24.4 Consumers of fibre, filament and technical yarns in the technical textile sector in India

Fibre, filament or technical yarns, manufactured by respondent raw material manufacturers are generally used by firms operating in Agrotech, Buildtech, Clothtech, Geotech, Hometech, Indutech, Meditech, Packtech and Mobiltech segments.

Table 24.3: Type and forms of fibre, filament and technical yarn manufactured in India

Name of the fibre, fabric and technical yarn	Consumer Segments
Polyester stable fibre	Agrotech, Buildtech, Clothtech, Geotech, Hometech, Indutech, Meditech, Packtech, Mobiltech
Polyester filament high tenacity yarn	Buildtech, Geotech, Indutech
Nylon 6, nylon66 and polyester monofilament yarn	Agrotech, Indutech, Mobiltech
Nylon 6 multifilament yarn	Agrotech, Indutech

24.5 Import of raw materials from outside India to produce fibre, filament or technical yarn

The respondent firms reported import of materials such as SMBS, DMF, Titanium Oxide, VAM, CAN (acrylic-based) which are sourced from Europe, US and China.

Table 24.4: Import of raw materials by fibre, filament, and technical yarn manufacturers in India

Type of fibre	Raw material imported	Countries from where raw material is imported
Polyester	Polyester Granules	Europe
	PET lumps/chips	USA, Europe, Nigeria, Poland, Saudi Arabia, France
Nylon 66	Polyamide (Nylon) 66 granules	USA, Europe
	Co-polyamides granules	Europe
Acrylic	Sodium metabisulphite (SMBS)	Germany, Thailand, Turkey
	Dimethyl Formamide (DMF)	Saudi Arabia, China, Europe (Germany)
	Titanium Dioxide	Germany
	Vinyl Acetate Monomer (VAM)	Singapore, Korea, US, China, Saudi Arabia
	Acrylonitrile (ACN)	Korea, USA, Europe, Singapore, China, Brazil

The respondent firms reported poor availability of SMBS, DMF and titanium dioxide in India. They also reported that the incentives offered to importers by exporting firms in Singapore for raw materials like VAM and CAN make it lucrative for Indian firms to import from them. Raw material manufacturers import polyester (PET) lumps/chips/flakes and granules from Europe, USA, Nigeria, Poland, Saudi Arabia and France. Other type of fibres, like PA66 and co-polyamides, are also imported from USA and Europe.

24.6 Manpower engaged in raw material manufacturing

Manpower requirements can be grouped into skilled, semi-skilled and unskilled labour. Of the total manpower employed, the respondent firms reported that skilled labour constitutes 31 percent to 49 percent of the total manpower, semi-skilled labour ranged from 28 percent to 38 percent, while unskilled labour ranged from 23 percent to 31 percent. This indicates a relatively high dependence of firms on skilled labour. In terms of shortfall between available and required workforce, the only shortfall reported was in skilled workforce category.

24.7 Emerging segments and products in the technical textile industry

Respondents identified Buildtech, Meditech, Mobiltech, Geotech and Indutech as the emerging segments of technical textiles for which there is a rapidly growing demand in the Indian market. Clothtech and Hometech were reported by raw material manufacturers as the emerging segments for which there is a high demand in the international market. Products expected to have a high demand in domestic market include those in Mobiltech segment (airbags, seat belts and super high tenacity yarns), Geotech segment (polyester grids and UV stabilised high tenacity low elongation yarn) and Indutech segment (polyester activated adhesive yarn).

24.8 Technical collaborations undertaken by fibre, filament, and technical yarn manufacturing firms in India

Technology transfer and machinery imports are two most common forms of foreign collaborations entered into by Indian raw material manufacturing firms. Based on responses received, it can be inferred that the Indian raw material manufacturers are mainly dependent on in-house technology. Some acrylic based raw material manufacturers reported collaboration in the form of technology transfers with firms from Italy and USA. Few collaborations in the context of machinery support have also taken place with Japanese firms.

24.9 Technological gaps faced by the raw material manufacturers

Indian manufacturers have not established sufficient capacities for production of high-performance and functional fibres which are primarily used in protective textiles (ballistic and fire protection), ropes, composites and sports textiles. Para-aramid fibres (Kevlar, Technora, Twaron, etc.), meta-aramid fibres (Nomex), gel spun UHMWPE fibres (Dyneema, Spectra), carbon fibres and Nylon 66 fibres. These are imported from countries like USA, Japan, The Netherlands, etc. Functional fibres (antibacterial, heat retaining, UV protective, moisture management) are also not being manufactured by Indian manufacturers. The processes and technologies required for them have been developed on a pilot scale. However, scaling up is proving to be difficult because the size of the domestic market is not yet large and attractive enough for raw material manufacturers to invest in setting up production capacities.

The respondent firms reported significant limitations of in-house technology as well as that of inadequate number of technically trained professionals. In addition, lack of domestic machinery manufacturers/suppliers results in heavy dependence on imported equipment, which adds to the cost of production. Testing facilities for downstream applications are inadequate and it acts as a constraint for raw material manufacturers and prevents them from adopting new techniques and methods that are better aligned with the demands of their customers.

Respondent firms offered several suggestions to overcome the challenges. Measures should be introduced to encourage foreign collaborations including joint ventures in the field of technical textiles. R&D infrastructure in the country should be scaled up significantly. Attractive incentives should be offered for promoting local manufacture of machines. Centralised testing facilities for different downstream applications should be established. Prototype machines should be installed at these centralised facilities and these should be managed by technically competent personnel. These machines must be for covering, warping, weaving, heat setting, stentering, coating, curing, adhesion etc. Application-based testing facilities should be established for testing characteristics of finished goods, such as flame retardance, dust repellence, UV and colour fastness, adhesion, abrasion, creep of Geotextiles etc.

24.10 Suggestions to promote domestic manufacturing of raw materials in India

The respondent firms gave several suggestions to improve the eco-systems of raw material production for technical textile industry in India. These suggestions are stated as follows:

- Establishment of more capacity in academic institutions for teaching and training in technical textiles so as to make adequate level of skilled manpower available. Institutions and courses can be improved with the help of public-private partnership (PPP) mode.
- Entering into more free trade agreements (FTAs) with countries that have a high demand for raw materials from India.
- Setting up of application-based testing facilities with subsidies for prototype machineries and third-party accredited testing facilities.
- Promotion of technology upgradation fund scheme (TUFS/ ATUFS) among yarn manufacturers by providing subsidies for upgrading the testing and manufacturing facilities.
- Taking steps to prevent dumping of industrial yarn (IDY) and other downstream products by countries with surplus production. Preventing circumvention of anti-dumping duty (ADD) provisions and evasion of ADD by Chinese suppliers of products such as 940 D HT, 940 LS & 6100 D HT.
- Inclusion of polyester-based industrial yarns in BIS standards to promote product applications in Geotextiles, conveyor belts, tyre cords, lifting equipment etc.
- Promotion and incentivisation of environment-friendly technologies by manufacturers (for example recycling of plastic and polyester (PET) waste).

25. Technical Textile Machine Manufacturing Firms: Findings from Primary Survey

The findings from the responses received from the machine manufacturing firms who supply machines to the technical textile product manufacturers in India are presented in the following paragraphs.



25.1 Functions performed by technical textile machine manufacturing firms

The respondent firms are engaged in various functions related to machine manufacturing such as assembly, importing components and machines as well as exporting components, assemblies and machines. Around 50 percent of the respondents manufacture machines for technical textiles producers in India. Almost all of the respondent firms reported that they were importing machines and/or machine components into India. Some of the respondent firms were representatives/agents (25%) of foreign firms as well. Around 58 percent of the respondents were subsidiaries/ branches of international machine manufacturers and were engaged in various activities pertaining to machine manufacturing in India.

25.2 Types of machines manufactured/ assembled/ imported/ marketed by the firms

The respondent firms manufacture, assemble, import as well as market various types of technical textiles machines in India. The details are presented in the following table.

Table 25.1: Machines manufactured, assembled, imported and marketed by the respondent firms		
Machines Manufactured	**Machines Imported**	**Machines Marketed**
• High speed rapier looms • High speed air jet looms • Machine components • Biaxial warp knitting • Multiaxial warp knitting • Uni-directional/spreading • Warp knitting with weft insertion • Warper/ Sectional warper • Direct warper for filament • Polybeamer for PP/HDPE Tapes • Fully automatic nonwoven bag making machine, box bag making machine, fruit cover making machine, loop handle making machine, bag printing machine, face mask making machine	• Blow room • Carding machine • Web card • Nonwoven card clothing • Air texturising machines • Air covering machines • Heavy duty rewinders and assembly winders • Rapier and airjet weaving machines • Nonwoven • Raschel knitting • Shoddy yarn machine	• Rapier and air jet weaving machines • Curling range for technical textiles • Multi-functional coating heads • Calendars For technical textiles • Technical textile stenters • Radio frequency dryer for technical textiles • Process control equipment • Circular knitting • Sectional warping machine • Nonwovens

Some respondent firms also reported assembling of machines such as direct warper for filament, sectional warping machine and machines for nonwovens. It is apparent from the information presented in the table shown above that even though a number of machines are being manufactured in India for technical textile industry, most of these are of older generation and used by production units that use relatively older technology for production of technical textiles. Very often, the machines made in India are also less than optimal for speed and quality. Manufacturers of technical textiles who use contemporary technology are still dependent on imported machines.

25.3 Supply of machines to various segments of technical textile industry in India

Segment wise details of machines being supplied by the respondent firms are presented in the following table:

Table 25.2: Machines supplied to various segments of technical textiles	
Technical Textile Segment	**Machines/ Accessories Supplied**
Meditech, Hometech, Sportech, Clothtech	Blow room, Web card C 70, air texturizing machines, nonwoven machines
Indutech, Mobiltech, Geotech	TMT industrial yarn, rapier weaving machine, tyre cord air jet machines, sectional warping machine
Geotech, Buildtech, Indutech	Bi/Multiaxial for composite glass, warp knitting for geogrid, warp knitting for billboard
Geotech, Packtech	Poly beamer, warper for WP knit

Agrotech, Buildtech	Direct warper for filament, direct warper for warp knitting, nonwoven bag making machine
Various Segments	Felting needles, jet strips, weaving accessories, weaving preparatory machines (knotting machines, drawing-in machines & cleaning machines), knitting needles, sewing needles, tufting components, card wire

25.4 Import of Machines

Machine manufacturing for technical textiles remains very limited in India. This is corroborated by the fact that most of the respondent firms reported that they import machines/machine components from outside India (Germany:33%, Japan: 25%, Italy: 25% and China: 25%) and some of them import these from Switzerland and Belgium. Details of these imports are presented in the following table:

Table 25.3: Technical textiles related machines imported in India

Name of the Country and percentage of respondents importing	Machines/machine components imported	Incentives/benefits reportedly associated with import from the particular country
Germany (33%)	• Felting needles, jet strips weaving accessories, weaving preparatory machines, knitting needles sewing needles, tufting components, card wire • Nonwovens machines • Complete lines and individual machines for making high quality nonwovens from staple fibres through needle punch process, hydroentanglement machine, thermal bond and chemical bond process (partly with partners)	• Precise drive controls leading to improved machine performance. • Good quality
Japan (25%)	• Waterjet loom • Pneumatics	• CEPA certificate for zero import duty • Reliability of product performance
Italy (25%)	• Air texturising • Gear Box	• Higher process flexibility
China (25%)	• Nonwoven • Raschel warp knitting • Ultrasonic and other components	• Cheaper rates
Switzerland (8%)	• Blow room, web card • Heavy duty winders, air covering, nonwoven card clothing	• State of the art technology

25.5 Measures suggested to promote machine manufacturers for technical textile industry

The respondent firms suggested several measures that can be introduced to promote machine manufacturers of technical textiles in India.

- One of the key problems that machine manufacturing firms face is the long time taken for delivering the machine. Since most of the machines are special purpose machines which have to be customised many a times, it often takes two years or more to deliver the machines. Hence government must introduce a series of supporting measures to help the machine manufacturing firms to cope with financial requirements of lengthy time cycle involved. Amendments and addition of provisions may be required in ATUFS.
- India needs an institution of global standards which promotes Indian machine manufacturers for technical textile units. In due course this will increase the demand for Indian made machines for technical textiles in India. The Government should also approve more research and development projects in the technical textile machine manufacturing domain.
- The Government should provide financial incentives to encourage machine manufacturers of technical textiles to expand and modernise their capacity by providing them subsidies such as interest subsidy, capital subsidy, and tax benefits, manageable loan sanctions, etc.
- Despite the high market potential and current set of incentives from the Government, opportunities for machine manufacturers for technical textile is constrained due to limited volumes and less variety of products produced in India. This is able to attract only a small number of domestic machine manufacturers due to unviable business model. Hence, there is high import dependence for technical textile machines in India.
- Currently, most of the research and development on manufacturing the components for technical textiles is taken up overseas and the final outcome of the product research is imported into India for sale to end-users. To overcome this and to promote technical textiles machine manufacturing, India should closely follow the international efforts towards research and development and develop a range of machines in India.
- The Government should encourage investments in various segments of technical textiles with incentives for technology transfers.

26. Contribution of Manufacturers' Associations

Manufacturers' associations act as an important platform for the manufacturing factory owners to work together and act as a group to further their interests, enhance competitiveness, foster exchange and dissemination of information that is relevant for the respective industry and improve working of the industry. A survey of such manufacturers' associations was carried out to elicit important information about their respective industry. Initially, there was a list of 12 such associations that was prepared. Out of these, seven associations which were active, were approached to obtain their individual responses. Eventually, the responses received from four of them have been presented in this section.

The survey was followed up by secondary research about the role and contribution of manufacturers' associations in technical textiles industry to assess the current level and effectiveness of their activities as well as document their opinions about various facets of the industry. Summary of the responses that were obtained are presented for each of the associations individually.

26.1 Association of Synthetic Fibre Industry

Association of Synthetic Fibre Industry (ASFI) was incorporated in 1972. It works for safeguarding the interests of synthetic fibre producers of India. ASFI has submitted certain important information about synthetic fibre industry which are detailed below.

As per the ASFI, the major fibres/filaments used in Technical Textiles in India are:

1. Nylon 66
2. High Tenacity Nylon 6
3. High Tenacity Polyester
4. Polypropylene
5. Ultra-High Molecular Weight Polypropylene
6. Aramid
7. Carbon Fibre

Table 26.1: Raw material, technology, domestic demand and capacity and imports of filaments

S. No.	Filament type	Raw material availability	Technology for filament/ fibre production	Domestic Demand (MTPM)	Domestic Capacity (MTPM)	Imports MTPM
1.	Nylon 66	Not Available	Available	650 TCF 100 Airbag 150 Others	100 MTPM, Low Denier for Sewing Thread Application	600 MT in Fabric and 200 MT in Yarn
2.	High Tenacity Nylon 6	Available Partially	Available	13500	10850	5000
3.	High tenacity Polyester	Available Partially	Available	4000	5000	1000
4.	Aramid	Not Available	Not Available	120	Nil	120
5.	UHMWPE	Not Available	Not Available	15 (150-170 MTPA)	Nil	15 (150-170 MTPA)
6.	Carbon Fibre	Not Available	Not Available	20 (220-240 MTPA)	Nil	20 (220-240 MTPA)

26.1.1 Nylon 66

- The domestic market of Nylon 66 has shown a growth of 12% over the five-year period from 2015-2019. Major growth is in Nylon 66 Tyre Cord Fabric Segment. The domestic market in India is mainly serviced through imports.
- Due to lack of availability of raw material at affordable prices, high import duty on chips, high rates of electric power and high investment required for setting up a new plant acting as a barrier for entrepreneurs, the Indian technical textile product manufacturers have to depend on imports for meeting their requirements.
- Major producers in the world are Invista, PHP, Toray, Shenma, Asahi, Ascend, and Hyosung. Invista has a 38% share in the global Nylon 66 yarn market.

26.1.2 Nylon 6 (High tenacity/Non-Apparel Application)

- India has the capability and technology to produce good quality Nylon 6 yarn. It is Indian producers who meet a large proportion of the demand of domestic technical textile product manufacturers.
- A part of the requirement of Nylon 6 yarn is also being imported from China. Chinese producers are able to offer yarn at a lower price due to their lower cost of production and the benefits derived from incentives offered by the Chinese government.
- Investment required for setting up a new manufacturing unit in India is more than it is in competing countries. The cost of manpower and electric power is also higher than the competing countries. Due to these reasons, new plants are slow to come up in the Indian market.

26.1.3 Polyester Industrial Filament

- The global polyester filament market has grown at a CAGR of 5% by volume; however, due to fall in prices in the international market, the market has grown at a CAGR of only 1% in terms of value.
- Indian manufacturers have the capacity to produce 60,000 MPTA whereas the domestic demand is 50,000 MTPA. Despite India having excess capacity, 15,000 MPTA of yarn is imported from China.
- The cost of production is lower in China, and the Chinese exporters dump their yarn into the Indian market at very low prices, making it very attractive for buyers in India.
- The sector faces similar issues as Nylon 66 and Nylon 6 – high cost of production due to unavailability of manpower and high cost of power.

26.1.4 Aramid

- Consumption of Aramid in India is growing faster than its consumption in the global market. Since there are no manufacturers of Aramid in India, the entire requirement is met through imports.
- The Aramid market in India is expected to grow at a high rate for the next five years due to higher spending on bullet proof jackets.
- The Indian manufacturers who want to enter the Aramid market face the following challenges: patented production process, closely guarded technology, little availability of technical know-how, and lack of availability of raw materials.
- Some of the large global manufacturers are Teijin, Du Pont, Kolon Industries and Hyosung, Yantai Tayho Advanced Materials, X-FIPER New Material, and Toray.

26.1.5 UHMWPE: Ultra High Molecular Weight Polyethylene

- The yarn is used in small quantity for manufacturing protective textiles in India. The demand is entirely serviced through imports.
- The Indian market for UHMWPE is very small for any new manufacturer to be motivated to invest in new production facility.
- In addition to the small market size, patented manufacturing technology, lack of availability of raw material, and high investment, are some of the other challenges faced by any new manufacturers in India.

26.1.6 Carbon Fibre

- The domestic market for Carbon Fibre is very small (200-240 MTPA). The global capacity is higher than the global demand.
- Manufacturing units are not coming up in India due to patented manufacturing technology, lack of availability of raw material, high investment cost, low domestic demand, and high cost of electric power.

- Some of the large global manufacturers are Toray, SFL, MCCFC, Teijin, Hexel, Solvay, Sonstige, and Hyosung.

26.2 FRP (Fibreglass Reinforced Plastics) Institute

The FRP Institute was constituted in 1999 and its members are now spread all over the country. They range from large multinational corporations to small fabricators. The list of members includes raw material suppliers, fabricators, machinery manufacturers, scientists, composite specialists, consultants, designers, defence laboratories and educational institutions. The Institute works in close collaboration with industries and institutions for upgrading the technology used for manufacturing composites and to promote the growth of Indian composites industry.

Technical textiles are an essential part of almost all composites manufacturing processes. This section focuses on composites related information provided by FRP Institute.

26.2.1 Indian Composites market

The Indian composites market has experienced growth over the years but it still remains very small when compared to the global market. The market has experienced an increased use of mechanised processes, improvement in the quality of raw materials, growth potential in renewable energy and increased infrastructural capabilities. However, lack of awareness about composites and high raw material costs have been major bottlenecks. Added to these is the lack of funding, limited technological capability, and limited co-operation between the government and industry which has slowed down the growth of this sector.

The volume of composites output has been growing over the years. The estimated volume of composites output was estimated to be around 380,000 tonnes in March 2019. The total volume of composites output in the world was around 17,700,000 tonnes in 2019.

Total number of companies involved in producing composites is around 3000 in India. In addition to that there are about 1750 units in the unorganised sector.

India's Potential

Some technologies and product applications used by Indian composites manufacturers are at par with the best in the world. Aerospace and defence sector, mainly catered to by government organisations, research institutions and a few private companies, are performing well in terms of manufacturing capability, technologies and output. However, there are very few organisations in this field.

Composites, as the optical fibre support member in telecommunication applications, is another sector that is doing well. The huge volume of exports in the optical fibre communication is an evidence of the progressiveness, cost competence and quality maintenance of Indian players in this sector.

Fast-paced innovations in manufacturing technologies related to composites are happening globally. However there is considerable delay by Indian firms in adopting globally proven technologies. This is due to high initial investment in machinery, high initial prices of the products and therefore limited market penetration and growth, and, limited technological capabilities for manufacturing.

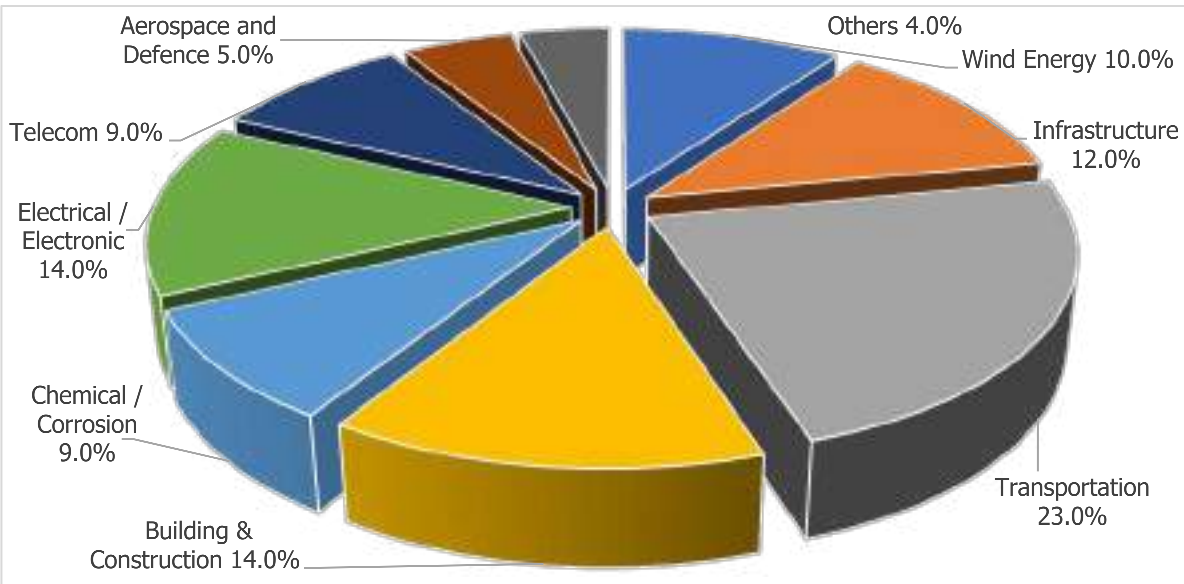
Manufacturing technologies adopted by Indian companies

- Hand lay up (also called as contact moulding)
- Pultrusion
- Vacuum Infusion method
- Filament winding
- Compression Moulding
- LRTM
- RTM
- Thermoplastic Injection Moulding

26.2.2 Application of Composites in various sectors

The applications of composites are spread across various sectors and the breakup of the volume with respect to application sectors is given below:

Figure 26.1: Applications of Composites in various sectors



Source: FRP Institute

26.2.3 Major technology gaps

- Absence of low-cost technology options: Most advanced composites processes require high initial investment in process equipment and high operating cost of the process equipment. Absence of low cost technology options keeps away many innovators from new product developments.
- Inadequate number of machinery manufacturers: Considering the vastness of our country, the number of companies involved in making machinery for composites is very less.
- Adoption of mechanisation is slow: Adoption to mechanised manufacturing technologies is slow and it negatively impacts product quality, consistency and productivity.
- Low levels of automation: Automation is not widely practiced because the volume of composites required by the end-users is low. Manufacturers find it unattractive to make high initial investment that is required for automation.
- Quality and reliability of composites: In some cases, end-users are not aware of the material and cannot distinguish good quality from poor. Poor-quality products that enter the market at low prices often lead to drastic reduction in market growth due to low level of confidence from the consumers.
- Non-Destructive Testing (NDT) of Composites: NDT is often neglected in large number of private sector enterprises and is only being conducted in a few government organisations. There is a huge gap in conducting NDT when compared with advanced countries.

26.2.4 Cultivating the innovation culture in India

- Reward for innovation: Efforts of successful execution of projects related to composites should be recognised and rewarded in major events. This will motivate more enterprises to participate and bring about faster growth.
- Co-operation among industry, academia, and government: Increased co-operation between industry, academia and government institutions and organisations should be fostered.
- Exchange programmes: The exchange of faculty, students and industry experts with internationally reputed educational institutions, research organisations and leading global industries should be encouraged for Indian composites professionals to update themselves on the latest trends.
- Start-up incubation centres: Start-up incubation centres should be set up with amenities for composites product development.
- Government funding: Funding for industry through Advanced Composites programme of Technology Information Forecasting and Assessment Council (TIFAC) should be revived. This will be a much welcome support for deserving units, entrepreneurs and start-ups in the field of composites.
- Export focus, import substitution and indigenisation: Various products needed by the government are listed under the Self-Reliant India 'Atmanirbhar' initiative. This will create a lot of business opportunities for Indian composites industry and stimulate innovation.
- Attracting talent: It is important to attract talent towards the composites industry. Except in aerospace and defence sectors and to some extent in wind energy sector, the opportunities and salaries, growth

opportunities and stability are not very attractive in composites industry. If the industry is able to shift its emphasis towards exports, then it can earn higher profits and attract and retain best talent.

26.3 Indian Textile Accessories and Machinery Manufacturers Association (ITAMMA)

ITAMMA, formerly known as "Association of Merchants & Manufacturers of Textile Stores & Machinery (India) was established in 1943 and is the oldest textile association in India.

ITAMMA is the voice of SMEs in the Indian textile engineering and accessories industries. They advocate for policies and institutional support to bolster members' capacity to innovate and spur economic growth through the textile machinery industry.

26.3.1 Types of technical textile machines/spares in India

The following table consists of a list of machines/spares that are manufactured, supplied (through imports) and exported by the member companies of ITAMMA. These members include Inspiron Engineering Pvt. Ltd., SKAAT Machine Works India Pvt. Ltd., Ashton International Pvt. Ltd., Technocraft Industries, and Bharat Beams Pvt. Ltd.

Table 26.2: Types of technical textile machines/spares manufactured, supplied and exported from India

S. No.	Name of machine/spares	Manufactured	Supplied in the domestic market	Exported
1	Stenters for heat-setting	Yes	Yes	No
2	Finishing and Dryer for coating application	Yes	Yes	No
3	Hot air stenter machine	Yes	No	Yes
4	Soft core and rigid core spinning machine	Yes	Yes	Yes
5	Spindle monitoring machine	Yes	Yes	Yes
6	Roving stop motion	Yes	Yes	No
7	Cop Sorter	Yes	Yes	No
8	Synthetic condenser rubbing aprons	Yes	Yes	Yes
9	Condenser tapes	Yes	Yes	Yes
10	Spindle tapes	Yes	Yes	Yes
11	Combing aprons	Yes	Yes	Yes
12	Conveyer and hopper feed lattices	Yes	Yes	Yes

13	Wooden/Aluminum lags with pins	Yes	Yes	Yes
14	Rag tearing pins	Yes	Yes	Yes
15	PVC/PU conveyor belts	Yes	Yes	Yes
16	PU round belts and tubes	Yes	Yes	Yes
17	Flexible/Metallic Card Clothing	Yes	Yes	Yes
18	Weaver and warper beams	Yes	Yes	Yes
19	Hydraulic equipments of handling beams	Yes	Yes	No
20	Reed storage racks	Yes	Yes	No

26.3.2 Challenges faced and suggestions by Technical Textile machines/spares manufacturers of India

Challenges

The Indian machine manufacturers face tough competition from European manufacturers for sophisticated machinery with high-end quality and from Chinese manufacturers for cost efficient machines.

Lack of technical expertise, lack of technology transfer, lack of product differentiation and diversification, lack of R&D and acceptance, limited domestic market requirement, high production costs, and lack of awareness of quality standards are the major challenges faced by machine manufacturers.

More specifically, bottlenecks like imported electronic components, high import tax, high cost of steel and aluminum, dependence upon Chinese manufacturers and logistics costs make it difficult for some of these manufacturers to grow.

Suggestions

Since some of the machines are being imported into India from countries with low production costs, provisions and policies should be made to prevent dumping of technical textile goods at unreasonably low prices.

The government should also come up with special schemes for R&D, technology transfer, and technical collaboration in technical textiles machinery to encourage and produce innovative technology.

26.4 Textile Machinery Manufacturers Association (TMMA) India

TMMA represents the interest of textile machinery manufacturers in India aims to promote the growth of the Textile Engineering Industry in India through its interventions. It provides various services to its members aiming to strengthen the competitiveness of the industry and promoting 'Made in India' brand in the global market.

The Indian textile machinery sector

The Indian TEI is dependent on cost effective machines, critical components and accessories from China, Korea and Taiwan. About 50% of the machines are imported from China. High quality equipment and machines are imported from Japan and Europe.

Many leading Indian companies have shown keen interest in seeking opportunities for Joint Ventures, Technology Transfer and Collaboration for future R&D.

26.4.1 Different types of textile machines which can be produced in India

Table 26.3: Different types of textile machines which can be produced in India

S. No.	Machine type	Import (Rs. Crores)	Source of import	R&D/JV/FDI at present
1	Weaving loom (Rapier, airjet and waterjet)	2000	Belgium - Picanol Italy - Itema Japan - Tsudakoma China - Kingtex	Indigenous R&D done and seek FDI/JV for airjet and waterjet commercialisation
2	Knitting machines (high speed circular, WEFT and Flat knitting)	1500	Germany - Karl Mayer Korea - Taeho, Raschel Taiwan - Pai Lung Japan - Shima Seiki, Fukuhara China - Birdy	Indigenous R&D to be done-to be commercialised
3	Embroidery machines (Horizontal and Multi-heads)	1100	Germany - Lasser Switzerland - Saurer Japan - Barudan, Tijima China - Birdy, KSA	Indigenous R&D to be done-to be commercialised
4	Processing machines (Drying, dyeing and bleaching)	1000	Switzerland - Benninger China - Fong's Germany - Menzel, Bruckner Italy - IPC	FDI/JV and Indigenous research to be done- to be commercialised
5	Spinning machine (Autowinders/Autoconers)	900	Germany - Saurer Japan - Murata Italy - Savio	FDI is possible for 'Make in India'

26.4.2 Challenges faced by technical textile machine manufacturers in India

- Brand perception – India Vs Europe Vs China – Indian products are better than Chinese but are more expensive. On the other hand, Indian products are comparable in quality to European products but are cheaper. Buyers prefer to have European quality at Chinese prices from an Indian manufacturer.
- Land & Building Infrastructure – Land acquisition is difficult and ease of doing business in creating infrastructure is still low in India.
- Competition – There is competition from imported second-hand machines or refurbished machines which are often sold as brand-new machines. Foreign manufacturers and Indian companies are unable to survive due to such practices in India.
- Extra incentive for imported machines – Indian Government offers ATUF subsidy on imported machines and there are infrastructure and fiscal benefits offered by other countries (China, US, Europe) to their enterprises. It makes it difficult for entrepreneurs to run profitable ventures in India
- Disadvantageous government guidelines – Inverted duty structure, un-pragmatic QCO by Ministry of Steel on import of High-quality but required in low-volume (steel) by the Indian industry, poses a threat to the survival of Technical Textile Machine manufacturers.

27. Stakeholders' Workshops

IIT Delhi organised seven stakeholders' workshops to elicit opinions to enrich the understanding of the industry and to capture voices of stakeholders. These were conducted online to prevent the spread of Covid infection. The stakeholder groups for the respective workshops (1-7) were as follows:

1. TRAs, COEs and Academic Institutions
2. Apex Industry Associations and Institutions
3. Business Leaders from Protech Segment
4. Business Leaders from Meditech Segment
5. Business Leaders from Clothtech, Hometech and Sportech Segments
6. Business Leaders from Agrotech, Geotech and Oekotech Segments
7. Business Leaders from Buildtech, Indutech, Mobiltech and Packtech Segments

The opinions and ideas contributed by the stakeholders during the deliberations in these workshops have been processed and are presented in this section. This effort is meant to improve the understanding of how the business leaders perceive strengths, weaknesses, opportunities and threats of Indian technical textiles industry. The content has been organised as per individual workshops and an attempt has been made to capture key aspects of the industry as they were discussed in the workshops. Common concerns across segments have also been retained to highlight their significance.

Conclusions from all the workshops are presented in the following sections across four pillars:

1. Resource availability for Technical Textiles
2. Markets and marketing of Technical Textiles
3. Future developments expected in Technical Textiles
4. Impediments to growth of Technical Textiles in India

27.1 Resource availability for Technical Textiles

27.1.1 TRAs, COEs and Academic Institutions

- The Indian manufacturing units use the hand lay-up technique. The use of modern injection moulding or compression moulding processes is relatively lower as compared to that among units in other countries with whom India competes in the international markets.

- Most of the machines used in technical textiles manufacturing in India are being imported. There is lack of availability of standards as well as well-equipped laboratories for checking the quality of machines as well as technical textiles products.
- India's technical textiles industry is characterised by lack of availability of domestically produced high-performance fibres (Carbon, Kevlar, UHMWPE, Nylon 66, etc.) and functional fibres (UV protective, moisture management, antibacterial, etc.).

27.1.2 Apex Industry Associations and Institutions

- Lack of availability of various high-performance fibres is a defining characteristic of India's technical textiles industry today.

27.1.3 Protech

- Lack of availability of raw materials and high cost of developing advanced products, are major challenges to the protective textile industry. Moreover, due to the high cost of the product, the domestic demand for protective clothing is small.
- The ballistic textile market is highly dependent on imports because the two major fibres – Ultra-high molecular weight polyethylene (UHMWPE) and aramid fibres – whose requirement is in the ratio of 80:20 and are not manufactured in India.
- There is a severe lack of skilled (soft and technical) engineers with management knowledge. It is proving to be a major deficiency for the industry. Absence of any specific curriculum for teaching and training about technical textiles to the students results in high training and onboarding costs for the industry. This reduces the competitiveness of Indian firms.
- High level of dependence on imported raw materials (e.g. Nylon 6 and Nylon 66) is one of the major barriers to growth. There is a woeful lack of indigenous manufacturers of high-performance fibres.

27.1.4 Meditech

- Most nonwoven components of Meditech are imported. An example was cited. Some components of a diaper – top and back sheet, acquisition distribution layer (ADL) and soft nonwovens – are all imported.
- Major challenges faced by the Indian medical textiles industry as a result of covid pandemic are – sudden jump in price of hygiene and sanitation products, increased cost on health of employees, 25 percent drop in utilisation of productive assets and drop in manufacturing efficiency due to social distancing norms, difficulty in restoring manpower availability, higher absenteeism, disruptions in supply chain due to delay in receipt of input materials, widened supply-demand gap resulting in hike in prices, difficulties and delays in cargo handling, drop in demand and cancellation of international orders/tenders, denial of small orders by raw material suppliers which has negatively affected new business possibilities and uncertainty on Merchandise Exports India Scheme (MEIS) incentives.
- A comparative analysis was presented comparing established and small manufactures. Established manufactures have the capacity for large production, multiple manufacturing facilities across the globe,

better control on raw material supplies as well as costs and superior distribution and sales network, whereas the small manufacturers have better reach in the local market with more flexibility in product customisation. The larger players highlighted the competition they faced from smaller players who control 50% of the domestic Meditech market.

- There is a critical shortage of suitably skilled manpower for medical textiles.
- The biggest problem in development of Indian medical textile market is lack of raw materials. Unavailability of Pilot/Small batch process, weak supply chain management (SCM) and inadequate R&D for innovative products, high dependence on imported raw materials and machinery are the major weaknesses of Indian technical textile industry in general and Meditech in particular.
- In the context of high value added Meditech products, the investment required for establishing capital infrastructure and buying technology is very high for Indian manufacturers.

27.1.5 Clothtech, Hometech and Sportech

- There is a lack of good converters to finished products in Indian textile supply as well as lack of collaboration between industry and technical institutions for research & development that is required to address this gap.
- There is a huge gap between R&D laboratories where product development for technical textiles takes place and the fabric producers.
- The lack of facilities to promote manufacturing of raw materials and inputs has created a disadvantage for Indian Clothtech manufacturers especially in export markets.
- In Clothtech segment, lack of local machine manufacturing has resulted in high dependence of Indian Clothtech producers on machines imported from China.
- Because of insufficient consumer demand which discourages local investors and entrepreneurs, many products of the Sportech segment are not manufactured in India and have to be imported from outside.
- There is lack of raw material manufacturing capacity in the country for Sportech industry.
- The Hometech industry in India is characterised by low levels of commercialisation of new products and lack of access to advancement in new technology.
- It was highlighted that India is the largest producer of cotton. Farm level traceability (that is required by markets in developed countries) of Indian grown cotton is not practiced in our textile supply chain. One more important fact is the lack of branding of cotton fibre (we only have Kasturi Cotton). These two deficiencies have a huge negative impact on acceptability of Indian Hometech products by international buyers.
- India fulfils its requirement of speciality fibres through import from China, Japan, USA or EU countries. Even though India has ample natural fibre resources, it has lagged behind in commercialisation of these fibres due to processing and manufacturing difficulties.
- There is very little collaboration among industry, academia and researchers towards better utilisation of advanced technology.

- Import of machinery from countries such as Taiwan and other European countries leads to large cost outgo for the industrialists in all the segments covered during the workshop.
- The testing facilities for Clothtech , Hometech and Sportech are inadequate.

27.1.6 Agrotech, Geotech and Oekotech

- The practice of using refurbished machines which many a times are of sub-standard quality is widely prevalent among the product manufacturers. It often leads to final products being of inferior quality.
- High dependence on imports for technical textile machinery, lack of domestic source of speciality raw material for specific end application, lack of technical expertise and human resource, lack of focus on innovation of new products and very little research and development are the main challenges faced by Indian Geotech industry.
- Lack of local raw material and machine manufacturers is a major challenge for Fishnet industry. Graduates in engineering and technology often are not keen to work in textile industry due to prevalence of low salaries and poor work-environment among a large number of firms.

27.1.7 Buildtech, Indutech, Mobiltech and Packtech

- Poor availability of industry ready manpower is one of the foremost challenges faced by Packtech industry. Appropriate Packtech courses/programmes with industry interface are unavailable in Indian academia even as there is a critical need for such courses/programmes.
- The Packtech segment offers an estimated 60,000 white and 300,000 blue-collar jobs annually. It is an export-oriented sector that offers lot of growth opportunities.
- Four very important aspects that need to be expanded on are raw materials, skilled man power, advanced machinery and sound knowledge in technology for better growth of the segments.
- Technology and machines for manufacturing of most Indutech products continue to be imported in large numbers into the country causing a big capital outflow for firms in the segment.
- Shortage of raw material, lack of testing facilities, lack of development of more sustainable and green products and need for more technological up-gradation and research are major issues to be tackled for better growth of Indutech segment.

27.2 Markets and Marketing of Technical Textiles

Almost all the participants of the workshop asserted that a vibrant domestic market for technical textiles is a necessity for the growth of Indian technical textiles industry. In the absence of regular data gathering from the Indian technical textiles market through market tracking and market research exercise, the assessment made by different experts and stakeholders (most notably business leaders) about domestic market for technical textiles can often act as an important component of the situation analysis of technical textiles in India. It needs to be formalised so that regular and updated estimates of market size are made available to entrepreneurs and investor community. One of the important trends that has emerged in recent years is the increased emphasis on recycling and on reducing the use of plastics. It is likely to emerge as one of the major drivers for increased use of technical textiles in coming years. Some of the key observations that were shared during the workshop are detailed below:

27.2.1 TRAs, COEs and Academic Institutions

- New applications of jute hold a lot of promise. The use of jute geotextiles for slope stabilisation, rural road construction, riverbank protection and railway track construction is being tried out. The use of jute agrotextiles for sapling bags, grass mat and wrapping fabric has also been demonstrated.
- Lightweight composites for aerospace applications, masks, water filtration cartridges, geotextiles for road construction, breathable and antibacterial fabrics, etc. are some of the emerging products that will be dominating the market in future.
- Domestic fibre manufacturing companies do not venture easily into manufacture of high-performance and functional fibre because of their feeling that manufacturing these is less rewarding but this is due to their focus on Indian market and unexplored export markets.
- There is lack of awareness among consumers about the use and utility of various technical textiles products.

27.2.2 Apex Industry Associations and Institutions

- Indian technical textiles market is expected to grow at a CAGR of 12.20% between 2018 and 2023 and is expected to reach to US$ 32 billion in FY 2023.
- Robust manufacturing infrastructure, abundant workforce at competitive wages, self-sufficient textile value chain and encouraging policy environment and Government support are the strengths of the Indian technical textiles industry.
- India has become the 2nd largest manufacturer of PPE in the world after the COVID-19 outbreak.
- Key enablers of growth of Indian technical textile market are demand creation, quality assurance, innovation and R & D and integration of supply chains.

27.2.3 Protech

- Domestic sales are just about 20-30% of total sales for all major Indian Protech players.
- Primary use of PVC coated fabrics is in protective clothing and in automotive industries.
- A major challenge as reported by the participating entrepreneurs from Protech industrial units in organised sector is the tough competition from a widely proliferating players in the unorganised sector. This not only influences but causes distortion in the costs and prices of the products.

27.2.4 Meditech

- According to the participants of the workshop, the Indian Meditech market is growing at a compound annual growth rate (CAGR) of 9% and is likely to reach Rs. 7,500 Crores by 2022.
- According to the estimates by the participants, the CAGR for domestic market of baby diaper, fem care and adult care category are 20%, 15% and 20% respectively. Estimates furnished for the global market of PP nonwoven peg a CAGR of 7% for hygiene products.
- Main drivers for growth in Meditech market in India are as follows:
    - Large and regular addition to the population that is aware and willing to consume Meditech products
    - Technological advancements and easy adoption of such advancements by stakeholders
    - Rise of health consciousness and increased awareness of personal hygiene among common people
    - Easy availability of low-cost manpower
    - Existence of complete textile value chain
    - Emergence of India as a popular and credible destination for medical tourism among patients from countries in south and western Asia
    - Government initiatives, subsidies and incentives as part of 'Atmanirbhar Bharat' (Self- reliant India)
    - Existence of infrastructure of COEs/incubation centres
    - Existence of regulated technology parks
    - Growing popularity of medical insurance leading to higher propensity to avail medical treatment
- Rapid rise in demand is leading to significant innovation in this segment.
- The outbreak of COVID pandemic has created an unexpected and unprecedented rise in demand of masks, PPE kits and other products in this segment. Many self-funded manufacturers in the Meditech industry (over 150 of them are BIS certified) rose to the challenge of the pandemic and commenced production of raw material and masks indigenously.

27.2.5 Clothtech, Hometech and Sportech

- According to the participants, sewing threads dominate the Clothtech segment with 60 percent of the market share. It is followed by cloth labels which have a market share of 18 percent. Sewing velcro, zip fasteners, elastics and shoelaces are products in this segment which have high growth potential.
- Only about 5 percent of the total production under Clothtech is exported, mainly to Bangladesh and Sri Lanka.
- Most of the demand for Clothtech products is satisfied by domestic production but there are certain Clothtech products which are imported e.g. taffeta fabric used for umbrella, interlining, elastic, and velcro.
- Government intervention in standardisation, regulation, and generating awareness for promoting the use of technical textile products will create a necessary market pull for this industry.
- Circular economy i.e., recycling technology and the drive for sustainability is also going to provide a significant market opportunity.
- Sewing threads, shoelaces, interlinings, zip fasteners, textile labels, hook and loop fasteners (Velcro), elastic narrow fabrics, and umbrella cloth are products where major opportunities exist for Indian entrepreneurs.
- In the home textile segment, consumer preference has continued to shift from fashion and luxury to health and hygiene. Demand for sustainable products has been going up.

27.2.6 Agrotech, Geotech and Oekotech

- According to the participants, Agrotech market is expected to reach over US$ 14,363.2 Million by 2025 growing at a CAGR of 5.5% between 2017 and 2025, indicating a growing need for agro-textiles in India.
- Central government has launched the scheme "Promoting usages of agro-textiles in Northeastern region" to popularise Agrotech products in the North-East of the country and to improve the yields of agricultural, horticultural, floricultural produce by the use of appropriate agro-textiles like shade nets, ground cover, crop cover, etc.
- Geotextile industry in India is in its nascent stage and is attempting to rapidly catch up with the economically developed countries. Exports have grown at a rapid pace, almost at a CAGR of 30% over the last 5 years, reaching Rs. 1,000+ Crores annually.

27.2.7 Buildtech, Indutech, Mobiltech and Packtech

- The Indian Indutech market has evolved from recycled polyester fibres to PP spunbonded fabric to PVC coated textiles.
- Estimated automotive fabric consumption in India is approx. 28 million sq. meters. The estimated domestic market size of high-performance seating fabric including passenger vehicles, commercial vehicles, railways and airlines is estimated at Rs. 1,100 Crores per annum.

- India is dominating the Packtech segment with a global market share of 40-45%. There are 34 Indian companies whose aggregate annual exports is about US$ 1 billion.
- Use of better packing material to prevent wastage of food grains is catching on. There is a success story for use of insect repellent packing which has led to the reduction of wastage of food grains from 8% to 2.2% in Punjab mandi.
- There is a success story in Buildtech segment in the form of 'flex'. Initially, flex was imported from China and Korea but gradually India has become a net exporter of flex.


27.3 Future developments expected in Technical Textiles

27.3.1 TRAs, COEs and Academic Institutions

- ATIRA is working with ISRO for making lightweight composites for aerospace applications.
- SASMIRA's activities in the domain of agricultural textiles and support to NER project sponsored by the Textile Ministry can be taken as model project for the development of technical textile products.
- There is a need for development of biodegradable raw materials from agro wastes for poor farmers who are often unable to afford woven and knitted HDPE shade net and green house.
- In order to make fibre development economical and sustainable, there is a need to focus on domestic as well as industrial market.
- Development of standards for some technical textiles segments such as agrotextiles need immediate attention.
- Lightweight composites for aerospace applications, masks, water filtration cartridges, geotextiles for road construction, breathable and antibacterial fabrics, were highlighted as some of the emerging products.

27.3.2 Apex Industry Associations and Institutions

- Public procurement by railways, defence forces, Govt. hospitals, etc. will continue to play an important role in demand creation in technical textile market.
- Sportech, Buildtech, Protech and Geotech are segments with high potential for India.
- Composites for bunkers in railway coaches, protective clothing for defence forces and firefighters, use of geotextiles for bullet train project, moisture management fabric for sportswear application, etc. are all innovative products and applications in technical textiles that are being deployed.

27.3.3 Protech

- Emerging technologies in Protech segment are as follows:
    - Seamless garmenting
    - Additive manufacturing
    - Threat detection technologies
    - Radiation barrier fabrics
    - IR protective nets
    - Polyurethane coated fabrics
    - Filtration media for virus and bacteria
    - Air/water filtration nano-membranes
    - Artificially intelligent fabrics
    - Health monitoring and control sensors
    - Biochemical finish
    - Graphene
    - Printable conductive coatings
    - Phase change materials
    - Nanofibers
    - Conductive inks
    - Aluminium coated fabric panels and
    - Hybrid fabrics used for protective applications (gloves, helmet, bulletproof jacket, etc.)
- Opportunities for Indian protective textile manufacturers exist in various applications in space, sports, civil, and defence industries.

27.3.4 Meditech

- The emerging technologies in Meditech segment are as follows:
    - Spunbond nonwovens
    - Face masks
    - Caps
    - Aprons
    - Diapers (adult and baby)
    - Sanitary pads
    - Nanocore
    - Filters employing nonwovens
    - Composites with nonwoven
    - Sustainable, eco-friendly, and biodegradable medical textile products

27.3.5 Clothtech, Hometech and Sportech

- The emerging technologies in Hometech segment are as follows:

    - Fabrics for soundproofing (room and building acoustic)
    - Nonwoven products for window blinds
    - 100% recyclable carpet backing cloth
    - Waterproof and thermal insulator nonwovens
    - Carpet tiles
    - Jute for tufting carpets and fabric tiles
    - Luxury tiles

- Sports textiles is a great opportunity for India. The emerging technologies in Sportech segment are as follows:

    - Sports towels
    - Specialty nonwoven for sports shoes
    - Artificial grass
    - Smart Textiles
    - 3D printing segments
    - Hydro cotton
    - Coated textile fabrics which have high export potential

27.3.6 Agrotech, Geotech and Oekotech

- Nonwoven technology appears to be gaining traction among Agrotech products.
- The emerging products in Agrotech segment are as follows:

    - Crop covers
    - Shade nets (especially low GSM shade nets)
    - Anti-insect nets
    - Fish nets
    - TFO twister and multifilament based knotless fishnet (international market)
    - Scaffolding nets
    - Anti-Hail nets
    - Crop protection nets
    - Bird nets
    - Fog catcher nets
    - Woven sacks & fabric



- The major use of geotextiles is in landfills, mining and erosion and landslide control. Emerging geosynthetic products in Geotech are as follows:

    - Geo-grid
    - Geostrap
    - Geonet

- Geomembrane
- Geocells
- Nonwoven geotextiles
- Carpet tiles for geotextile application
- Glass fibre composite based Geotech products
- Geotextile underlay for paver blocks
- Geotextile wall planters for vertical gardens
- Pond liners

- There is a lot of business interest in the Oekotech segment but it still is in the nascent stage.

27.3.7 Buildtech, Indutech, Mobiltech and Packtech

- Emerging products and technologies in Indutech are as follows:

  - Nanofibre membranes
  - Lamination and coating technologies
  - Filtration technologies
  - Conveyor belts and hoses
  - Ropes
  - Slings
  - Webbings
  - Carbon fibre-based composites

- Emerging products and technologies in Mobiltech are as follows:

  - Tyre cords
  - Roof linings
  - Filtration cloth
  - Seat covers
  - Seat belts
  - Airbags
  - Knitted fabric for seating
  - PVC coated textiles for seating
  - Nonwovens
  - Woven fabric is being replaced with knitted fabric
  - PVC coated textile

- Trends in Mobiltech suggests growing use of:
  - More compostable, degradable, biodegradable, and recyclable polymers.
  - Products with single polymers becoming more popular as they render it more recyclable.
  - Flex-based food storage products with antibacterial activity.


27.4 Impediments to growth for Technical Textiles in India

27.4.1 TRAs, COEs and Academic Institutions

- Lack of availability of high-performance fibres (Carbon, Kevlar, UHMWPE, Nylon 66 etc.) and functional fibres (UV protective, moisture management, antibacterial etc.) from the domestic suppliers is hampering the self-reliance and growth of the technical textile industry.
- As technical textiles require specialised knowledge, lack of qualified and skilled manpower is one of the major impediments. A multidisciplinary team is needed by the industry and TRAs. However, for the small-scale technical textile units under MSME and even for TRAs, it is quite challenging to recruit and retain such qualified manpower.
- Most of the Indian industries use hand layup (38%) technique whereas the use of injection moulding or compression moulding is relatively less. This is a major inhibitor in the growth of Technical Textiles.
- There are a very limited number of big players and most of the manufacturers come under the ambit of MSME or SMEs. This limits the pace of growth of the industry as a whole.
- Inferior quality of raw materials such as raw jute, absence of quality mark like wool mark, use of primitive machines and high labour requirement are some of the major hindrances.
- Lack of updated standards is a major obstacle.
- There is lack of awareness among consumers about the utility of various technical textiles products.
- Use of manual labour and lack of use of modern machines are important reasons behind poor quality and less competitive technical textiles products.

27.4.2 Apex Industry Associations and Institutions

- Lack of raw material, lack of indigenous R&D, imported machinery, lack of awareness of using technical textile products, limited skilled workforce and lack of standardisation and regulations for technical textiles were flagged as major impediments for growth of Indian technical textile industry.

27.4.3 Protech

- There appears to be a general lack of awareness among common people about safe practices and safety equipment.
- There is a lack of adequate legislation for mandatory usage of protective clothing in industries.
- There is a gross absence of stringent , research-based standards and regulation for in the Indian protective textile industry.
- Lack of quality benchmarking for the development and export of technical textile products is a major impediment for India’s Protech products.

27.4.4 Meditech

- Major threat to formal players emanates from numerous unorganized players who manufacture Meditech products in poor hygiene condition, with very low-quality and absence of adherence to standards. Fast and speedy implementation of new Medical Device Rule (MDR) of 2017 which describes removing medical devices from drugs and cosmetic act is needed. Standardization of medical textile products is crucial to stop the mushrooming of unorganised players with low standard products. Fluctuating cotton prices, pollution issues in processing, bioburden in cotton fibre, low sterilization capacity etc. are threats to the medical textile industry.
- Lack of adequate standards for products and low awareness of end application of medical textiles is a major hurdle to the growth of this segment.
- At present, the import duty on raw material and finished diapers is the same which has consequently led to import of inferior quality products in Indian medical textile market.
- Lack of testing facilities of Meditech products has led to the domination of inferior quality products in the market.
- Excessive reliance on imports is a key impediment in development of the medical textile industry.
- Availability of skilled manpower for medical textiles is another hindrance against the growth of this sector.

27.4.5 Clothtech, Hometech and Sportech

- Inverted duty structure is prevalent in the textile supply chain and has a negative influence on the cost of products that ultimately reduces their consumption.
- Lack of good converters of technical textile finished products in Indian textile supply chain impacts Clothtech negatively.
- Absence of product standards, less availability of garmenting facilities in India and multiple GST structures for textile products are key impediments for Clothtech segment.
- Lack of adequate and updated BIS standards and certified laboratories serve as major impediments in the growth of Clothtech and Hometech.

27.4.6 Agrotech, Geotech and Oekotech

- Limited consumption of Agrotech products in the agriculture sector is the biggest challenge in India. The Agrotech segment is dominated by SME players and the segment has a relatively small share in Indian technical textiles when compared to its potential. Lack of big players, less acceptance of advanced technology and low cost of conversion, lack of standardisation of Agrotech products are among the major limitations to the growth of this segment in India.
- Major gaps for Geotech and Oekotech segments are low consumer confidence, absence of standards and usage guidelines, and resistance to adoption by the end users. A major reason cited for low user confidence is the bad experience of users due to poor quality of Geosynthetics often being used for construction by project contractors.
- Another hurdle to end user adoption of Geotech and Oekotech products is that of getting approvals for usage of products or change of designs or change of scope, financial approvals in Engineering, Procurement and Construction (EPC) contracts, provision in Schedule of Rates (SORs) / Demand signal repository (DSRs) for tendering purposes.
- Lack of a centralised system for product certification and quality assurance is a major technological gap for Geotech and Oekotech. Lack of standards and codes of Geotech and Agrotech products leads to less end user adaptation of these products.
- Lack of awareness among the approving authorities for Geosynthetics uses in infrastructure was spoken of as another major impediment.
- Lack of integration between a product designer, geotechnical expert, and structural engineer to frame an appropriate specification of a geotextile product is a key hindrance in development of Geotech and Oekotech segments.
- In many countries, geotextiles sells as a product with proper specifications. In India however, it is sold as a solution for civil construction. It becomes difficult for textile manufacturers to convince inter-departmental authorities to adopt geotextiles as Government procedures in India do not easily permit such multiple authorities to take decisions.
- Geosynthetics is at a nascent stage in India. Indian users are largely unaware of the benefits of utilising Geotextiles as a better alternative to other material for some applications. Lack of awareness regarding the use such products is a major impediment to the growth of Geotech and Oekotech.
- Guidelines of the ATUFs scheme are very stringent and not clear to new entrepreneurs.
- Long user trial periods specified for Geotech products are very time consuming and discourage innovators and engineers from contributing more to the advancement of these segments.

27.4.7 Buildtech, Indutech, Mobiltech and Packtech

- A major challenge for Indian manufacturers is to produce consistent quality Buildtech and Indutech products according to defined standards.

- The time required for product development in case of highly developed products in Mobiltech segment is at least four to five years. Such long gestation period requires long-term investment for which support from an agency like the government is necessary.
- Lack of international level testing facility (Branded international facility) is one of the hurdles to the development of Mobiltech segment.
- Lack of reliability of vendors who are outsourcing partners in the Indian Mobiltech segment is a major concern for Mobiltech product manufacturers.

27.5 Factors Affecting Technical Textiles Industry: Expert Opinion

27.5.1 Introduction to factor analysis of responses from workshop participants

The factors that impact the growth and development of technical textile industry in India need to be highlighted based on the opinion of experts from the industry. This is important because the business leaders which include entrepreneurs operating in the industry have a practical exposure and experience in their respective segment. With this perspective in mind, the study team has captured and documented the views of industry experts who are important stakeholders of technical textile industry in India. Their views regarding enablers and impediments to growth were sought by administering a questionnaire to them.

27.5.2 Methodology of factor analysis of responses

A questionnaire was developed which consisted of questions about various aspects of technical textiles industry that contribute towards its promotion and inhibition. An exhaustive list of factors was collated and questions were specifically formulated around them. The questionnaire contained questions grouped in three broad areas. All the questions were designed with the use of 5 point Likert scale where 1 meant "Strongly Disagree" and 5 meant "Strongly Agree". The responses of 33 industry experts to the questionnaire were obtained prior to their participation in stakeholders' workshops. Factor Analysis was used to draw relevant inferences and conclusions from the collected data.

Factor Analysis is a statistical technique which is used to reduce a large number of variables into a fewer number of factors using variability and correlation among the variables (Child, 1990; Shrestha, 2021)[*]. A factor score is generated from factor analysis and it is then used to obtain a fewer number of unobserved variables.

[*] *Child, D. (1990). The essentials of factor analysis. Cassell Educational.*

Shrestha, N. (2021). Factor analysis as a tool for survey analysis. American Journal of Applied Mathematics and Statistics, 9(1), 4-11.

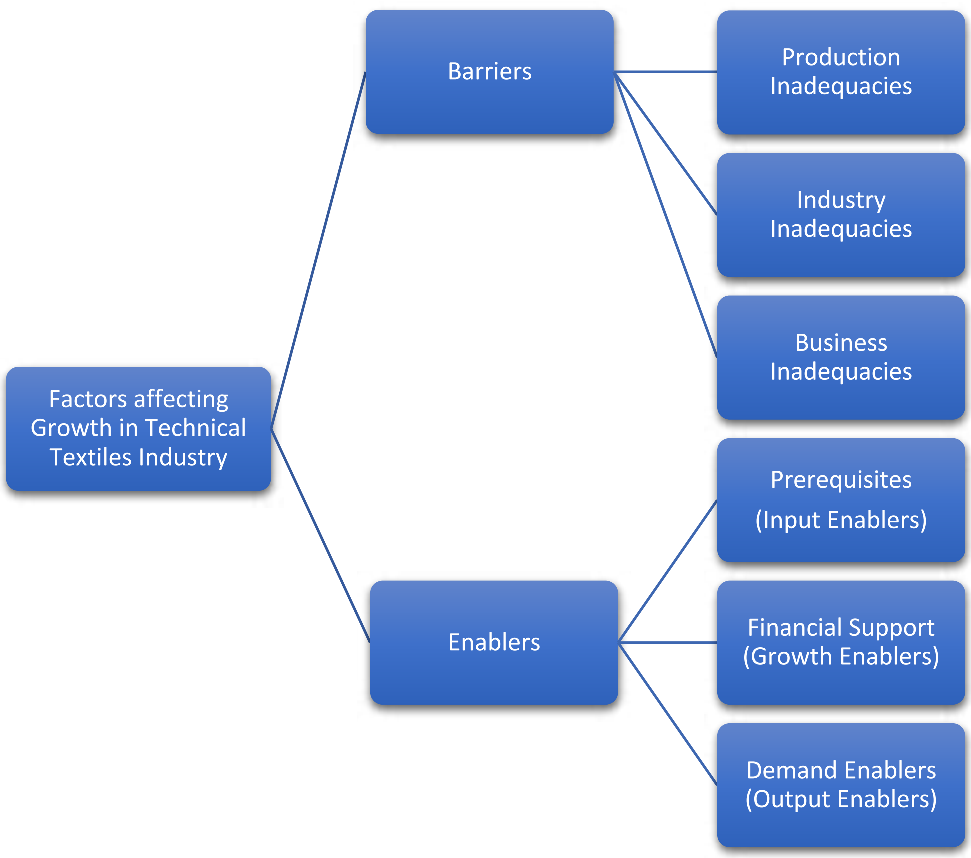
27.5.3 Results of factor analysis of responses

The following paragraphs present the findings of the factor analysis:

Factors affecting growth of technical textiles industry in India

The first group of question attempted to analyse the factors affecting the growth of technical textile industry in India. The results based on the responses received from 33 industry experts are presented in Figure 27.1.

Figure 27.1: Factors affecting the growth of technical textile industry in India



According to the industry experts, the various factors that act as a barrier to the growth of the industry can be classified under the heads of production, industry and business inadequacies. Similarly, the various enablers to growth can be classified under heads which are prerequisites, growth enablers and finance related.

Barriers to growth

The specific barriers under each of the heads are presented in Figure 27.2.

Figure 27.2: Barriers to growth

Production Inadequacies

- Non-availability of raw materials
- Non-availability of technical competence to lead product and process innovation
- High cost of developing new or improved products or processes
- Manufacturers lack economies of scale in production

Industry Inadequacies

- Inadequate product testing facilities
- Inadequate adherence to quality standards
- Inadequate domestic cooperation with: other firms, experts in universities, experts in government laboratories, professional technical support service, and research associations

Business Inadequacies

- Inadequate business interest among the large companies in India in the technical textiles
- Inadequate indigenous research and innovation in the country
- Inadequate organisational culture for innovation
- Inadequate interest among entrepreneurs in India in the technical textile sector
- Lack of marketing capability for new products
- Lack of consumers' acceptance of new products

Enablers of growth

The specific enablers under each of the heads are presented in Figure 27.3.

Figure 27.3: Enablers of growth

Prerequisites (Input Enablers)

- More number of graduates passing out from Institutes with adequate knowledge related to technical textiles
- Adoption of rapidly changing technologies
- Marketing and Business Development
- Better supply chain management, linking-up with global value chains

Financial Support (Growth Enablers)

- Availability of Seed (start-up) funds
- Easy access to long-term financing for start-ups
- Financing for expansion of companies (non-start-up)

Demand Enablers (Output Enablers)

- Low fiscal duties
- More stability in exchange rates
- Boost international demand (exports)
- Magnify domestic demand

Factors responsible for technological gaps in Indian technical textile industry

Development of technical textile industry is being driven by rapid advancements in technology and introduction of innovation. In order to stimulate growth in the future, it is imperative to understand the factors that are responsible for technological gaps that are holding back Indian technical textile industry. Analysis of the responses received from the experts revealed that the following market deficiencies and barriers to innovations contribute to the technological gaps.

Figure 27.4: Factors responsible for technological gaps in technical textile industry in India

Market deficiencies

- A market dominated by established companies
- Lack of long-term business strategy
- Lack of information on technology
- Lack of internal absorptive capacity
- Inadequate market size
- High investments for setting up new technology plants

Barriers to innovation

- Lack of availability of funds
- Very high direct innovation costs
- Lack of manpower with innovation capabilities
- Lack of focus on innovation by the majority of the companies
- Lack of credibility and trust in the indigenous innovation

Impediments to adoption of advanced technology in technical textiles

Diving deeper into understanding the low adoption of advanced technologies in the context of technical textiles, the experts opined and indicated the following organisational barriers and process barriers to adoption of advanced technology:

Figure 27.5: Impediments to adoption of advanced technologies in Indian technical textile industry

Organisational Barriers

- Organisational resistance for any change
- Lack of support from the top management
- Resistance from workers' union
- Skill Inadequacy
- Difficulty in imparting training
- Hight Attrition rate
- High capital expenditure
- Lack of R&D investment
- High operational expense
- Difficulty in Technology Acquisition/License

Process Barriers

- Lack of regulations/standards
- Lack of transparency with supply chain partners
- Lack of information about technologies/products
- Lack of after sales services

The above findings clearly indicate that there is a need for creating an environment that caters to the challenges and impediments faced by entrepreneurs on aspects related to production, process, market, and organisational aspects so that the industry can have an accelerated pace of growth.

27.6 Suggestions proposed by participants of the workshops

- **For all segments**: Government should allow subsidy on refurbished branded machines which will reduce the investment of initial heavy capital for industrialists. India should also start manufacturing technical textile machinery. In addition to reducing the initial cost of purchase, this will also reduce the cost of maintaining and servicing the machines.

27.6.1 Suggestions by TRAs, COEs and Academic Institutions

- SASMIRA's support to NER project can be considered as model project for the development of technical textile products.
- Sports Authority of India must adopt clear cut standards for quality checking to give a boost to Sportech segment.

- There should be more focus on techno-commercial research projects and industry linked projects by academic institutes.
- Fibre development requires acquiring or developing technology that requires huge capital investment and is a long term (10-15 years) initiative. It should be supported by the government.
- Focus of Indian players should be on domestic as well as international markets.
- Inter-ministerial cooperation among various ministries is required to promote the use of technical textiles.
- Creating a market development team for technical textiles based in Ministry of Textiles, can help in enhancing consumer awareness through trade fairs and other awareness events.
- There should be focus on techno-commercial research projects and industry linked projects by the academic institutions for the progress of technical textiles industry.

27.6.2 Suggestions by Apex Industry Associations and Institutions

- Government must enhance its push for the usage of technical textiles by various schemes such as Jal Jivan Mission, Swachh Bharat Mission, Khelo India, Ayushman Bharat to increase the demand.
- Digital facilitation of licensing, single window clearances and fast track approvals and regulation processes should be increased so that it can be helpful for the industry.
- Government should establish skill universities in different regions of India to produce trained manpower to help upgrade the sector.
- Mandatory usage of technical textile products in certain areas, ensuring availability of functional raw materials, awareness about technical textile products and notification of more HSN codes, should be implemented to help increase the demand in this industry.
- In order to promote foreign investment into this industry, easy transport, better-equipped port and smooth transits are the key factors in giving boost to the technical textiles business.

27.6.3 Suggestions by representatives of Protech segment

- Government should provide encouragement and funding to start-up innovators. Industry collaboration with academic institutes involved with technical textiles training and education must be fostered.
- Adaptation of global standards as per Indian environment must be done at the earliest.
- Government should mandate the use of protective textiles by institutional consumers (road transport and highways, rail, hospitals, construction, etc.) and prepare a comprehensive national database of suppliers of technical textiles.
- Government must strengthen the regulations pertaining to industrial safety to give a boost to the demand for protective textile products.

- Collaboration of Indian companies with global leaders in production of high-performance fibres should be encouraged for ensuring reliability of supply and for promoting domestic manufactures.
- The Government must support and encourage IITs and other technical institutes to include specialised academic programmes on technical textiles.
- Manufacturing of high-performance fibres needs long term planning and huge investments with a robust R&D infrastructure. Government of India must offer funds for fundamental materials research.

27.6.4 Suggestions by representatives of Meditech segment

- There should not be any import duty on raw materials and machines for the growth of domestic and export markets of medical textiles.
- Government should facilitate easy and effective interactions between Multinational Corporations and Indian entrepreneurs who are involved with the technical textiles industry.
- Government must issue formal notifications for mandatory and appropriate use of Meditech products.
- Global level standardisation of Meditech products should be taken up by the Government and industry.
- Government should consider creating and then leasing out manufacturing facilities to new entrepreneurs as part of its efforts to improve infrastructure for the Indian technical textile industry.
- Proper disposal mechanisms are extremely crucial in case of medical textiles. Use of biodegradable eco-friendly polymers and fibres in medical textile products should be encouraged.
- Protection of IPR policy is a major concern for research and development teams in the field of medical textiles. Protection of product patents will lead to improvement in quality of products in the market.
- ISI mark should be made mandatory for all the products procured against government tenders as this will bring in good quality of products in the market.
- Involvement of the government is required in setting up good facilities and infrastructure for leasing to entrepreneurs. Such an initiative will ultimately compel the manufacturers (especially MSME) to follow good manufacturing practises (GMP) and improve the overall competitiveness of the industry.

27.6.5 Suggestions by representatives of Clothtech, Hometech and Sportech segments

- Government must provide encouragement to Indian companies to invest in R&D to introduce new products and technologies in the market.
- The Government of India should expand the testing facilities for various technical textile products.
- Multiple GSTs is an area of acute concern for industrialists in technical textiles industry. The government should propose single GST to promote transparency and efficiency in the system.
- Supportive measures should be introduced to enhance the contribution of Centres of Excellence to advancement of technology in technical textiles.

- A common centralised database should be established from where any stakeholder can access data on various innovations in technical textiles.
- The government should alter the inverted duty structure in the textile supply chain as a path-breaking move for the development of technical textile industry.
- R&D must work hand in hand with the marketing department to develop new products and find new markets to increase the size of the market.

27.6.6 Suggestions by representatives of Agrotech, Geotech and Oekotech segments

- Government must establish a common platform for accessing information regarding Geotextile products across all projects in the country so as to improve standardisation of procured products.
- Government should provide subsidies on procurement of good quality refurbished branded machines to reduce the burden of initial heavy capital outflow for manufacturers.
- One of the biggest gaps in India is the lack of alignment among product designers, geotechnical experts, and structural engineers in suggesting appropriate specifications for geotextile products. This should be remedied by the Government setting up institutional mechanisms.
- A very important ground level problem in Geotech and Agrotech is the lack of user trials for new products. Due to longer trial periods, follow up is generally poor and most of the effort is in vain. It is suggested that regional trials with joint research ventures by manufacturers and regional authorities can be a worthwhile idea to pursue.
- India must consider adopting some of the best practices of Government-industry partnerships from across the world. For example, The Every Day Counts (EDC) scheme of the US Department of Transportation where the department adopts existing and new technologies and accelerates their usage in public projects.
- Collaboration between Government and research agencies should be fostered to deliver efficient product trials.
- Establish a quality assurance programme where an independent body should audit manufacturing practices, quality control processes, raw materials used, and issue approvals. In this context, the

National Transportation Product Evaluation Program (NTPEP) practiced by USA and British Board of Agreement practices in the UK are important models to study and adopt.

- A major hurdle on end user adoption in Geotech and Oekotech is of getting approvals of higher authorities for usage of products or change of designs or scope, financial approvals in engineering, procurement and construction (EPC) contracts, provision in Schedule of Rates (SORs) / Demand signal repository (DSRs) for tendering purposes. Circulars and instructions from ministries must be issued to mention such guidelines which can permit field engineers to be flexible and change tenders and design processes under certain specific conditions.
- Mandatory usage of geosynthetics should be encouraged to provide savings in natural resources, improve construction time and quality and save costs. In this context an example was given of Pradhan Mantri Gram Sadak Yojana (PMGSY) in India where in 15% (or as decided by ministry) of area has to be constructed by mandatory usage of geosynthetics.

Coir Geotextiles roads in rural areas under PMGSY-III
(Representational purpose only)

- In the Geotech and Oekotech segment, recommendation was made about strengthening and empowering CoEs or IITs to act as an authority to vet the design changes or change of scope in projects and to guide the project staff in implementing the same.
- Help must be taken by Government of India from agencies like Conformitè Europëenne (CE), British Board of Agrément (BBA), and National Transportation Product Evaluation Program (NTPEP) to improve product and system certification for Geotech and Oekotech.
- In the textile industry inverted GST duty structure is present where all the raw materials have a GST value of 18% whereas the end-product retains 5-12% GST. This increases working capital requirement for the manufacturer. A common input and output GST model must be implemented as it might prove to be more useful for the growth of this industry.
- The submission of report of the Technical Advisory and Monitoring Committee (TMAC) set up by the Ministry of Textiles to establish BIS standards for Agrotech products should be expedited to overcome lack of standards acting as an impediment.
- Government of India should take necessary steps to alter the product specification in various public departments so as to facilitate the use of Geotech and Oekotech solutions.
- Government should establish product certification and application-based testing institute with advanced research amenities for Geotech and Oekotech.
- Ministry of Textiles, Government of India should launch a vigorous awareness campaign for Indian users to familiarise them with the benefits of using Geotech and Oekotech solutions.

27.6.7 Suggestions by representatives of Buildtech, Indutech, Mobiltech and Packtech segments

- BIS should come out with a revision of Indian standards every three years as these need to be continuously aligned with international standards.
- Government should facilitate setting up of testing laboratories of global standards so that these can help speed up the product development process.
- Existing skill development centers should also be equipped for latest technology needed for the technical textiles industry.
- Joint ventures with companies of developed countries should be promoted as those will prompt more investment in the market.
- Technology upgradation is a major concern in this industry. In this context, R&D support from institutes and COEs to the industry should be encouraged as these will strengthen innovative solutions for efficient processes and quality products at economic prices.
- Universities and Institutions should be supported to add technical textile courses and programmes in their curriculum.

28. Emerging Technologies and Technology Trends in Technical Textiles

Technical textiles are evolving at a rapid pace due to research and development efforts in both material and production technologies. Developments that have happened in other areas such as nanotechnology, biotechnology, material science, electronics and information technology have facilitated innovations by technical textiles companies that are continuously developing products to meet challenging functional requirements. This trend of developing new technologies and products is likely to continue as new areas for application of technical textiles keep getting discovered. The developments related to the emerging technologies in the context of technical textiles and highlights about some material and technology in selected segments of technical textiles are documented in this section.

28.1 Emerging Technologies in Technical Textiles

The emerging technologies in technical textiles related to smart textiles, nonwovens and textile preforms for composites have been documented in the section below.

28.1.1 Smart textiles

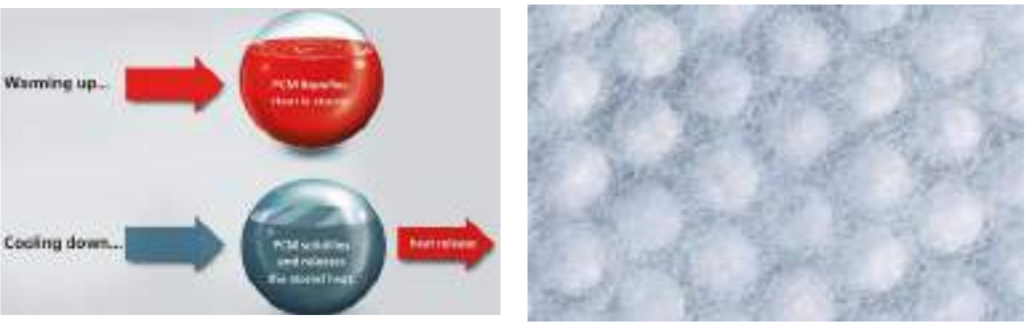
In the recent times, certain textile products have come to have an active component embedded in them, enabling them to sense the stimuli that are present in the ambient environment and follow it by reaction and response in the corresponding textile structure. The stimuli and reaction to stimuli can be electrical, thermal, magnetic, or of some other origin. Such 'Smart Textiles' with active components are becoming increasingly popular with service and functionality ecosystem that is outside the traditional value chain of textiles. This area of smart textiles opens up a vast opportunity for textile developers to innovate and develop new products, each with special intelligence and response. Textiles can be used as sensors, actuators, signal processors, energy harvesters and energy storage devices. It is expected that a lot of innovative research will happen in this domain in the near future. Smart textiles are divided into three subcategories [1]:

i. Passive smart textiles can only sense the environment; they are sensors.
ii. Active smart textiles can sense the stimuli from the environment and react to them; besides the sensor function, they also have an actuator function.
iii. Very smart textiles take a step further, having the gift to adapt their behaviour to the circumstances.

28.1.2 Phase change textile materials

Phase Change Materials is a collective term for materials with the capacity to alter their aggregate state within a certain temperature range: from solid to liquid or from liquid to solid. Water is an example. It turns into ice at 0°C and evaporates at 100°C. These phase change materials are encapsulated by microencapsulation which is followed by their application on textiles. For example, Schoeller®-PCM™ creates an individual comfort climate (Figure 28.1). Even if there are extreme temperature fluctuations, it prevents body from experiencing extremes of temperature helping to retain body's performance capacity [2] .

Figure 28.1 (a) Mechanism of cooling and heating by phase change material and (b) fabric coated with Schoeller®-PCM™



28.1.3 Smart textiles with sensors

Textile based sensors provide an interface between user and an electronic system by converting physiological or environmental signals into electrical signals. Wearable tech garments are capable of monitoring variables such as strain, pressure, temperature, displacement, humidity, etc. Adidas has developed a sports bra for sensing heart rate. This bra contains a conductive fibre which has eliminated the need for separate chest monitoring sensor. This bra also has transmitter, and the data can be seen on the mobile phone and is shown in Figure 28.2 (a) [3]. Another important application of textile sensors is in the medical field. Xenoma has developed a lounge suit that detects motion and alerts medical personnel. It is shown in Figure 28.2 (b) [4]. LEAP technologies have developed smart yoga pants that contain shape memory polymer and carbon which detects incorrect movements and protects the athlete from any muscle tear, injury and inflammation when working out. It is shown in Figure 28.2 (c) [5]. Nike Adapt Basket Ball shoes contain textile-based sensors which can sense the tension needed by the foot and adjusts the fit of the shoe accordingly to keep the foot snug (Figure 28.2 (d)) [6].

Figure 28.2 Textile sensors based (a) Smart sports bra (b) Sleep lounge suit (c) Yoga pants and (d) Basketball shoes

(a) (b) (c) (d)

28.1.4 Smart mask

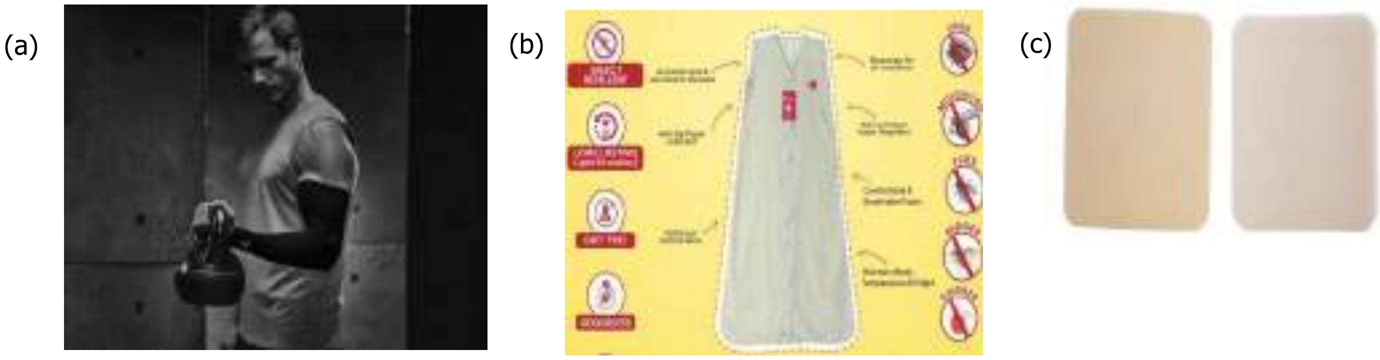
XUPERMASK technology is developed by Honeywell and this smart mask contains dual 3-speed fans and HEPA filters for enhanced breathability. Alongside its integrated features, XUPERMASK boasts active noise cancelling audio and microphone capabilities, Bluetooth® 5.0 connectivity, LED day glow lights, a magnetic earbud docking system. Figure 28.3 shows the XUPERMASK technology [7].

Figure 28.3 XUPERMASK Technology

28.1.5 Textile with controlled drug release

The use of textile materials as a drug carrier for biomedical applications has been widely researched. Different forms of textiles, viz. woven and nonwoven, have been used for this purpose due to their physical and structural properties [8, 9]. The textile material can be loaded with pain killers, mosquito repellent, antiseptic etc. Some commercially available products with controlled drug release are shown in Figure 28.4.

Figure 28.4 Different textile fabrics loaded with (a) pain killer (b) insect repellent and (c) silver for better wound healing



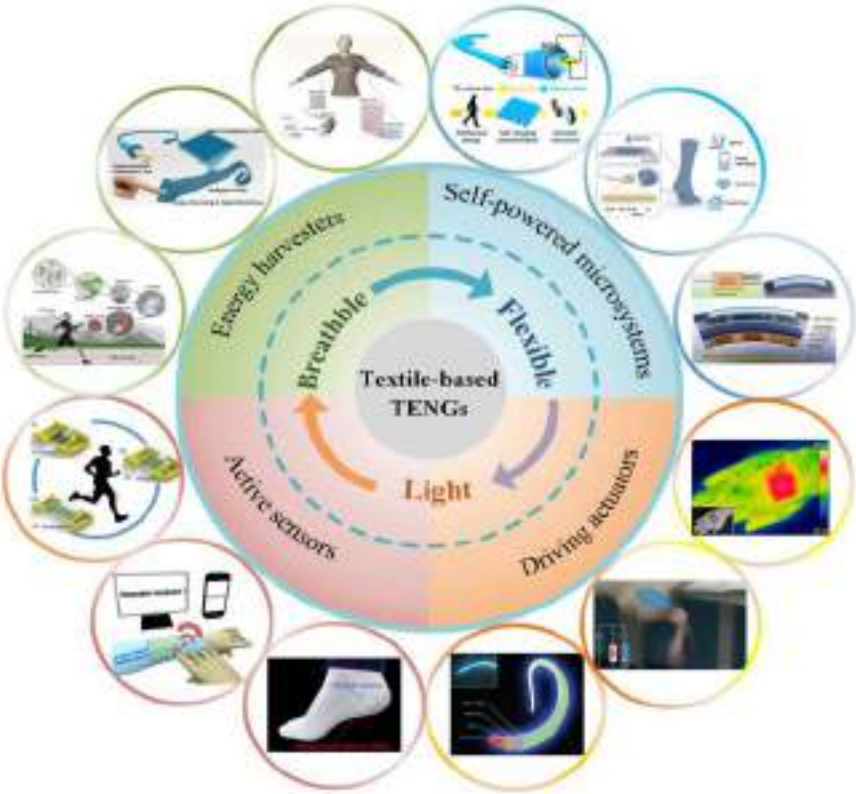
28.2 Technological trends in energy harvesting smart-textiles

Smart and wearable textiles can replace batteries with energy harvesting devices. These can harvest energy from external sources, such as the sun, using fibre-shaped solar cells. Alternatively, excess energy from the immediate environment can be utilised, e.g., in the form of body motion by exploiting the triboelectric or piezoelectric effect. The term "Piezoelectric" means ability of material to produce electric charge in response to applied mechanical stress. On the other hand, triboelectric nanogenerators (TENG) can produce electric charge in response to movement in our surroundings (like human motion, machine vibration, and wind energy [10–12].

28.2.1 Triboelectric nanogenerators

Triboelectric materials include most textile polymers and materials, which facilitate the production and application of textile-based triboelectric nanogenerators (T-TENG). Nylon, silk, polyethylene terephthalate, polyurethane, polylactic acid etc. are used as the contact surface of TENG. Metals or metal particles (Gold, Silver, Copper etc.) are often used as positive electrode materials for triboelectric effect. Materials such as polyvinylidene fluoride, PTFE, polydimethylsiloxane, and silicone rubber are also usually covered on fibres or fabrics to enhance the output of textile based nanogenerators [13]. Figure 28.5 shows the potential applications of T-TENG.

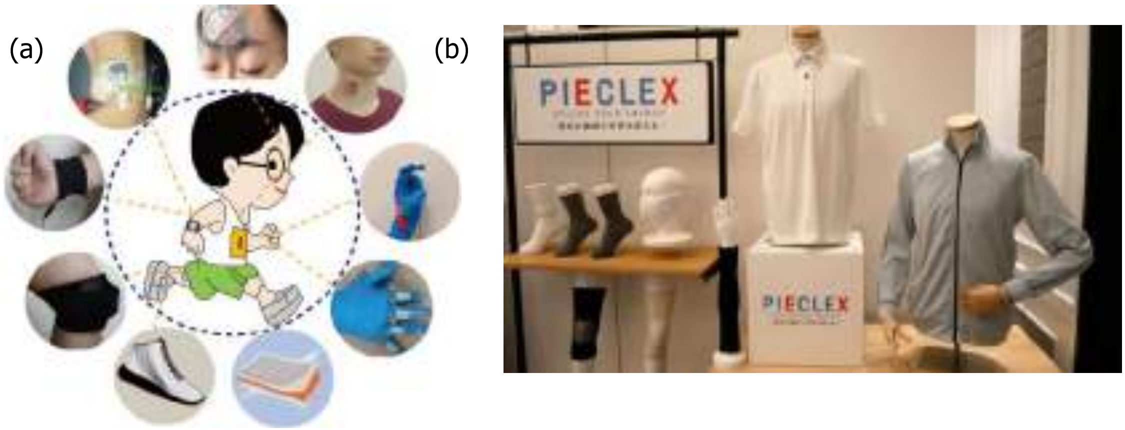
Figure 28.5 Self-powered microsystems based on textile-based triboelectric nanogenerators



28.2.2 Piezoelectric textiles for energy harvesting

Wearable textiles based on piezoelectric nanogenerator (T-PENG) can be used extensively in electronic devices. To make this approach successful, they need to harvest a large amount of energy. Textile materials capable of energy harvesting include PVDF, P(VDF-TrFE), P(VDF-HFP), PP, Nylon11, PAN etc. Recently, two Japanese companies, Murata and Tenjin, have launched an innovative fibre "PIECEX", which can harvest energy from human movement. PIECLEX utilises the piezoelectric effect of plant-derived polylactic acid fibre to generate electricity from the movement of the wearer and can have an antibacterial function without using chemicals and is shown in Figure 28.6 [10, 14].

Figure 28.6 (a) Application of piezoelectric nanogenerator and (b) Commercial products manufactured by PIECLEX



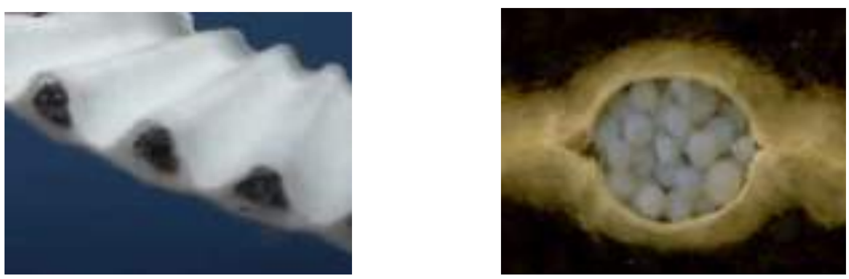
28.3 Nonwoven Manufacturing

Nonwoven fabrics are engineered textile materials that are manufactured directly from fibre. As per definition by ISO standard 9092 and CEN EN 29092- "A nonwoven is an engineered fibrous assembly, primarily planar, which has been given a designed level of structural integrity by physical and/or chemical means, excluding weaving, knitting or paper making. In a nonwoven fabric, the fibre webs are bonded together chemically, mechanically or by application of heat. The manufacturing of nonwoven is a three-step process.

28.3.1 HydroSpace technology

HydroSpace is an economical way of adding value and functionality to a fabric at the point of manufacture. HydroSpace spunlace fabrics are light weight nonwovens with predefined cavities in the cross-section and these cavities can be engineered to many different shapes and sizes. These cavities can either be left empty or they can be filled with gels, waxes, cosmetics, detergents and solid particle to functionalise fabric. This technology is being used in fire retardants, ballistic protection devices and blood filtration equipment. These nonwovens are manufactured by simple retrofit to existing production line where the fabric is produced by hydroentanglement [15]. The products manufactured by this method are shown in Figure 28.7.

Figure 28.7 Nonwovens with different cavities manufactured with HydroSpace technology



28.3.2 Wetlace nonwoven process

This process combines two techniques – welt-laying and hydroentanglement. This production method is ideal for producing flushable wipes. Wetlace nonwoven production is carried out in four steps in the neXline system as shown in Figure 28.8 and 28.9. For the flushable wipes, they must have excellent tensile strength to withstand the production process as well as the handling during the usage. Once these wipes are flushed into water, their stability will disappear entirely and they will gradually dissolve in the sewage water system[16].

Figure 28.8 neXlineWetlace process flow

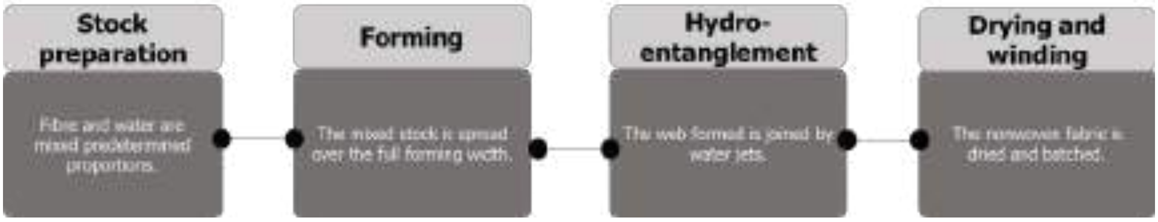
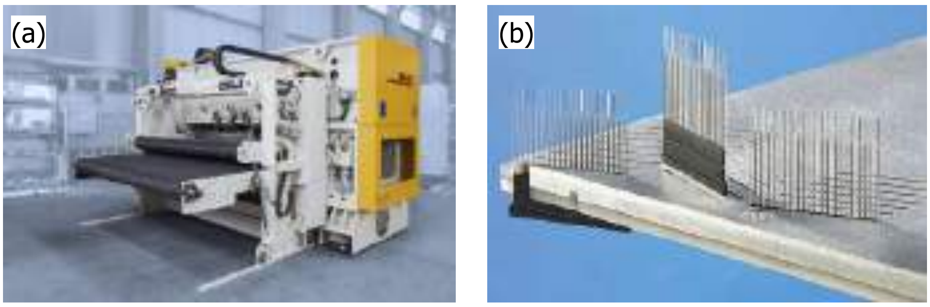


Figure 28.9 Flushable green wipes by Wetlace process

28.3.3 Hyper-punching nonwoven

In this method, the nonwovens are prepared by conventional needle-punching technique; the process of punching the fibrous web is modified. This modification in the punching offers minimal fibre damage with higher production rates. As compared to regular drive mechanism, the needles in the hyper-punch move along with the material rather than blocking the material passage. Also, the needles in this system have elliptical shape, which ensures maximum throughput rate [17]. The hyper-punch needle loom and its needle module is shown in Figure 28.10.

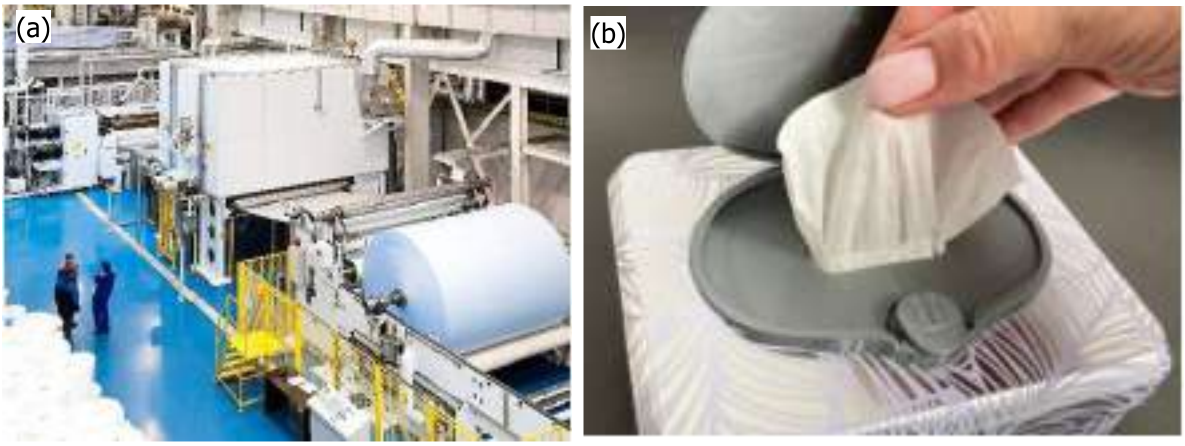
Figure 28.10 (a) Hyper-punch needle loom and (b) needle module used



28.3.4 Phantom nonwoven technology

This is a hybrid nonwoven technology which combines air-laid and spun-melt technologies to deliver new, flexible ways of creating wet and dry wipes (Figure 28.11). Phantom technology offers additional benefits by reducing resources and cost, while increasing overall performance. The spun-melt and air-laid processes are merged into one step to combine cellulose fibres, long fibres such as cotton, or even powders with polymer fibres in extraordinary ways [18].

Figure 28.11 (a) Phantom technology and (b) manufactured end-product

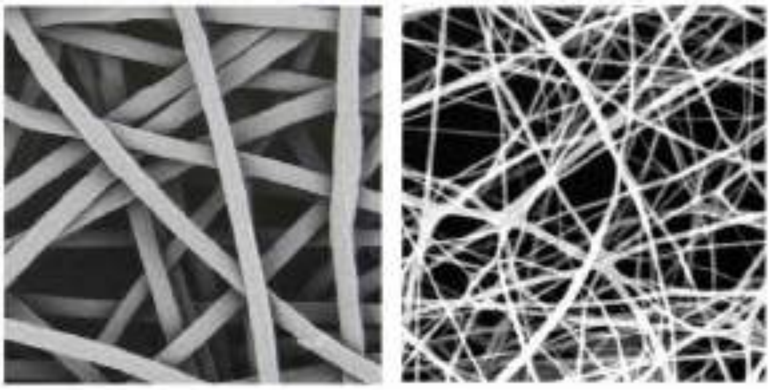


28.3.5 Electro-spun nonwovens

Electrospinning is a technique of producing fibre with a diameter in nano range by dissolving the polymer in a suitable solvent followed by spinning of the polymer solution through a spinneret under a high-voltage electric field. These electro-spun fibres have wide range of applications such as filtration, composite materials, medical membranes etc. Elmarco's Nanospider™ NS 8S1600U is the base spinning unit for the industrial production of nanofibers and is shown in Figure 28.12. This is needle-free technology which offers a high production rate of nanofibers. Figure 28.13 shows the microscopic images of nanoweb [19, 20].

Figure 28.12 Electro-spinning production line for nonwoven

Figure 28.13 Electro-spun fibrous web

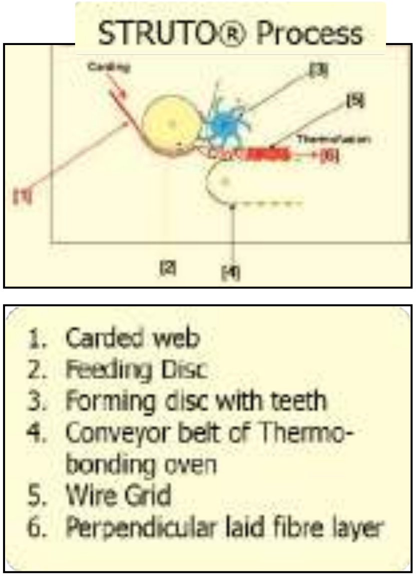


28.4 Technologies for the production of 3D nonwoven structures

28.4.1 Vertical lapping system

With the expansion of the application domain of the nonwovens, different approaches have been used to impart special properties to the final product. One such approach is to use Highloft nonwoven structures [21, 22]. Highloft nonwovens have low density with high thickness to weight ratio. STRUTO® is a nonwoven manufacturing technology which produces Highloft nonwoven structures in which the fibrous webs are lapped vertically. STRUTO® in the basic system consists of a STRUTO® vertical vibration lapper and through-air thermobonding chamber. Figure 28.14 shows the schematic of STRUTO® with the sample cross-section.

Figure 28.14 Process flow of vertical lapping process and cross-sectional images of different samples manufactured [22]



STRUTO® filter media

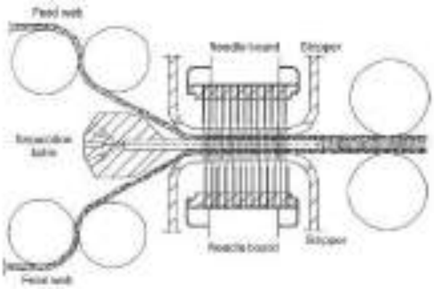
STRUTO® -Virgin polyester

28.4.2 3D Web Linker technology

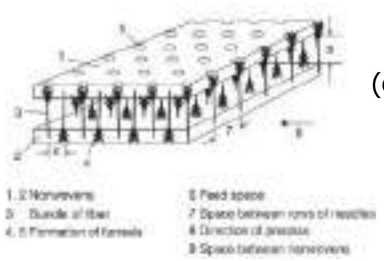
For manufacturing nonwoven with high bulk and 3D structure, NAPCO® utilised two needle punched webs with defined space between them, maintained with the help of a specially designed spacer. This technique uses 3D Web Linker®, a special machine developed by Laroche. NAPCO® technique along with end product manufactured is shown in Figure 28.15 [23, 24].

Figure 28.15 Pictorial presentation of (a) 3D web formation technique (b) structure of end product (c) end-product with 5 mm spacer using fork type needle

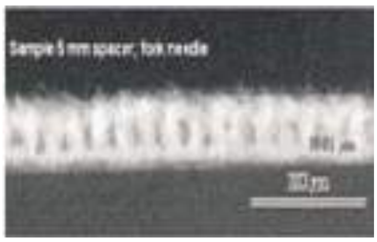
(a)



(b)



(c)

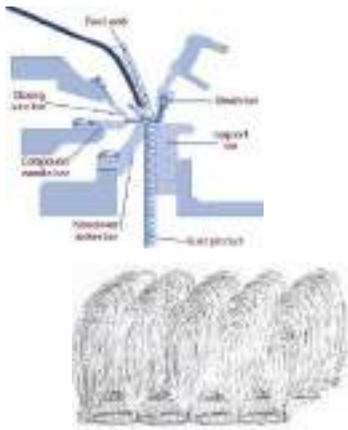


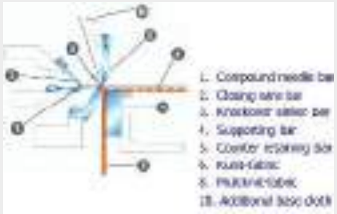
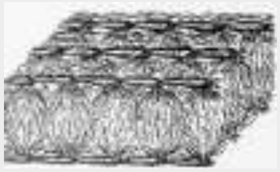
In this process, special barb or fork needles that are arranged in rows penetrate simultaneously from both sides of the two pre-needled nonwovens that creates fibre bridges formed by fibre bundles, and therefore the structure of the layers should contain enough unbounded fibres of sufficiently great fibre length. This type of hollow nonwoven can be filled with different materials in various forms such as granules, powder, foam etc. to make composites suitable for wide variety of applications [25].

28.4.3 Stitch bonding (Maliwatt, Malivies, Kunit, Multinit)

Stitch bonding is a method of joining fibrous web to form nonwoven structure by means of external yarn or by looping the fibres available in the fibre web and depending upon technique used for binding the fibre web, the material can be stitched in both machine as well as in cross direction [26, 27]. These nonwoven fabrics with stitch bonding show enormous potential for various applications such as aerospace composites, automotive, wind energy, upholstery, filtration, geotextiles etc.

Table 28.1: Stitch Bonding Techniques

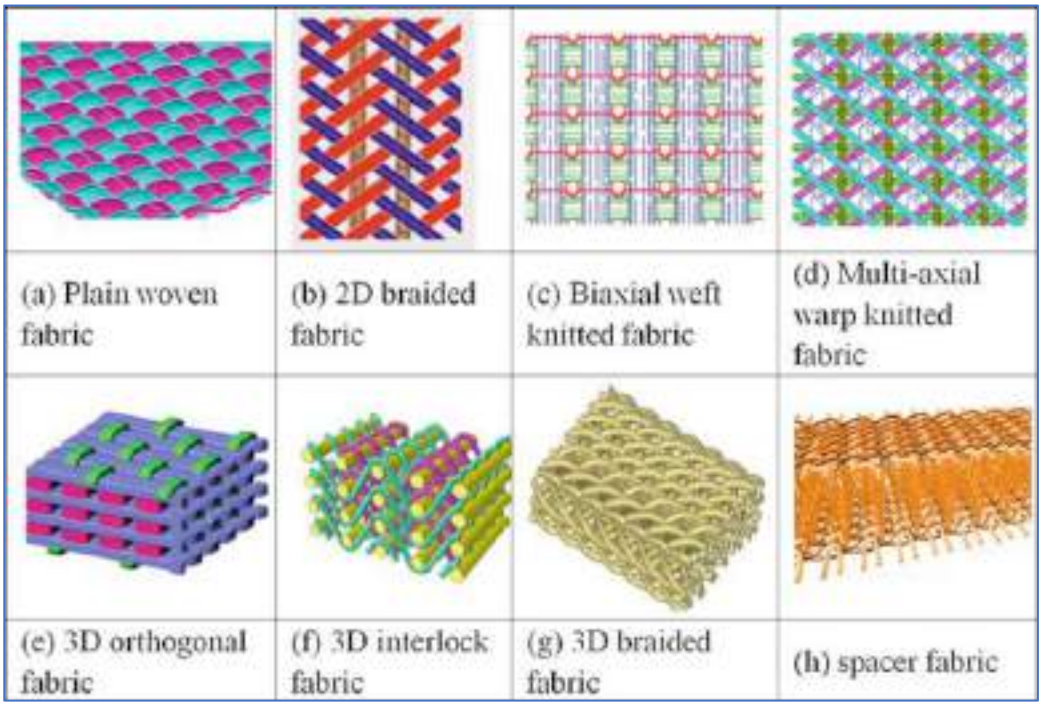
Stitch bonding technique	Working principle		Ref.
Maliwatt	In this process, set of pointed needles adjacent to each other pierce the stitching yarn through the fibre web in a simple or complex pattern to form a nonwoven fabric.		[26]
Malivlies	In this technique, multi-layered webs are stitched together without any additional stitching yarn. The webs are connected by the loops which are formed from the fibrous web itself.		[26, 28]
Kunit	These are three-dimensional nonwoven fabric manufactured by joining lengthwise oriented web in which one side has stitches while the other side has pile structure with vertical fibre arrangement. This technique produces nonwovens up to 10 mm thickness.		[26, 28–30]

Multikunit	One or two nonwoven fabrics preferably kunit nonwovens are used as base material. In the end product, the two nonwoven surface textiles are interlaced by fibres, forming a uniform and tight surface, being connected by almost vertically arranged fibres. This technique produces nonwovens up to 16 mm thickness.	 	[30, 31]

28.5 Textile preforms for composites

The use of composites as engineering material has opened up a new horizon in materials science. The widespread use of composites in structural and semi-structural applications has played an important part in shaping modern developments. Textiles are among the most efficient reinforcements for composite materials. The employment of fibres such as carbon, glass, Kevlar and natural fibres has been augmented in several industrial applications. Textile reinforcements can be in the form of fibre, yarn, and fabric depending on the end-use application. Figure 28.16 shows the different type of textile preforms used in composites [32–34].

Figure 28.16 Different types of textile-preforms used as composite reinforcement

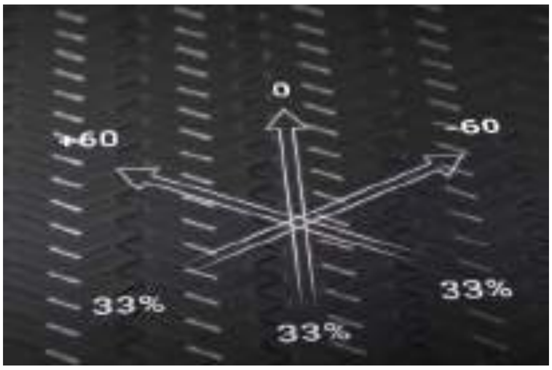


Textile preform manufacturing technologies

28.5.1 Single layer quasi-isotropic fabric

This braided triaxial fabric is balanced in all directions in a single layer. It has quasi-isotropic architecture which provides uniform stiffness in all directions and also allows easy lay-up of multiple layers. This type of preform has application in fields such as industrial communication and tooling, automotive, aerospace, and recreational. In case of woven preform, the fabric needs to be cut at different angles to manufacture quasi-isotropic laminates which leads to lot of material wastage. But in case of "QISO" the plies can be tailored and cutting does not require any rotational placement [35].

Figure 28.17 Quasi-isotropic braided triaxial fabric



28.5.2 Near-net shape preform by unidirectional fibre

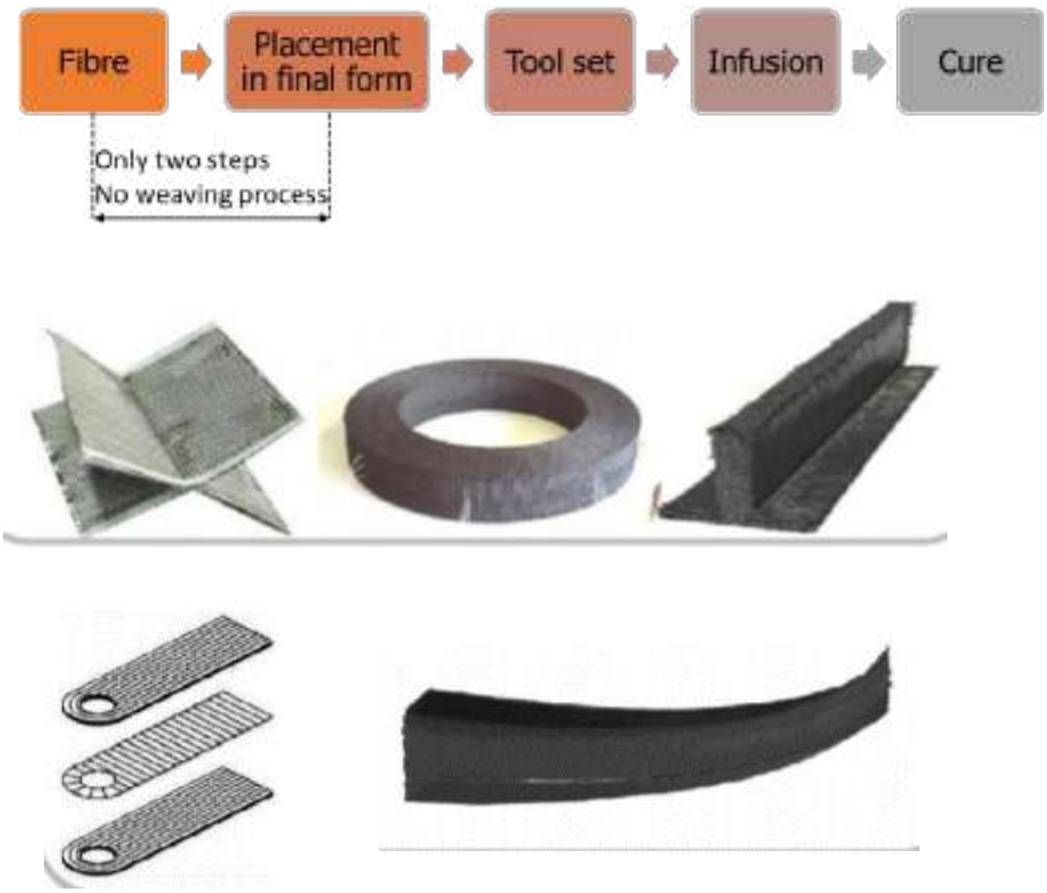
In this indigenous process, unidirectional dry fibres are directly converted into near-net shape preforms. This method is known as "D3D" fibre preform where "D" stands for "dry" and "3D" stands for "three-dimensional". This process eliminates the cutting stage thus leading to minimal material loss. In this process in-plane fibres can be arranged in any direction along the principal structure pattern without cutting the fibres [36].

Figure 28.18 (a) Process flow of "D3D" process (b & c) Final products prepared by this method

(a)

(b)

(c)



28.5.3 Radial braiding technique for 3D preform

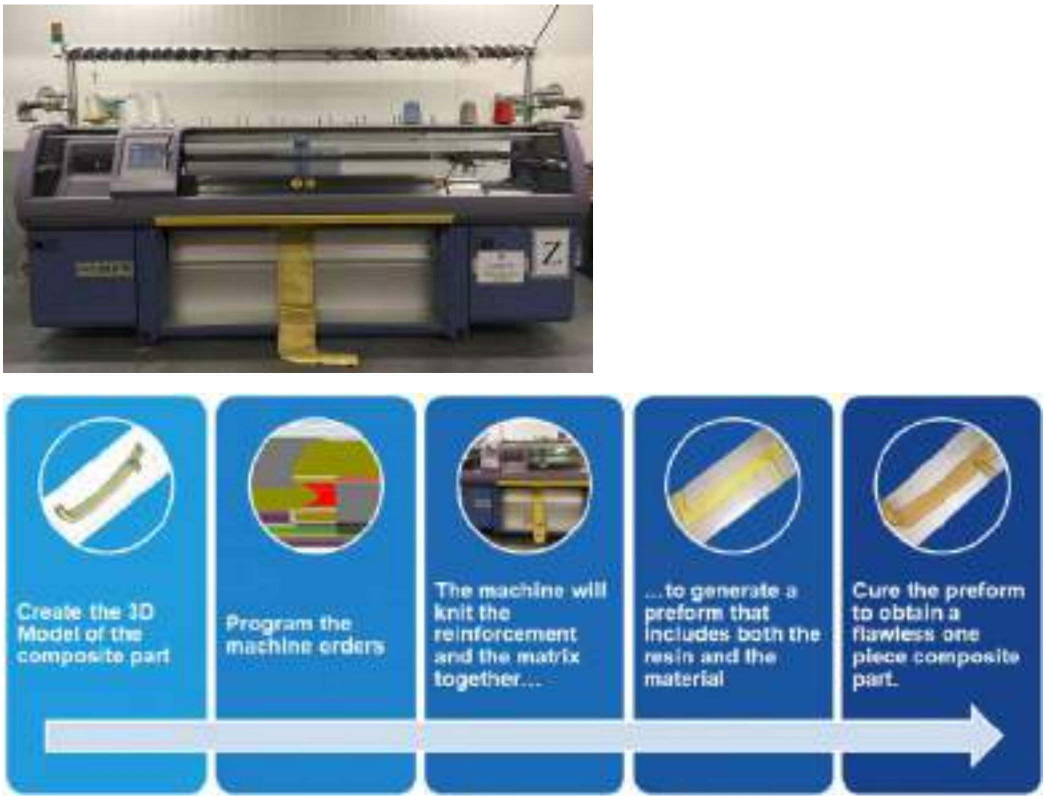
Herzog radial braiding cell is developed to manufacture lightweight braided 3D preforms with biaxial and triaxial set-up and is shown in Figure 28.19. The bias set-up angles may vary from 10° to 80°. In this technique, the manufacturing of complex shapes 6-axis can be manipulated. The yarn packages are arranged radially to have minimum fibre damage with wide range of material processing capacity such as carbon, Kevlar, ceramic, and metallic fibre [37].

Figure 28.19 Radial braiding technique

28.5.4 3D Knitting Technology

This 3D-knitting technology offers an excellent solution for manual layup and cost-effective manufacturing. The RT2i® technology can manufacture near-net shape preform in one piece with variety of different yarns such as carbon, glass, or quartz and is shown in Figure 28.20. With this process, there is no raw material waste and cutting and draping times are significantly reduced. The thermoplastic resin can also be knit together with the reinforcement materials to enhance quality and reduce raw material handling cost [38].

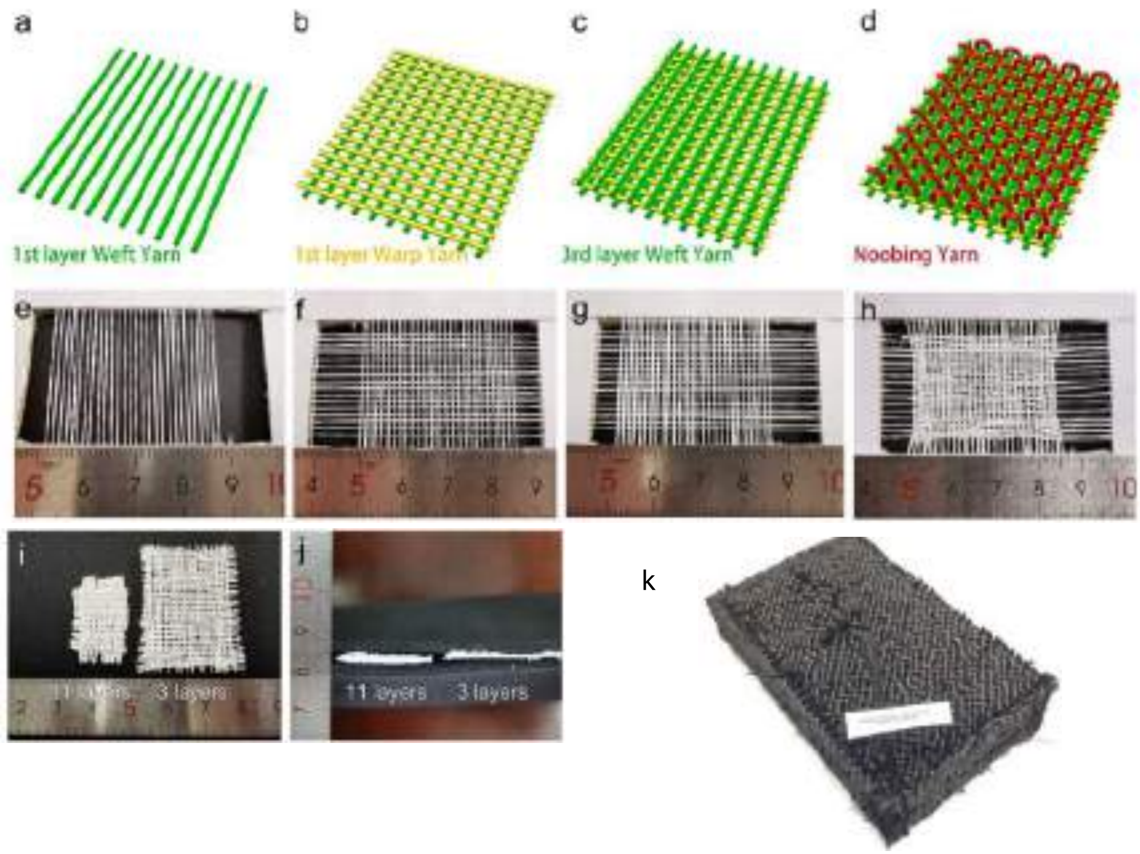
Figure 28.20 Fully automated 3D Knitting Technology



28.5.5 3D-Crimpless preform by Noobing

Noobing is a technique designed to manufacture 3D-crimpless fabrics. This technique was first pioneered by Nandan and Fredrik in 1997. Noobed fabrics are currently developed by Fureha, AB. Noobed fabrics can be prepared using various fibres like carbon, ceramic, aramid, glass, flax etc. The composites reinforced with noobed fabrics can be used for load-bearing and thermal applications [39–41]. The schematic figure of the noobing process and commercially available products are shown in figure 28.21.

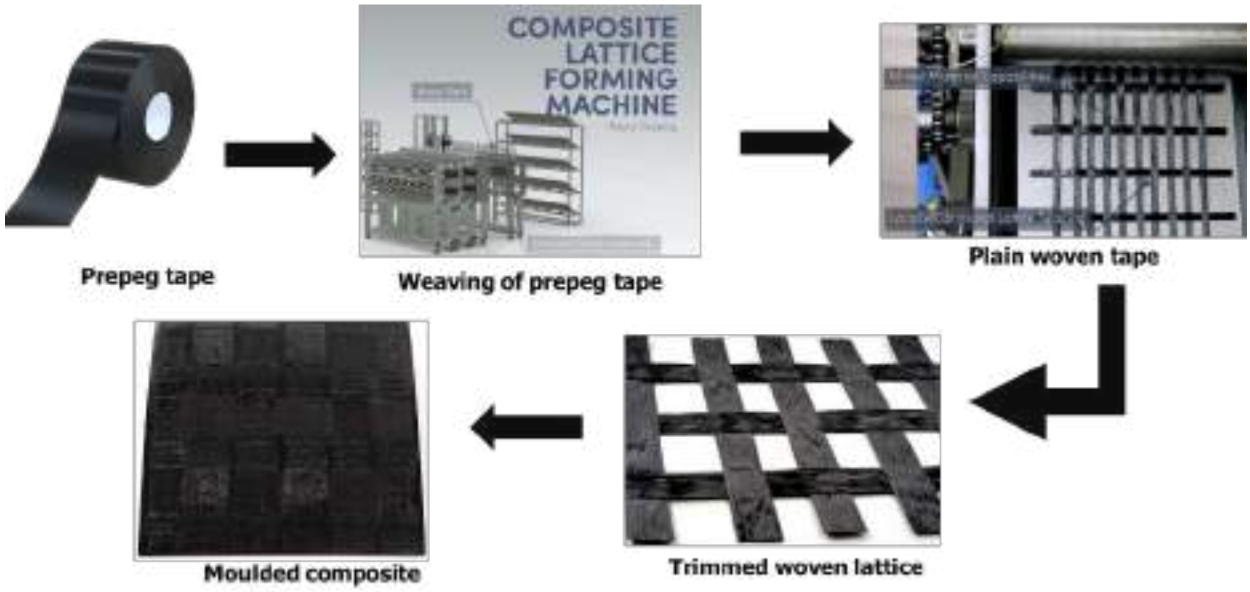
Figure 28.21 (a, b, c & d) Schematic of the Noobing process with three yarn layers, (e, f, g & h) Noobed fabric prepared by corresponding four steps (i & j) Noobed fabric with 11 and 3 layers, (k) commercially available carbon fibre-based noobed fabric



28.5.6 WEAV3D process for thermoplastic prepeg consolidation

It is a patented technology "WEAV3D" which produces tape lattices which are designed for use in high-volume moulding processes like thermoforming, compression moulding, or injection moulding. The process flow of this technique is shown in Figure 28.22 [42].

Figure 28.22 Process flow of WEAV3D process from tape to composite

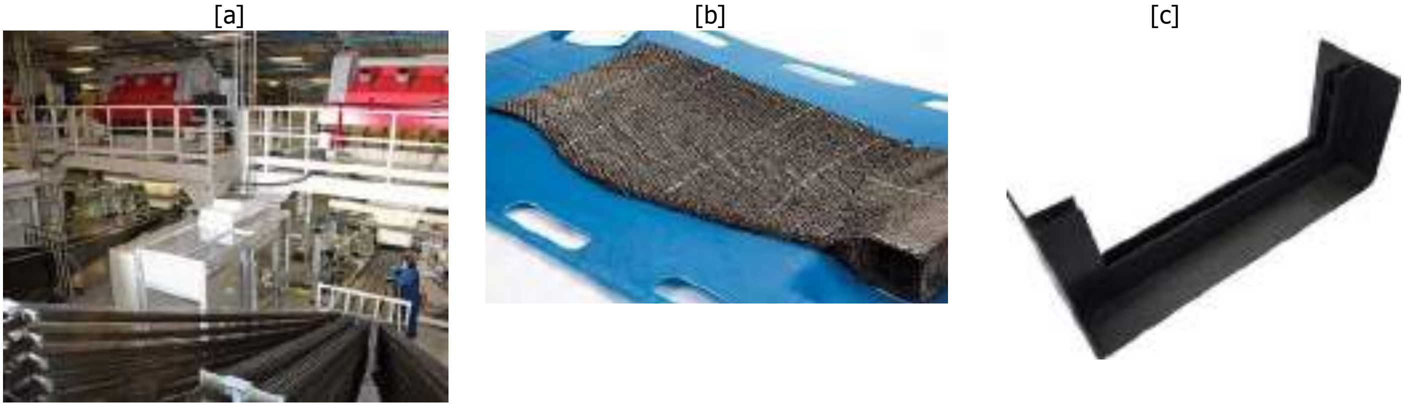


28.5.7 3D-woven preforms by Jacquard weaving

These modified jacquard looms produced 3D fabrics by splitting the warp fibre (oriented in the direction of fabric production) to create multiple sheds (spaces through which the weft or filling fibres are inserted at right angles to the warp) and is shown Figure 28.23. If the warp ends are moved up or down during weaving, then the fabric can be made to consist of several layers stacked vertically. Warp ends can be interlaced with fill fibres in the adjacent layer to produce layer-to-layer locked fabrics, or they can be interlaced with fill fibres in the top and bottom layers to create 3D fabric preform [43].

Figure 28.23 3D woven preform (a) manufacturing process by jacquard loom (b & c) 3D woven preform of aeroplane parts

[a] [b] [c]

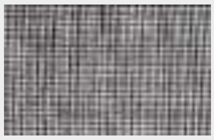


28.6 Material and Technology Trends in Technical Textile Products

Technical textiles cater to different areas of applications such as agriculture, automotive, medical and hygiene. Unlike traditional textiles, technical textiles is a knowledge driven, innovation led, low volume and high value industry. The global market is led by US and EU.

Due to availability of raw material, presence of a well-established textile supply chain, low labour cost and high domestic consumption, India has a high potential for growth in the field of technical textiles. Favourable Government policies and support with innovation and product development can further boost investments in technical textiles in India. A glimpse of important products is presented here.

Table 28.2: Agrotech

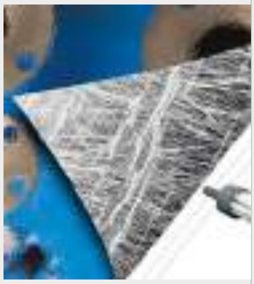
Crop Covers	Leno fabric woven from black PP yarns with approximately 50% open area. The open mesh design reduces wind speed without creating turbulence. Ideal for protecting fruit trees, plants, and crops from damaging winds.	 	[77]
Knitted net for crop protection	This knitted net provides protection against rain splash, hailstorm, rabbits, pigeons and other vermin.	 	[78]
Woven nets for protecting fruit flies	These closely woven anti-UV treated polyethylene nets prevent the intrusion of Drosophila suzukii in soft fruit crops. These nets provide very good aeration and high resistance.		[79]

Bird net	A knitted high-density polyethylene (HDPE) monofilament net. It is used to protect vegetable crops against damage to seeds and young plants caused by birds.		[80]
Anti-hail Net	This net is knitted from 100% HDPE monofilament and provide protection to the crops against hailstorm.		[81]
Biodegradable mulching fabric	It is a woven textile comprising a unique mix of two polymers, one biodegradable and one compostable. After three years of efficient weed control this fabric will eventually break down, and biodegrade and convert into humus, water, and CO_2.		[82]
Mulch net	It is a mulching sheet made by spunbond technology. Due to its simple structure, this material allows sunlight to penetrate while protecting against UV rays and retaining moisture.		[83]
Foliage removal fabric	This is a UV stabilised, white polypropylene woven fabric, reinforced for extra strength. It is specially designed to fit in greenhouse corridors and has excellent performance due to the reinforced edges.		[84]
Anti-frost mesh	This mesh is a nonwoven fabric which acts as agricultural thermal blanket. It is UV stabilised. Because of its porosity, it allows the passage of air and water. It can be used in different types of crops: agriculture, horticulture, fruit growing, and nurseries.		[85]

Table 28.3: Geotech

Thermally bonded nonwoven for erosion control	This nonwoven is composed of continuous polypropylene filaments. The fibre extrusion process produces thousands of superfine continuous filaments, which pass through a "pre-stretch" stage. This nonwoven can be used in railway, erosion control, roads, and drainage.		[86]
Needle-punched nonwoven paving fabric	This is a needle-punched nonwoven polypropylene paving fabric that is recyclable, and compatible with placement directly on milled and smooth pavement surfaces. This fabric has 360° of strength homogeneity.		[87]
Recycled fibre-based nonwoven for drainage	It is a nonwoven geotextile used to construct retaining structures, linear constructions, waste deposits, drainage systems, etc.		[88]
Laminated nonwoven for hydro insulation	This inter-grain, geonet is made from high-density polyethylene (HDPE) laminated by polypropylene (PP) geotextile on one side and by hydro insulation foil on the other one. Its pattern creates channels with high flow capacity under pressure and also at very low gradients.		[89]
Woven fibre mesh for construction	These meshes are made from woven glass fibre strands which are embedded into wet basecoat plaster. These fibre glass meshes are used for reinforcing plaster and mortar.		[90]
Coastal protection	These geotextile tubes are monolithic-tubular containers fabricated by multiple pieces of engineered synthetic woven fabrics. These structures provide coastal protection to seawalls, dunes, breakwaters, groins, and revetments, etc.		[91]

Green nonwoven for filtration and separation	It is a 100% biodegradable, mechanically bonded separation, and filtration nonwoven, that fulfils the functions of separation, filtration, and protection.		[92]
Jute geotextiles for highways and embankments	Jute geotextiles have been found useful for control of surface soil erosion, construction of embankment on weak soil as well as strengthening road pavement and surface for separation drainage and temporary reinforcement		[93]

Table 28.4: Indutech			
Laminated nonwoven filter-tube assemblies	These filter socks are available in both PP and ePTFE felt backed laminates and are used to filter tube assemblies.		[68]
Hot gas filtration	Nonwoven felts of meta-aramid or para-aramid, ceramic or glass fibres which can withstand high temperature and thus suitable for hot gal filtration.		[69]
Conveyer belts	These belts are manufactured using a fabric having high tenacity, straight warp threads and dense weft yarn construction. The cover compounds used in conveyor belts ensure higher longitudinal flexibility while guaranteeing very low elongation while working with high loads.		[70]

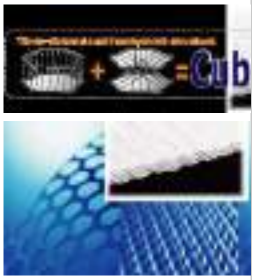
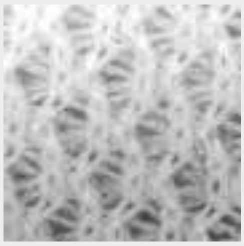
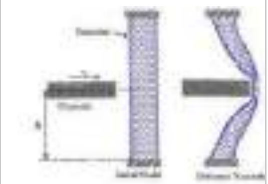
Hose pipes	Flexible hose pipe with knitted or braided casing and latex polymer at the core.		[71]
Abrasive fabrics	Nonwoven and woven cloth combined and coated with aluminium oxide to give finishing to surfaces.		[72]
High-performance ropes and cordages	Braided ropes of UHMWPE or other high-performance fibres used for mooring ships and boats.		[73]
Advanced composites for oil and gas	Umbilicals utilise thermoplastic unidirectional tapes for their lightweight and high tensile strength. umbilicals are ideal for protecting important electronics used to communicate with equipment below the surface. Also, these composites are inherently fire retardant without the addition of secondary toxic fillers		[74]
Honeycomb structure	It is manufactured by unique 3D honeycomb structure with a diagonally braced double-raschel weave through an advanced process.		[75]
Braided shackles	This soft shackle is made of Stealth Fibre® UHMwPE. Stealth Technology® simultaneously increases fibre crystallinity, provides abrasion-resistant protection, and evens out all stresses in ropes.	 Stealth Technology	[76]

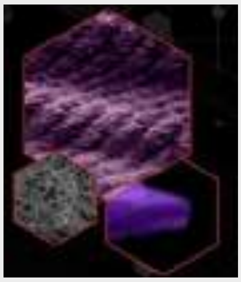
Table 28.5: Meditech			
Implantable medical Textiles	Different types of yarns polyester, polypropylene, PGA, PLA, PTFE, nylon, UHMWPE, Lycra/Spandex are used to manufacture medical textiles. These medical grade polyesters are produced using special extrusion.		[52]
Water repellent hospital linen	Highly-absorbent and disposable sheet technology by encapsulating liquid and moisture, while also preventing penetration and at the same time providing optimum care and comfort for the patient.		[53]
Reusable Personnel protective equipment	100% polyester woven PU coated breathable and reusable fabric for protection of the health care professional. The polyester used in this fabric is made from 100% recycled polyester fibre.		[54]
Knitted compression stockings and bandages	Weft circular knitting and warp mesh knitting for custom-made products.		[55]
Composite knitted Mesh for Hernia	3D mesh prepared from collagen coated polyester yarn by warp knitting.		[56]
Biodegradable sutures	Undyed short-term absorbable synthetic monofilament suture made of glyconate for stitching of soft tissue. Monofilament sutures appear to have the lowest infecting rate and cause less tissue drag and less tearing because of their smoothness.		[57]
Surgical mask	These are nonwoven masks with straps ideal for surgical and general-purpose use.		[58]

Table 28.6: Mobiltech

Seat belt	100% polyester woven webbing, is UV resistant with shrink, rot, moth, and mildew resistance.		[60]
Airbag fabric	Tightly woven fabric with high strength and low gas permeability, it helps enhance driver and passenger safety.	 	[61]
Car headliner fabric	These knitted fabrics have versatility of drawings and different type of yarns. This knitted fabric offers advantage as headliners because it's easier to mould due to its elasticity and high ripping resistance.		[62]
Natural fibre composite for door trim	The main materials used include kenaf, which grows year-round and has excellent CO_2 absorbing properties, and plant-derived plastic, making them environmentally friendly.		[63]
Smart textile for car seat	Thermal Comfort is designed to deliver a personal climate environment via specific zonal controls to the occupant.		[64]
Multifunctional fabric for seat covers	A layered system that can be customised for seat covers to include any or all of the following protective attributes: anti-odour to absorb odours and inhibit growth of mildew and bacteria; anti-static to eliminate static electricity; anti-dusting to resist dust.		[65]

Specially finished woven car mat	Using Wilton fabric, a traditional British textile, this painstakingly woven product is highly durable, making it suitable for sports driving. This car mat also has deodorant, antibacterial and soil-resistant functions.		[66]
Woven carbon fabrics for automotive roof	It is a range of carbon fabrics which have been processed for a smooth, closed weave and uniform cosmetic appearance. The fibre tows are spread in both the warp and weft direction for unique aesthetic appeal. It is used in BMW roof.		[67]

Table 28.7: Protech			
Soft body armour	Multi-layered assembly of woven or unidirectional fabrics made from aramid or UHMWPE fibres that can give protection against 9 mm bullet, fulfilling the requirement of Indian standard IS 17051: 2018.		[44]
Bulletproof suit	This custom suit is made from carbon nanotubes. The material is thinner, lighter, and more flexible than Kevlar.	 	[45]
Protection against sharp objects	P-aramid microfilament fabric with a functional silicon carbide coating that is bonded by a special matrix system. Provides protection against ballistic impact, sharp and pointed weapons.		[46]
Flame retardant textiles	Polyacrylate based yarn resistant to flames, high temperatures, and chemical agents.		[47]

Extreme cold protective textiles	Multilayer assembly of fibrous materials containing breathable fabric layer and hollow fibres. Used for cold protection.		[48]
Nuclear, biological, chemical (NBC) protective suits	Textile material coated with double PVC coating quipped with HEPA filters. Welded safety boots and voice communication system.		[49]
Electromagnetic shielding and reflecting textiles	Silver or copper plated-Nylon fabrics (woven and non-woven) can be used in sensors, EMI shielding, and reflection.		[50]
High visibility clothing	Reflective coating on polyester yarn combined with glass beads for high visibility clothing.		[51]

*All references in this section are detailed out in Annexure 35 – Citations for Section 28 (*Emerging Technologies and technology trends in technical *textiles)*

29. Recommendations to overcome impediments to growth of Indian Technical Textile industry

29.1 The case for making recommendations

There has been a rapid increase in the use of technical textiles throughout the world. The level of resources and number of available opportunities that characterise Indian technical textile industry seem to suggest that there is a huge potential that is waiting to be unlocked. Technical Textiles not only offer better and cheaper substitutes for other materials but also provide appropriate choices for completely new applications. This has resulted in emergence of new ideas, development of large number of innovations and introduction of new products and processes. Experts believe that this trend will accelerate further in the coming years. The current scenario makes it imperative that impediments to growth of Indian technical textile industry be identified and recommendations to counter those impediments be made. Such an approach is likely to contribute significantly towards enhancing the growth of Indian textile industry by improving its international competitiveness. The impediments and recommendations have been described in the following sections:

29.2 Impediments to growth of technical textiles industry in India

The Indian technical textile industry faces several impediments to growth. The major impediments identified as part of the present study are as follows:

1. **Inadequate production of High Performance Fibres in India** despite a growing demand is not only a cause for drain of precious foreign exchange reserves of the country, but is also representative of loss of an attractive business opportunity for the domestic industry. The research related to smart and electronic textiles that is being conducted in India is still at a nascent stage and some of it is being carried out by non-textile departments of technology institutes.
2. **Absence of a formal mechanism for regular collection of reliable and comprehensive nation-wide data** of production capacity and enterprise level medium and long-term production plans for different technical textile products makes it difficult to assess degree of alignment of production

output with product level production capabilities and market demand. Therefore, it becomes difficult to identify and properly target the incentives towards those items for which high production and market potential exists in the country.

3. **Lack of entrepreneurship culture and absence of skill-training for entrepreneurship development** in the area of technical textiles makes it difficult to attract investment and augment existing production capacities in the country.
4. **Deficient supplier-manufacturer and customer connect and lack of fora for enabling their close collaboration** often leads to information asymmetry and sub-optimal decisions which cause wastage and inefficiencies in the value chain.
5. **Inadequate number (207) of designated HSN codes for technical textiles** makes it challenging to determine accurate 'actual' product-wise and enterprise-wise trade data. This may be causing sub-optimal planning and inaccurate targeting of export benefit/incentives in India.
6. **Lack of globally-aligned quality standards for technical textiles in India** makes it challenging for Indian manufacturers to produce technical textile products that are widely accepted around the world. This has the effect of reducing global competitiveness of Indian technical textile industry. The inadequacy of standards also makes it difficult for manufacturers to engage in continuous innovation.
7. **High level of import and export dependence on a limited number of countries** has been observed in case of certain critical technical textile items. This affects the reliability and affordability of supplies of crucial technical textile inputs at times. Indian industry's dependence on only a few partner countries as export destinations reduces its ability to negotiate good terms of trade.
8. **Inadequate domestic production capacity of certain products whose consumption in India is high** (E.g. high performance sportswear and swimwear, Smart textiles etc.) has resulted in dependence on imports to meet the demand. This represents a significant loss of a business opportunity for Indian technical textile manufacturers who may have the capability to produce the required products.
9. **Inadequate production capacity for technical textile machinery and components** is a dampener for the operations and growth aspirations of many entrepreneurs in India's technical textile industry. Due to their being imported, the machines and equipment are not designed exactly for Indian requirements and conditions, often the cost of the imported machines is high and access to supply of spares and comprehensive service support is difficult. Therefore, the reliance on imported machines and machine components makes it relatively uncertain and expensive for the Indian manufacturers to execute not only their existing operations but also their expansion and diversification plans.
10. **Small share of international trade for Indian exports** may be acting as a discouragement for Indian entrepreneurs and making them perceive the industry to be less attractive and having uncertain prospects.
11. **Inadequate R&D facilities for technical textiles in the country** is a hurdle for the industry because it stifles innovation in a field that is characterised by fast changes in products and processes.
12. **Relative inability of textile industry to attract and retain talent** is proving to be a major impediment to the growth of the industry because availability of good quality human resources is at the

core of industry's performance. The relative lack of high quality individuals working in the industry makes the investors and entrepreneurs perceive higher risk, more uncertainty and less competitiveness for the industry.

13. **Low level of adoption of latest technologies** such as 3D nonwovens, multiaxial braiding, 3D weaving, warp knitted spacer etc. has contributed towards reducing competitiveness of domestic industry.
14. **Inadequate testing facilities in the country for technical textiles** act as a bottleneck for the growth pathway of the technical textile industry as it leads to delays and inaccurate assessments at the industry level. Due to the lack of some of the specialised testing facilities (even at the CoEs), the technical textile units are compelled to send samples to testing laboratories located abroad, which often involves very high cost and leads to delays in product development and marketing.
15. **Prevalence of current inverted duty structure** puts manufacturers of technical textile products in India at a significant disadvantage and it makes domestic manufacturing of certain technical textile products uneconomical when compared with importing them.
16. **Lack of international exposure for stakeholders** through participation in trade shows, exhibitions, workshops, conferences, impedes their learning from networks and updating their knowledge about latest developments resulting in missing out on business opportunities.
17. **Slow pace of development of standards and their adoption** may be holding back the pace of industry's growth and its global competitiveness.
18. **Delay in strengthening of the educational institutes (textile engineering/technology institutes)** is likely to be one of the contributing factors towards lack of high-quality trained human resources in India's technical textile industry. Absence of a dedicated/exclusive centre of technical textiles has deprived the industry of a knowledge hub that can serve as a focal point for exchange and dissemination of latest knowledge about technical textiles. Faculty development programmes specifically aimed at equipping textile engineering faculty with latest knowledge and research in technical textiles is also a major lacuna that is negatively impacting the technical textile industry. The courses and programmes in the institutes have not been updated in a manner that they include technical textile training and education as a significant part of modern textile engineering and technology education. Most of the educational institutes offer only one course subject related to 'technical textiles' which proves to be inadequate in promoting appropriate exposure to existing and emerging developments. This deprives the industry of new knowledge and acts as an impediment.
19. **Delay in strengthening the Textile Research Associations (TRAs) and Centres of Excellence (COEs)** has resulted in TRAs and CoEs being unable to attract and retain high quality talent on a consistent basis, especially at the middle and junior levels for scientific research and development. A large number of research scientists are appointed on contractual basis, and their salary scale is not at par with DST or CSIR institutes/organisations. TRAs are also beset with research infrastructure that has not kept pace with rapid rate of changes in technical textiles. This has led to the industry missing out on sustained growth. Further, most of the COEs are located in the western region of India constraining the access to their facilities by the user groups.

29.3 General recommendations to promote growth of technical textiles industry in India

The recommendations for addressing the impediments to growth have been classified into two broad categories, general recommendations and specific recommendations. The general recommendations have been further divided into three groups, short-term (for implementation within a two year period), medium-term (for implementation within a three year period) and long-term (for implementation within a five year period).

29.3.1 Short-Term Recommendations

1. **Expert-group to be set up to recognise and incentivise products that have good potential for production enhancement across all technical textile segments:** The field of technical textiles is in its early evolution phase. The pace of change is fast and rate of product obsolescence is high. It is recommended that the Ministry of Textiles (MoT), Government of India should constitute a special expert-group to study and document the current production capabilities (from a product and application perspective) of Indian technical textiles manufacturers and clearly identify those Indian user industries whose market growth is moderately constrained due to their partial dependence on imports of technical textiles. The focus should be on such user industries which will be able to expand their domestic and export markets if the Indian technical textile producers could supply them inputs of acceptable quality at competitive prices. Once the expert-group recognizes such user industry and their technical textiles inputs, a package of incentives and other measures must be rolled out by Government of India to motivate India's technical textile producers of identified products to ramp up their production capacities significantly and quickly. Ministry of Textiles (MoT) must facilitate a intra industry platform where the leaders of user industries can freely interact with leaders of technical textile input producing enterprises to iron out difficulties and improve efficiency of the entire Value Chain due to free flow of information about requirements and capabilities.
2. **Set up a committee to identify those technical textile products for which the domestic market is steadily increasing and to recommend measures to help boost their production in India:** It is important for MoT to identify and prepare a list of those products that rely on technical textiles as an input and whose demand is likely to experience an expansion at relatively faster rates in the years to come. It is recommended that a committee must be set up to examine all the application segments of technical textiles and identify high-growth products and then suggest measures that can serve as financial and non-financial incentives to boost production of the technical textile inputs for such products.
3. **Encourage and financially support the designing and conducting of industry-oriented short-term courses and programmes to encourage and support entrepreneurship in technical textile industry:** Growth of entrepreneurship in the emerging field of technical textiles is an absolute

must for not only enhancing domestic production capacities but also generating employment and augmenting growth in the economy. Therefore, the focus of training and educational institutions in this sector must be on offering short term courses and special programmes that equip the participants and students with necessary confidence, knowledge, skills and practice to think practical business and become entrepreneurs or intrapreneurs in the field of technical textiles. MoT must take a lead and provide a platform for collaboration among the industry associations such as ITTA, CII, FICCI, ASSOCHAM etc., the leading technical institutions and Business Schools of India and skill training institutions to formulate training and education programmes that are necessary to foster entrepreneurial culture and enable the participants to leverage the learning acquired in such courses to set up and expand technical textile ventures. MoT can consider earmarking separate funds to financially support institutions who are able to propose, offer and conduct such entrepreneurship-oriented programmes.

4. **Leverage the existing Focus Incubation Centres (FICs) to foster incubation:** The eleven FICs established by the Ministry can be leveraged to enhance business incubation and support start-ups. The success stories from some of the FICs can help to develop different models of incubation among the FICs.

5. **Foster better supplier-manufacturer-customer connect to improve effectiveness of value chain:** The free flow of adequate and appropriate information can significantly improve the efficiency of technical textile industry is India. Since the industry is in its early evolution phase, it is characterised by the industry participants often exhibiting lack of transparency and being reluctant to share information due to the fear of losing competitive advantage. It is suggested that MoT must have a two-fold approach to facilitate faster and accurate information flow among stakeholders of the technical textile value chain in India. Firstly, a pilot project must be launched to have a web-based information sharing portal/section hosted on the MoT website for 3-6 months. Latest content about important developments and techno-commercial information related to technical textiles must be hosted on an interactive module available on MoT website. Based on the learning derived and feedback that is received from users, the pilot module must be expanded to become a full-fledged information portal about technical textiles. A mechanism must be established to update the information that is hosted on the portal so that it is available to users. Later on, a subscription based model can be considered so that the costs of the portal can be offset and it can be ensured that the portal acts as a forum for genuine and serious users of the information. Secondly, The MoT must support formal buyer-supplier meets, workshops etc. through online as well as physical mode. It is recommended that these should be regular events with pre-declared six monthly/annual schedule so that the formal meet activity acquires a certain degree of importance and participants prepare seriously for better outcomes.

6. **Continuously expand the HSN Code list of technical textiles to keep pace with the development and emergence of ever newer products in the industry:** The Harmonized System (HS) is an internationally accepted standard for the classification of different products. HS facilitates international trade by enabling the participant countries to classify the trade goods on a common basis in a systematic manner. In 2019, the Directorate General of Foreign Trade (DGFT), Government of India incorporated a list of 207 items as technical textiles items from chapter 1 to 99 of HSN classification book. This special classification of 207 codes is a pioneering step to boost the growth of technical textile industry in India by helping to better monitor the import and export data and to better

target the fiscal support to the deserving units in technical textile industry. IIT Delhi has followed a well-defined process and recommends that this list of 207 HSN codes for technical textiles be expanded to 449 codes and Government of India must actively consider notifying these 449 HSN codes in accordance with the analysis and segment-wise classification carried out by IIT Delhi team.

It is also recommended that MoT must work closely with the Ministry of Commerce to ensure that the exercise of rationalisation and notification of technical textile codes should be an ongoing one and even this list of 449 codes recommended must keep getting augmented and updated as new developments in material science, application engineering and international trade take place. As an example, it may be noted that none of the items in the 449 codes suggested pertains to Oekotech segment due to lack of accurate information. This, among others needs to be updated as more information about new developments becomes available.

29.3.2 Medium-Term Recommendations

7. **Encourage establishment of globally-aligned quality standards and their rapid adoption among all members of the value chain:** The improvement in credibility and consumer acceptance of technical textile products is linked to establishment and notification of globally aligned quality standards. The MoT, the technical institutions, the research laboratories and the industry associations must work in close collaboration with BIS on a continuous basis to help establishment of globally aligned standards for technical textile input material as well as final products. The efforts towards this when carried out for sufficient period will contribute towards reduction of uncertainty and improving industry-wide efficiency and effectiveness. This will also result in improvement of international competitiveness of India's technical textile industry. MoT must initiate the creation of an empowered group of experts from among different stakeholder groups and provide Government's support for this effort. Further, safety and other related regulations need to be enforced across industries to propel demand for technical textiles products. Efforts should be made to create awareness about quality standards to the last member in the value chain for wider adoption of the standards.
8. **Support identification and conducting of trade with more partner countries so as to reduce India's export-import dependence and de-risk operations of technical textiles industry:** The technical textile products for which India's industry relies heavily on a very small number of export and import partner-countries must be identified. Such a situation is fraught with high degree of risk for Indian economy. The de-risking exercise involves finding and entering markets of hitherto unexplored countries/ emerging markets of technical textiles to serve as export destinations and identifying and negotiating with new partner countries to act as sources of imports. This task must be taken up by MoT in collaboration with different trade bodies as well as Ministry of Commerce and Ministry Of External Affairs. A focused target-oreinted approach with defined milestones must be launched to de-risk India's economy by reducing dependence on small number of countries.

9. **Actively encourage domestic production of products with high-consumption potential:** Additional production capacity needs to be established for those products, which have a high potential for consumption such as high-performance swimwear and sportswear to leverage 'Khelo India' initiative, the latest and the most prestigious programme of Government of India to foster a sports culture at grassroots level. The increase in interest among Indians to play sports and games has led to increase in the demand for 'high-performance' sportswear and swimwear (which has a significant content of contemporary technical textile material) for which India has to rely significantly on imported supplies. Since, the emphasis placed by Government of India on sports and games is likely to continue, the resultant increase in demand for high-performance sportswear and swimwear in the future is a certainty. It is strategically advisable for MoT to provide special support to the potential indigenous manufacturers so that affordable and adequate domestic production can be ensured and import dependence can be reduced. Such an initiative will act as a multiplier to Government's Khelo India initiative and is likely to contribute towards enhanced performance of Indian sportspersons. It is suggested that a special effort on the lines of the efforts made for stepping up domestic production of PPE Kits and masks in year 2020 be launched by MoT in collaboration with Ministry of Sports and Youth Affairs, Ministry of Industry and Ministry of MSME.
10. **Actively encourage and financially support indigenous development of technical textile machinery components:** The high dependence of Indian technical textile industry on imported equipment and machinery should be reduced. MoT must consider launching a special scheme to support industry-academia project proposals for research and development leading to indigenous manufacture of components initially and sub-assemblies/assemblies later on.

29.3.3 Long-Term Recommendations

11. **Continuously identify and focus on technical textile products and segments to align the support with priorities of *Atmanirbhar Bharat* (Self-reliant India) and expansion of India's exports. The following recommendations are proposed by IIT Delhi:** Chapter 9 of the present report includes an analysis of domestic and international consumer demand of technical textile products, an initial attempt has been made based on that analysis for identifying products and segments that can be focused on. The segment and product-based recommendations are listed as follows:

    i. Agrotech: The production of Agrotech products (Rs. 2,244 Crores in 2019-20) in India exceeds their consumption (Rs. 1,890 Crores in 2019-20). This presents India with the possibility of exporting its surplus of production over consumption. High quality production and expansion of Fishing Nets, Mulch Mats and Crop Covers should be given special support so that India can increase its exports.

    ii. Buildtech: Consumption of Buildtech products exceeds their production. India is a net importer and the gap between production (Rs. 4,196 Crores in 2019-20) and consumption (Rs. 5,008 Crores in 2019-20) is expected to remain almost the same in value terms for the next five years. However, the suggested focus of the government support should be directed towards encouraging production of Architectural Membranes and Acoustic fabric for import substitution and on Canvas tarpaulin and HDPE Tarpaulin for enhancing India's exports. The growth of India's current exports of Hoardings and Signages material (Flex fabrics and banners) are likely to slow down due to the non-bio degradable nature of the waste generated. Efforts should be made to develop environmentally benign material for hoardings and signages.

iii. Clothtech: The consumption (value estimated at Rs. 8,205 Crores in 2019-20) of Clothtech products exceeds the production (estimated value Rs. 7,680 Crores). India is currently an importer and is going to remain one even though the gap between production and consumption is likely to remain almost the same in value terms. The focus of government's incentives can be beneficially directed if Elastic narrow tape, Hook and loop fastener, Interlining and Zip fastener tape are encouraged for import substitution in domestic market. Incentives should be given to industries producing Labels and Badges as also those producing Specialised and Industrial Sewing thread so that their exports from India can be increased.

iv. Geotech and Oekotech: India is a net importer of products /solutions in this segment. Based on the data about the present situation and future prospects, it is proposed that it might be better to offer relatively more support to Geomembranes, Geotextile tubes and Geomats for the export markets. The support to upscaling of production of Geotextiles, Geocomposites, Geonets, Geogrids and Geostrips should be extended so that India becomes self-reliant for its needs.

v. Hometech: The data suggests that it may be better to extend relatively more support to the production of Fibre Fill (Polyester Staple Fibre) and Carpet Backing Cloth to enhance India's exports. The production of Plush Fabric for stuffed toys, Ticking Fabric for mattresses and Filter Fabric must be enhanced to avoid dependence on imports.

vi. Indutech: The consumption of Indutech products in India exceeds the production (estimated value at Rs. 11,489 Crores in 2019-20). India is a net importer of Indutech and is likely to remain so till 2024-25 except that the trade deficit percentage is expected to reduce during this period. Greater emphasis needs to be placed on rapid import substitution by backing the enhancement of textile inputs that go into the making of Cigarette Filter Rods, AGM glass battery separators, Coated Abrasives, Industrial filtration products, Industrial webbings and slings and Glass Fabric (as part of Composites). The export opportunities for Belting fabric and Ropes and cordages need to be exploited by offering export incentives or concessions to their manufacturers.

vii. Meditech: Indian manufacturers have been able to establish their presence in export markets for Surgical and Non-Surgical masks, gloves, PPE kits and other surgical disposables. Disposable linens and Surgical dressings are the other two product categories which should be supported to produce globally acceptable products for export markets. The import reliance on textile inputs required for sanitary napkins, baby diapers, compression stockings and garments, surgical sutures and special dressings needs to be reduced by providing incentives and support to their manufacturers from the government.

viii. Mobiltech: The consumption of Mobiltech products in India exceeds their production (estimated value Rs. 7,669 Crores in 2019-20) and despite the percentage trade gap likely to become smaller, India will continue to remain a net importer of Mobiltech products for the next five years. However, the rapid expected growth in mobility market will attract significant capacity addition in

India's domestic Mobiltech industry. It is suggested that based on the current capabilities of Indian manufacturers, the export markets for Tyre Cord Fabric and Automotive carpets should be exploited. The dependence on imports for textile component of Airbags, Helmets and Seat belt webbing should be reduced by offering support to their indigenous manufacturers.

ix. Packtech: The exports of FIBC (Jumbo) Bags and Leno Bags need to be backed up by encouraging continuous investment in product improvement for global markets. Jute Hessian and Synthetic Sacks, Polyolefin Woven Sacks and Treated/ Coated Wrapping Fabric may need support for meeting domestic consumption needs.

x. Protech: Current value of production (Rs. 2,850 Crores in 2019-20) of Protech products in India is lower than their consumption (Rs. 3,148 Crores in 2019-20). At present, India has to import its requirement of Protech items and even though India will reduce its trade gap significantly, it will continue to remain a net importer of Protech items till 2024-25. Government of India has been according a high priority to encourage defence related production industries for strategic reasons. The aim is to ensure that India must not only reduce its dependence on imports but must also become an exporter of defence products. It is suggested that the units which expand production of Bullet Proof Jackets, High Visibility Clothing, Fire retardant apparel should be given a higher support.

xi. Sportech: The value of domestic production of Sportech items in 2019-20 is estimated at Rs. 7,226 Crores which is a little lower than the value of domestic consumption. However, the deficit is likely to increase in the coming years due to increase in popularity of sports and games among the youth. The increased focus should be accorded to enhancing the production capabilities of High performance swimwear and sportswear, Parachute Fabric and Sports Footwear Components. The need for imports of Technical textiles elements in Sports Composites should be reduced by removing the bottlenecks that impede enhancement of its production capacity in the country.

MoT must consider offering special incentives which encourage Indian manufacturers and exporters of the items identified as above.

12. **Channelise finances from public and private sources to support upgradation of R&D ecosystem so as to improve innovation opportunities within India:** The government has decided to allow corporate India to use their mandatory corporate social responsibility (CSR) spending for investments in publicly-funded incubators and contribute to research efforts in science, technology, medicine and engineering at major institutions and bodies. MoT must provide a dedicated forum for interaction between the business organisations which are mandated to spend CSR funds annually and R&D organisations like CoEs, TRAs, FIBCs and engineering and technology institutions. The aim and therefore design of the forum should be such that it is able to help channelise CSR funds to R&D institutions for viable and relevant project proposals of research & development in the field of technical textiles.

13. **Financially support and incentivise 'Continuous Learning' initiatives in private and government sectors to attract, nurture and retain the right talent in the technical textile industry from technical to managerial levels:** MoT must offer a scheme to financially support

(through scholarships, contribution to fees) in part or in full the training and education of working professionals at all levels of technical textile industry. MoT must support establishment of a credible screening mechanism and invite applications from such professionals which must be duly screened for its correctness and merits by using the mechanism established for the purpose. The recommended cases must be assessed by the MoT and financial assistance provided in accordance with the Ministry's assessment.

29.4 Specific recommendations to promote growth of technical textiles industry in India

29.4.1 Technological necessities

1. **Increase domestic manufacturing of High Performance Fibres:** Industry experts believe that the demand for High performance fibres such as aramids, UHMWPE, carbon, Nylon 66 etc. is going to increase at a fast rate in future. In order to make Indian industry ready for the coming surge in demand, MoT must formulate new schemes/packages so that domestic manufacturers can be incentivised to set-up or expand capacity for producing High Performance Fibres. Multinational Companies who are producers of High Performance Fibres should be identified and invited to invest in establishing production facilities in India through any of the alternative investment routes that may be preferred by the MNCs without compromising the economic interests of India.

2. **Encourage adoption and penetration of new technologies for a sustainable future:** Industry experts suggest that MoT must consider directing the prevailing Technology Upgradation Fund Scheme (TUFS) towards certain identified modern technologies such as those related to 3D nonwovens, multiaxial braiding, 3D weaving, warp knitted spacer etc. It is these identified technologies that should be encouraged for adoption and penetration.

3. **Encourage domestic production of Smart textiles and electronic textiles:** With the advancement of Artificial Intelligence and digital metrology, there has emerged an increasing demand for smart and electronic textile products and ever new product introductions in the market. As this area is going to be very vibrant in the near future, immediate interdisciplinary research initiatives are needed in this area. The trend is likely to accentuate further and in order to have India acquire a prominent space in this market, Ministry of Textiles, Ministry of Electronics and Information Technology and Ministry of Science and Technology must work collaboratively and support interdisciplinary application research and product development projects in the field of smart and electronic textiles.

29.4.2 Business necessities

Establish adequate testing facilities: The expected increase in the production and use of technical textile products is likely to increase the volume of tests being carried out. The country-wide testing capacity needs to be expanded to ensure that testing bottlenecks do not hamper the growth of the technical textile industry. It is suggested that MoT must take steps to support organisations to establish dedicated test centres for exclusive testing of technical textile material and products with proper infrastructure and a trained workforce.

Launch increased efforts to change the current inverted duty structure: The Ministry of Textiles must intensify its efforts with the Ministry of Finance to rationalise the duty structure and remove the duty inversion so that domestic manufacturing of technical textile products becomes more attractive than importing them.

Support and facilitate international exposure: The Ministry of Textiles must consider enhancing its existing level of support to finance participation in trade shows, exhibitions, workshops, conferences so that entrepreneurs and professionals can develop networks, keep themselves updated about latest developments and make use of the business opportunities.

29.4.3 Necessity of Standards

Expedite the process of development of standards and their adoption: All the institutions/organisations involved with formulation and development of standards are recommended to develop and expand globally-aligned standards rapidly with the help from all the stakeholders. MoT must facilitate the collaborative working of all the stakeholders to promote the adoption of the new standards.

29.4.4 Necessity of Research, Education and Skill development

1. **Strengthen the educational institutes:** It is recommended that the Government of India must identify 3-4 textile engineering/technology institutes from across the country and focus on providing support for strengthening the technical textile education system and infrastructure for these identified institutes. Each of these identified institutions can focus and specialise in 2-3 segments of technical textiles.
2. **Establish department/centre of technical textiles in one of the new IITs:** IIT Delhi is the only IIT in the country that has a Department of Textiles. This is wholly inadequate. It is recommended that MoT should consider supporting the establishment of a centre of technical textiles in one of the newer IITs. This centre should be developed to function as a hub of latest knowledge exclusively for technical textiles.
3. **Support and promote faculty development in the area of technical textiles:** The knowledge of existing members of the teaching faculty has not been adequately updated regarding technical textiles. Therefore, a focused initiative is required for faculty development in the emerging areas as well as technical textiles in general. It is suggested that the efforts for faculty development should be multiplied and MoT and Ministry of Education must work jointly to promote and support faculty development in the area of technical textiles.
4. **Support development and introduction of new courses pertaining to technical textiles:** The technology and engineering institutes/colleges must be encouraged and if necessary supported by Ministry of Education and MoT to develop and launch more specialized courses in important areas of technical textiles (medical textiles, protective textiles, geotextiles, industrial textiles, automotive and filtration textiles, textile reinforced composites etc.) for the undergraduate and postgraduate students. The structure of these courses should be a healthy blend of theories and applications.

29.4.5 Necessity of Textile Research Associations (TRAs) and Centres of Excellence (COEs)

1. **Attract and retain talent in the TRAs:** It is recommended that improvement in effectiveness of TRAs should be achieved by ensuring that TRAs attract and retain high quality talent. This can be done by adopting a model of human resource deployment and compensation that is comparable to government institutions performing similar activities**.**

2. **Augment the research infrastructure of the TRAs:** The field of technical textiles is undergoing changes at such a rapid pace that it makes it necessary for institutions such as TRAs to plan a continuous investment in augmentation of R&D facilities. Therefore, it is suggested that MoT facilitates an advisory group that must periodically review the global developments in the field of technical textiles and the research and testing infrastructure in TRAs should be augmented based on the periodic suggestions of the advisory group.

3. **Strengthen the COEs:** It is suggested that MoT must support and encourage collaboration among Indian CoEs and well-reputed overseas COEs as well as industries. This can improve the research outcomes and inter-disciplinary collaboration in several emerging areas of technical textiles. The COEs are concentrated in the western part of India. This geographical concentration needs to be remedied so that the industry has easy access to adequate testing facilities in relatively close proximity.

ANNEXURES

Annexure 1

List of 207 HSN Codes notified by the Ministry of Textiles and proposed classification by IIT Delhi

S. No	ITC-HS Code	Description	Segment suggested by IIT Delhi	Segment reclassification done by IIT Delhi
1	56075010	Nylon fish net twine	Agrotech	No
2	56081110	Made up fishing nets: of nylon	Agrotech	No
3	56081190	Made up fishing nets: other than nylon	Agrotech	No
4	63061200	Tarpaulins, awnings and sunblindsetc.: of synthetic fibres	Buildtech	Yes, Sportech as per Ministry of Textiles
5	63061920	Coir blinds/awnings	Buildtech	Yes, Sportech as per Ministry of Textiles
6	63062200	Tents: of synthetic fibres	Buildtech	Yes, Sportech as per Ministry of Textiles
7	63062910	Tents of jute	Buildtech	Yes, Sportech as per Ministry of Textiles
8	59050010	Textile wall coverings: fixed on the backing of any material	Buildtech	Yes, Hometech as per Ministry of Textiles
9	59050090	Textile wall coverings: other	Buildtech	Yes, Hometech as per Ministry of Textiles
10	63061910	Jute tarpaulins (incl. Dwtarpauline)	Buildtech	Yes, Sportech as per Ministry of Textiles
11	54071095	Woven fabrics of synthetic filament yarn, including woven fabrics obtained from materials of healding 5404: other: bleached: other nylon and polyamide fabrics of filament yarn	Clothtech	Yes, Indutech as per Ministry of Textiles
12	54074113	Woven fabrics of synthetic filament yarn, including woven fabrics obtained from materials of healding 5404 other: bleached: other nylon and polyamide fabrics of filament yarn	Clothtech	Yes, Indutech as per Ministry of Textiles
13	54074123	Woven fabrics of synthetic filament yarn, including woven fabrics obtained from materials of heading 5404: other woven fabrics, containing 85% or more by weight of filaments of nylon or other polyamides: bleached : nylon tafetta	Clothtech	Yes, Indutech as per Ministry of Textiles
14	54074230	Other woven fabrics, containing 85% or more by weight of filaments of nylon or other polyamides: dyed: nylon tafetta	Clothtech	Yes, Indutech as per Ministry of Textiles
15	54074430	Other woven fabrics, containing 85% or more by weight of filaments of nylon or other polyamides: printed: nylon tafetta	Clothtech	Yes, Indutech as per Ministry of Textiles
16	54082215	Woven fabrics containing more than 85% or more by weight of artificial filament or strip or the like: dyed woven fabrics of rayon: rayon taffeta	Clothtech	Yes, Indutech as per Ministry of Textiles
17	54082415	Woven fabrics containing more than 85% or more by weight of artificial filament or strip or the like: printed: woven fabrics of rayon taffeta	Clothtech	Yes, Indutech as per Ministry of Textiles
18	54083213	Dyed: rayon tafetta	Clothtech	Yes, Indutech as per Ministry of Textiles
19	54083415	Printed: rayon tafetta	Clothtech	Yes, Indutech as per Ministry of Textiles
20	55122990	Woven fabrics of synthetic staple fibres, containing 85% or more by weight	Clothtech	Yes, Indutech as per Ministry of Textiles
21	56012190	Wadding; other articles of cotton wadding: other	Clothtech	Yes, Meditech as per Ministry of Textiles
22	56012200	Wadding of textile materials and articles thereof; textile fibres, not exceeding 5 mm in length (flock), textile dust and mill neps: wadding of man-made fibres	Clothtech	Yes, Meditech as per Ministry of Textiles
23	56012900	Wadding; other articles of man-made fibres wadding: other	Clothtech	Yes, Meditech as per Ministry of Textiles
24	58062000	Other narrow woven fabrics containing by weight 5% or more of elastomeric yarn/ rubber thread	Clothtech	Yes, Indutech as per Ministry of Textiles
25	53110015	Woven fabrics of other vegetable textile fibres; woven fabrics	Geotech	No

		of paper yarn : of coir including log form and geotextiles		
26	39181010	Floor coverings of plastics, whether or not self-adhesive, in rolls or in the form of tiles; wall or ceiling covering of plastics, as defined in note 9 to this chapter: of polymers of vinyl chloride: wall or ceiling coverings combined with knitted or woven fabrics, nonwovens or felts	Hometech	No
27	39189020	Floor coverings of plastics, whether or not self-adhesive, in rolls or in the form of tiles; wall or ceiling covering of plastics, as defined in note 9 to this chapter: of other plastics : wall or ceiling coverings combined with knitted or woven fabrics, nonwovens or felts	Hometech	No
28	57019020	Carpets and other textile floor coverings, knotted, whether or not made up: of coir including geo textile	Hometech	No
29	57032090	Carpets and other textile floor coverings, tufted, whether or not made up: of nylon or other polyamides: other	Hometech	No
30	57050090	Other carpets and other textile floor coverings, whether or not made up: other carpets and other textile floor coverings, whether or not made up: other	Hometech	No
31	58019090	Of other textile materials: pile fabrics and chenille fabrics not elsewhere specified or included	Hometech	Yes, Clothtech as per Ministry of Textiles
32	59041000	Linoleums	Hometech	No
33	59049010	Floor covering with jute base	Hometech	No
34	59049090	Other floor covering	Hometech	No
35	59070011	Fabrics covered partially or fully with textile flocks, or with preparation containing textile flocks: on the base fabrics of cotton	Hometech	No
36	59070012	Fabrics covered partially or fully with textile flocks, or with preparation containing textile flocks: on the base fabrics of man-made textile material	Hometech	No
37	59070019	Fabrics covered partially or fully with textile flocks, or with preparation containing textile flocks: on base fabrics of other textile materials	Hometech	No
38	94043010	Mattress supports; articles of bedding and similar furnishing (for example, mattresses, quilts, eiderdowns, cushions, pouffes and pillows) filled with feathers or down	Hometech	No
39	94043090	Other mattress supports; articles of bedding and similar furnishing (for example, mattresses, quilts, eiderdowns, cushions, pouffes and pillows)	Hometech	No
40	53101011	Unbleached: containing 100% by weight of jute: carpet backing fabrics	Hometech	No
41	53101014	Unbleached: containing 100% by weight of jute: jute canvas	Hometech	No
42	59011020	Prepared painting canvas	Hometech	No
43	59031010	Textile fabrics with poly (vinyl chloride): imitation leather fabrics of cotton	Hometech	Yes, Indutech as per Ministry of Textiles
44	59032010	Imitation leather cloth of cotton laminated plated, coated, etc. with polyurethane	Hometech	Yes, Indutech as per Ministry of Textiles
45	59032090	Other fabrics impregnated laminated plated and coated with polyurethane	Hometech	Yes, Indutech as per Ministry of Textiles
46	59039010	Textile fabrics, impregnated, coated, covered or laminated with plastics, other than those of heading 5902: of cotton	Hometech	Yes, Indutech as per Ministry of Textiles
47	59039020	Textile fabrics, impregnated, coated, covered or laminated with plastics, other than those of heading 5902: polyethylene laminated jute fabrics	Hometech	Yes, Indutech as per Ministry of Textiles
48	40093100	Tubes, pipes and hoses, of vulcanised rubber other than hard rubber, with or without their fittings (for example, joints, elbows, flanges): reinforced or otherwise combined only with textile materials: without fittings: tubes, pipes and hoses of vulcanised rubber reinforced/otherwise combined only with textile materials without fittings	Indutech	Yes, Meditech as per Ministry of Textiles
49	40101210	Conveyor or transmission belts or belting of vulcanised rubber: reinforced only with textile materials: where the rubber compound content is less than 25% by weight	Indutech	No
50	52112020	Canvas (including duck) of carded/combed yarn, mixed mainly or solely with man-made fibres, weighing more than 200 g/m2	Indutech	No
51	52113120	Dyed: plain weave: canvas (including duck) of carded/ combed yarn, mixed mainly or solely with man-made fibres, weighing more than 200 g/sqm	Indutech	No

52	54021910	Synthetic filament yarn (other than sewing thread), not put up for retail sale: nylon tyre yarn	Indutech	No
53	54021990	High tenacity yarn of nylon or other polymer (others) (less than 840 denier)	Indutech	No
54	54022090	High tenacity yarn of nylon or other polyester (others and textured yarns) 206	Indutech	No
55	54026100	Multi folded or cabled of nylon or other polyamides	Indutech	No
56	54031010	High tenacity yarn of viscose rayon: viscose rayon tyre yarn - 1,233 decitex	Indutech	No
57	54031020	High tenacity yarn of viscose rayon: viscose rayon tyre yarn - 1,833 decitex	Indutech	No
58	54049090	Synthetic monofilament of 67 decitex or more and of which no cross-sectional dimension exceeds 1mm; strip and the like (for example, artificial straw) of synthetic textile materials of an apparent width not exceeding 5 mm: other : other+c204	Indutech	No
59	56021000	Felt, whether impregnated, coated, covered or laminated: needle loom felt & stitch-bonded fibre fabrics	Indutech	No
60	56022100	Felt, whether impregnated, coated, covered or laminated: needle loom felt & stitch-bonded fibre fabrics	Indutech	No
61	56022910	Other felt not impregnated, coated, covered or laminated of other textile materials for machines other than cotton machinery	Indutech	No
62	56022920	Other felt not impregnated, coated, covered or laminated: of jute (including blended/union jute) not for machinery	Indutech	No
63	56022990	Felt, whether impregnated, coated, covered or laminated of other	Indutech	No
64	56029090	Felt, whether impregnated, coated, covered or laminated: other	Indutech	Yes, Hometech as per Ministry of Textiles
65	56031100	Nonwovens of man-made filaments: weighing not more than 25 g/sqm	Indutech	No
66	56031400	Nonwovens of man-made filaments: weighing more than 150 g/sqm	Indutech	No
67	56039100	Nonwovens other: weighing not more than 25 g/sqm	Indutech	No
68	56039200	Nonwovens other: weighing between 25 g/sqm and 70 g/sqm	Indutech	No
69	56039300	Nonwovens other: weighing between 70 g/sqm and 150 g/sqm	Indutech	No
70	56039400	Nonwovens other: weighing more than 150 g/sqm	Indutech	No
71	56041000	Rubber thread and cord, textile covered	Indutech	No
72	56049000	Other textile yarn and strip, impregnated coated or covered or sheathed with rubber or plastics	Indutech	No
73	56074900	Other cordage etc.: of polyethylene/ polypropylene	Indutech	No
74	56075020	Nylon tyre cord	Indutech	No
75	56075030	Viscose tyre cord	Indutech	No
76	56075040	Nylon rope	Indutech	No
77	56075090	Twine, cordage, ropes and cables of other synthetic fibres: other	Indutech	No
78	56079010	Coir, cordage and ropes: other than cotton	Indutech	No
79	56079020	Cordage, cable ropes and twine: of cotton	Indutech	No
80	56079090	Twine, cordage, rope & cables: other	Indutech	No
81	56081900	Other knotted netting of twine, cordage or rope: of man-made textile materials	Indutech	No
82	56089010	Other twine, cordage/ rope etc.: of cotton	Indutech	No
83	56089020	Other twine, cordage/rope etc.: of jute	Indutech	No
84	56089090	Other knotted twine, cordage/ rope nets: other	Indutech	No
85	56090090	Articles of yarn, strip or the like of heading 5404 or 5405, twine, cordage, rope or cables, not elsewhere specified or included: articles of yarn, strip or the like of heading 5404 or 5405, twine, cordage, rope or cables, not elsewhere specified or included: other	Indutech	No
86	58063110	Type writer ribbon cloth: of cotton: woven	Indutech	No
87	58063200	Narrow woven fabrics of man-made fibres	Indutech	No
88	58063910	Woven narrow goat hair puttis tape	Indutech	No
89	58063920	Woven narrow jute webbing	Indutech	No
90	59031090	Other fabrics impregnated, laminated plated and coated with PVC	Indutech	No
91	59039090	Other fabric plated laminated coated impregnated with other	Indutech	No

		plastics		
92	59069110	Rubberised textile fabrics other: knitted or crocheted: of cotton	Indutech	No
93	59069190	Rubberised textile fabrics other: knitted or crocheted: of other textile materials	Indutech	No
94	59069910	Rubberised textile fabrics, other than those of heading 5902, of other: insulating tape, electrical of cotton	Indutech	No
95	59069920	Rubberised textile fabrics other: rubberised cotton fabrics, other than knitted or crocheted	Indutech	No
96	59069990	Rubberised textile fabrics, other than those of heading 5902: of other	Indutech	No
97	59070091	Cotton fabrics coated or impregnated with oil or preparations with basis of drying oil	Indutech	No
98	59070092	Other fabrics coated or impregnated with oil or preparations	Indutech	No
99	59070093	Jute fabrics otherwise impregnated or coated, with oil or preparations	Indutech	No
100	59070099	Other textile fabrics otherwise impregnated, coated or covered; painted canvas being theatrical scenery, studio back-cloths or the like	Indutech	No
101	59080010	Wicks & gas mantle fabrics etc. of cotton	Indutech	No
102	59080020	Gas mantles of rayon	Indutech	No
103	59080090	Textile wicks, woven, plaited or knitted, for lamps, stoves, lighters, candles or the like; incandescent gas mantles and tubular knitted gas mantle fabric therefor, whether or not impregnated: others	Indutech	No
104	59090010	Textile hose piping and similar textile tubing, with or without lining, armour or accessories of other materials of cotton	Indutech	No
105	59090020	Textile hose piping and similar textile tubing, with or without lining, armour or accessories: of manmade fibre	Indutech	No
106	59090090	Textile hose piping and similar textile tubing, with or without lining, armour or accessories: of other textile materials	Indutech	No
107	59100010	Cotton canvas ply belting whether impregnated, coated, covered or laminated with plastics, or reinforced with metal or other material	Indutech	No
108	59100020	Rubberised cotton belting whether impregnated, coated, covered or laminated with plastics, or reinforced with metal or other material	Indutech	No
109	59100030	Other transmission, conveyor or elevator belts or belting of cotton whether impregnated, coated, covered or laminated with plastics, or reinforced with metal or other material	Indutech	No
110	59100040	Hair belting whether impregnated, coated, covered or laminated with plastics, or reinforced with metal or other material	Indutech	No
111	59100050	Flax canvas ply belting whether impregnated, coated, covered or laminated with plastics, or reinforced with metal or other material	Indutech	No
112	59100060	Fibre belt conveyor whether impregnated, coated, covered or laminated with plastics, or reinforced with metal or other material	Indutech	No
113	59100090	Other transmission or conveyor belts or belting, of textile material, whether impregnated, coated, covered or laminated with plastics, or reinforced with metal or other material	Indutech	No
114	59111000	Textile fabrics, felt and felt-lined woven fabrics, coated, covered or laminated with rubber, leather or other material, of a kind used for card clothing, and similar fabrics of a kind used for other technical purposes, including narrow fabrics made of velvet impregnated with rubber, for covering weaving spindles (weaving beams)	Indutech	No
115	59112000	Bolting fabrics, whether made up textile fabrics and felts, endless or fitted with linking devices, of a kind used in paper making or similar machines (for example, for pulp or asbestos-cement)	Indutech	No
116	59113110	Textile products and articles, for technical uses, specified in note 7 to chapter 59, weighing less than 650 g/sqm: felt for cotton textile industries, woven	Indutech	No
117	59113120	Textile fabrics weighing less than 650 g/sqm: woven textiles felt, whether impregnated or coated, of a kind commonly used in other machines	Indutech	No

118	59113130	Textile fabrics weighing less than 650 g/sqm: cotton fabrics and articles used in machinery and plant	Indutech	No
119	59113140	Textile fabrics weighing less than 650 g/sqm: jute fabrics & articles used in machinery/plant	Indutech	No
120	59113150	Textile fabrics weighing less than 650 g/sqm, of metalized yarn of a kind commonly used in paper making or other machinery	Indutech	No
121	59113190	Textile fabrics weighing less than 650 g/sqm: other	Indutech	No
122	59113210	Textile fabrics weighing 650 g/sqm or more: felt for cotton textile industries, woven	Indutech	No
123	59113220	Textile fabrics for technical uses weighing 650 g/m2 or more: woven textiles felt, whether impregnated or coated, of a kind commonly used in other machines	Indutech	No
124	59113230	Textile fabrics weighing 650 g/sqm or more: cotton fabrics & articles used in machinery/plant	Indutech	No
125	59113240	Textile fabrics for technical uses weighing 650 g/m2 or more: jute fabrics & articles used in machinery/plant	Indutech	No
126	59113250	Textile fabrics for technical uses weighing 650 g/m2 or more: of metalized yarn of a kind commonly used in paper making or other machinery	Indutech	No
127	59113290	Textile fabrics weighing 650 g/sqm or more: others	Indutech	No
128	59114000	Textile fabrics weighing 650 g/m2 or more: straining cloth of a kind used in oil presses or the like, including that of human hair	Indutech	No
129	59119010	Textile products for technical uses: paper maker's felt (woven)	Indutech	No
130	59119020	Textile products for technical uses: gaskets washers polishing discs & other machinery parts of textile articles	Indutech	No
131	59119090	Textile products for technical uses: others	Indutech	No
132	60024000	Knitted or crocheted fabrics of a width not exceeding 30 cm, containing by weight 5% or more of elastomeric yarn or rubber thread, other than those of heading 6001: containing by weight 5% or more of elastomeric yarn but not containing rubber thread	Indutech	No
133	60029000	Knitted or crocheted fabrics of a width not exceeding 30 cm, containing by weight 5% or more of elastomeric yarn or rubber thread, other than those of heading 6001: other	Indutech	No
134	60059000	Warp knit fabrics (including those made on gallon knitting machines), other than those of heading 6001 to 6004of artificial fibres: other	Indutech	No
135	68051010	Natural or artificial abrasive powder or grain, on a base of textile material, of paper, of paperboard or other materials, whether or not cut to shape or sewn or otherwise made up: on a base of woven textile fabric only: abrasive cloth	Indutech	No
136	68071010	Articles of asphalt or of similar material (for example, petroleum bitumen or coal tar pitch) : in rolls: tarfelt roofing	Indutech	No
137	70191100	Glass fibres (including glass wool): chopped strands of a length not more than 50 mm	Indutech	No
138	70191200	Glass fibres (including glass wool): rovings	Indutech	No
139	70191900	Glass fibres (including glass wool): other (silvers, yarn)	Indutech	No
140	70193100	Glass fibres (including glass wool): glass mats	Indutech	No
141	70193200	Glass fibres (including glass wool): glass thin sheets (voils)	Indutech	No
142	70193900	Glass fibres (including glass wool): other (webs mattresses boards etc)	Indutech	No
143	70194000	Glass fibres (including glass wool): woven fabrics of rovings	Indutech	No
144	70195100	Glass fibres (including glass wool) woven fabrics (excluding rovings) of a width not more than 30 cm	Indutech	No
145	70195200	Glass fibres (including glass wool) woven fabrics (excluding rovings) of a width more than 30 cm plain weave, weighing less than 250 g/sqm, of filaments measuring per single yarn not more than 136 tex	Indutech	No
146	70195900	Other woven fabrics of glass	Indutech	No
147	70199090	Other made-up articles of glass fibres (fibre glass)	Indutech	No
148	96121010	Computer printer ribbon	Indutech	No
149	61151000	Panty hose, tights, stockings, socks and other hosiery, including graduated compression hosiery (for example, stockings for varicose veins) and footwear without applied soles, knitted or crocheted: graduated compression hosiery (for example, stockings for varicose veins)	Meditech	Yes, Clothtech as per Ministry of Textiles

150	61152990	Panty hose, tights, stockings, socks and other hosiery, including graduated compression hosiery (for example, stockings for varicose veins) and footwear without applied soles, knitted or crocheted: of other textile materials: panty hose and tights of other fibres	Meditech	Yes, Clothtech as per Ministry of Textiles
151	30051010	Adhesive gauze bandage	Meditech	No
152	30051020	Adhesive tape (medicinal)	Meditech	No
153	30059010	Cotton wool, medicated	Meditech	No
154	30059030	Medicated lint	Meditech	No
155	30059040	Bandages without adhesive layer	Meditech	No
156	30059050	Burn therapy dressing soaked in protective gel	Meditech	No
157	56012110	Textile materials and articles thereof; textile fibres, not exceeding 5 mm in length (flock), textile dust and mill neps: wadding; other articles of cotton wadding: absorbent cotton wool	Meditech	No
158	59061000	Adhesive tape of a width not exceeding 20 cm	Meditech	No
159	96190010	Sanitary towels (pads) or sanitary napkins	Meditech	No
160	96190020	Sanitary towels (pads) and tampons, napkins and napkin liners for babies and similar articles, of any material: tampons	Meditech	No
161	96190030	Sanitary towels (pads) and tampons, napkins and napkin liners for babies and similar articles, of any material: napkins and napkin liners for babies	Meditech	No
162	96190040	Clinical diapers	Meditech	No
163	96190090	Sanitary towels (pads) and tampons, napkins and napkin liners for babies and similar articles, of any material: other	Meditech	No
164	59021010	Tyre cord fabric of high tenacity yarn of nylon or other polyamides: impregnated with rubber	Mobiltech	Yes, Indutech as per Ministry of Textiles
165	59021090	Tyre cord fabric of nylon or other polyamides: others	Mobiltech	Yes, Indutech as per Ministry of Textiles
166	59022010	Tyre cord fabric of polyester: impregnated with rubber	Mobiltech	Yes, Indutech as per Ministry of Textiles
167	59022090	Tyre cord fabric of polyesters: others	Mobiltech	Yes, Indutech as per Ministry of Textiles
168	59029010	Tyre cord fabric of others: impregnated with rubber	Mobiltech	Yes, Indutech as per Ministry of Textiles
169	59029090	Tyre cord fabric of high tenacity yarn of nylon or other polyamides, polyesters or viscose rayon: others	Mobiltech	Yes, Indutech as per Ministry of Textiles
170	87082100	Parts and accessories of the motor vehicles of headings 8701 to 8705: other parts and accessories of bodies (including cabs): safety seat belts	Mobiltech	Yes, Indutech as per Ministry of Textiles
171	87089500	Parts and accessories of the motor vehicles of headings 8701 to 8705: other parts and accessories: safety airbags with inflater system; parts thereof	Mobiltech	Yes, Indutech as per Ministry of Textiles
172	53101012	Unbleached: containing 100% by weight of jute: sacking fabrics	Packtech	Yes, Hometech as per Ministry of Textiles
173	53101013	Unbleached: containing 100% by weight of jute: hessian fabrics	Packtech	Yes, Hometech as per Ministry of Textiles
174	56031200	Nonwovens of man-made filaments: weighing more than g/sqm but not more than 70 g/sqm	Packtech	Yes, Indutech as per Ministry of Textiles
175	56031300	Nonwovens of man-made filaments: weighing more than 70 g/sqm but not more than 150 g/sqm	Packtech	Yes, Indutech as per Ministry of Textiles
176	56074100	Binder/baler twine: of polyethylene/ polypropylene	Packtech	Yes, Indutech as per Ministry of Textiles
177	63053200	Sacks and bags, flexible intermediate bulk containers: of man-made textile materials	Packtech	No
178	61161000	Gloves, mittens and mitts, knitted or crocheted impregnated, coated or covered with plastics or rubber	Protech	No
179	62102010	Outer garments for men's or boys' overcoats, car-coats, capes, cloaks, anoraks, windcheaters, wind jackets and similar articles other than those of heading 6202 not knitted or crocheted: of rubberized textile fabrics	Protech	No
180	62102020	Outer garments for men's or boys' overcoats, car-coats, capes, cloaks, anoraks, wind-cheaters, wind jackets and similar articles other than those of heading 6202, not knitted or crocheted: of fabrics impregnated, coated, covered or laminated with preparations of cellulose derivatives and other artificial plastic	Protech	No

		materials		
181	62102030	Outer garments, men's & boys' overcoats, car-coats, capes, cloaks, anoraks, wind-cheaters, wind jackets and similar articles other than those of heading 6202, not knitted or crocheted: of textile fabrics, otherwise impregnated or coated	Protech	No
182	62103010	Other outer garments for women or girls, overcoats, car-coats, capes, cloaks, anoraks, wind cheaters, not knitted or crocheted: of textiles impregnated, coated, covered or laminated with preparation of cellulose derivatives and other artificial plastic materials	Protech	No
183	62103020	Outer garments, men or boys' of rubberised textile fabrics not knitted or crocheted	Protech	No
184	62104010	Men's or boys' personal protective garments, not knitted or crocheted: bullet proof jackets, bomb disposal jackets etc.	Protech	No
185	62104090	Other men's or boys' personal protective garments not knitted or crocheted	Protech	No
186	62105000	Personal protective garments for women & girl's not knitted or crocheted	Protech	No
187	54071014	Unbleached umbrella cloth panel fabrics	Protech	Yes, Sportech as per Ministry of Textiles
188	54071024	Bleached umbrella cloth panel fabrics	Protech	Yes, Sportech as per Ministry of Textiles
189	54071034	Dyed umbrella cloth panel fabrics	Protech	Yes, Sportech as per Ministry of Textiles
190	54071044	Printed umbrella cloth panel fabrics	Protech	Yes, Sportech as per Ministry of Textiles
191	54071094	Other umbrella cloth panel fabrics	Protech	Yes, Sportech as per Ministry of Textiles
192	63072010	Life jackets and life belts of cotton	Protech	Yes, Sportech as per Ministry of Textiles
193	63072090	Life jackets & life belts excluding cotton	Protech	Yes, Sportech as per Ministry of Textiles
194	54071011	Unbleached parachute fabrics	Sportech	No
195	54071012	Unbleached tent fabrics	Sportech	No
196	54071021	Bleached parachute fabrics	Sportech	No
197	54071022	Bleached tent fabrics	Sportech	No
198	54071031	Dyed parachute fabrics	Sportech	No
199	54071032	Dyed tent fabrics	Sportech	No
200	54071041	Printed parachute fabrics	Sportech	No
201	54071042	Printed tent fabrics	Sportech	No
202	54071091	Other parachute fabrics	Sportech	No
203	54071092	Other tent fabrics	Sportech	No
204	62112000	Ski-suits	Sportech	No
205	63061990	Other tarpaulins, awnings and sunblinds; tents; sails for boats, sailboards or landcraft; camping goods	Sportech	No
206	63063000	Sails	Sportech	No
207	95069960	Sports nets	Sportech	No

Annexure 2

List of additional 242 ITC HS Codes proposed by IIT Delhi for inclusion as codes for Technical Textile items

Sl. No	ITC Codes	Description	Segment suggested by IIT Delhi
1	54071019	Woven fabrics obtained from high tenacity yarn of nylon or other polyamides or of polyesters: unbleached: other polyester fabrics	Agrotech
2	48142000	Wallpaper and similar wall coverings, consisting of paper coated or covered, on the face side, with a grained, embossed, coloured, design-printed or otherwise decorated layer of plastics	Buildtech
3	49111010	Trade advertising material, commercial catalogues and the like: posters, printed	Buildtech
4	49111090	Trade advertising material, commercial catalogues, and the like: other	Buildtech
5	52041110	Cotton sewing thread, whether put up for retail sale: not put up for retail sale: containing 85% or more by weight of cotton: cotton thread, sewing, containing any synthetic staple fibre	Clothtech
6	52041130	Cotton sewing thread, whether put up for retail sale: not put up for retail sale: containing 85% or more by weight of cotton: embroidery cotton thread	Clothtech
7	52041140	Cotton sewing thread, whether put up for retail sale: not put up for retail sale: containing 85% or more by weight of cotton: cotton sewing thread not containing any synthetic staple fibre	Clothtech
8	52041190	Cotton sewing thread, whether put up for retail sale: not put up for retail sale: containing 85% or more by weight of cotton: other	Clothtech
9	52041900	Cotton sewing thread, whether put up for retail sale: not put up for retail sale: other (excluding product containing 85% or more by weight of cotton)	Clothtech
10	52042010	Cotton sewing thread, whether put up for retail sale: put up for retail sale: cotton thread, sewing, containing any synthetic staple fibre	Clothtech
11	52042020	Cotton sewing thread, whether put up for retail sale: put up for retail sale: cotton thread, darning	Clothtech
12	52042030	Cotton sewing thread, whether put up for retail sale: put up for retail sale: embroidery cotton thread	Clothtech
13	52042040	Cotton sewing thread, whether put up for retail sale: put up for retail sale: cotton sewing thread, not containing any synthetic staple fibre	Clothtech
14	52042090	Cotton sewing thread, whether put up for retail sale: put up for retail sale: other	Clothtech
15	54011000	Sewing thread of man-made filaments, whether put up for retail sale: of synthetic filaments	Clothtech
16	54012000	Sewing thread of man-made filaments, whether put up for retail sale: of artificial filaments	Clothtech
17	54023300	Synthetic filament yarn (other than sewing thread), not put up for retail sale, including synthetic monofilament of less than 67 decitex: textured yarn: of polyesters	Clothtech
18	54023990	Synthetic filament yarn (other than sewing thread), not put up for retail sale, including synthetic monofilament of less than 67 decitex: other: other (excluding product of polypropylene and acrylic filament yarn)	Clothtech
19	54075290	Other woven fabrics, containing 85% or more by weight of textured polyester filaments: dyed:other	Clothtech
20	54075300	Other woven fabrics, containing 85% or more by weight of textured polyester filaments: of yarns of different colours	Clothtech
21	54076900	Other woven fabrics, containing 85% or more by weight of polyester filaments: other	Clothtech
22	54077200	Other woven fabrics, containing 85% or more by weight of synthetic filaments: dyed	Clothtech
23	54077400	Other woven fabrics, containing 85% or more by weight of synthetic filaments: printed	Clothtech
24	54078290	Other woven fabrics, containing less than 85% by weight of synthetic filaments, mixed mainly or solely with cotton: dyed: other	Clothtech
25	54079110	Other woven fabrics, containing less than 85% by weight of synthetic filaments, mixed mainly or solely with cotton: other than nylon and polyester: unbleached woven fabric	Clothtech

26	55132300	Woven fabrics of synthetic staple fibres, containing less than 85% by weight of such fibres, mixed mainly or solely with cotton, of a weight not exceeding 170g/m2: dyed: other woven fabrics of polyester staple fibres	Clothtech
27	55162300	Woven fabrics of artificial staple fibres: containing less than 85% by weight of artificial staple fibres, mixed mainly or solely with manmade filaments: of yarns of different colours	Clothtech
28	58012290	Woven pile fabrics and chenille fabrics, other than fabrics of heading 5802 or 5806: cut corduroy: other than cotton	Clothtech
29	58013690	Woven pile fabrics and chenille fabrics, other than fabrics of heading 5802 or 5806: chenille fabrics: other than carduroys	Clothtech
30	58041090	Tulles and other net fabrics, not including woven, knitted or crocheted fabrics; lace in the piece, in strips or in motifs, other than fabrics of heading 6002 to 6006: tulles and other net fabrics: other than cotton	Clothtech
31	58071010	Labels, badges and similar articles of textile materials, in the piece, in strips or cut to shape or size not embroidered: woven: of cotton	Clothtech
32	58071020	Labels, badges and similar articles of textile materials, in the piece, in strips or cut to shape or size not embroidered: woven: of man-made fibre	Clothtech
33	58071090	Labels, badges and similar articles of textile materials, in the piece, in strips or cut to shape or size not embroidered: woven: other	Clothtech
34	58079010	Labels, badges and similar articles of textile materials, in the piece, in strips or cut to shape or size not embroidered: other: felt or non-woven	Clothtech
35	58079090	Labels, badges and similar articles of textile materials, in the piece, in strips or cut to shape or size not embroidered: other: other	Clothtech
36	58081090	Braids in the piece; ornamental trimmings in the piece, without embroidery, other than knitted or crocheted; tassels, pompons and similar articles: braids, in the piece: other than cotton	Clothtech
37	58089010	Braids in the piece; ornamental trimmings in the piece, without embroidery, other than knitted or crocheted; tassels, pompons and similar articles: other: tapes, ornamental or cotton	Clothtech
38	58089040	Braids in the piece; ornamental trimmings in the piece, without embroidery, other than knitted or crocheted; tassels, pompons and similar articles: other: ribbons of rayon with ornamental trimmings	Clothtech
39	58089090	Braids in the piece; ornamental trimmings in the piece, without embroidery, other than knitted or crocheted; tassels, pompons and similar articles: other: other	Clothtech
40	58090090	Woven fabrics of metal thread and woven fabrics of metallised yarn of heading 56 05, of a kind used in apparel, as furnishing fabrics or for similar purposes, not elsewhere specified or included: other than zari borders	Clothtech
41	60012200	Looped pile fabrics: of man-made fibres	Clothtech
42	62179090	Other made-up clothing accessories; parts of garments or of clothing accessories, other than those of heading 6212: parts: other	Clothtech
43	63079090	Other made-up articles, including dress patterns: other (excluding floor-cloths, dish-cloths, dusters and similar cleaning cloths and life jackets and life-belt): other	Clothtech
44	96062990	Buttons, press-fasteners, snap-fasteners and press-studs, button moulds and other parts of these articles; button blanks: other: other	Clothtech
45	96071190	Slide fasteners: fitted with chain scoops of base metal: other than zip fasteners	Clothtech
46	96071910	Slide fasteners: other than fitted with chain scoops of base metal: zip fasteners	Clothtech
47	96071990	Slide fasteners: other than fitted with chain scoops of base metal: other than zip fasteners	Clothtech
48	96072000	Slide fasteners and parts thereof: parts	Clothtech
49	38244090	Prepared binders for foundry moulds or cores; chemical products and preparations of the chemical or allied industries (including those consisting of mixtures of natural products), not elsewhere specified or included: prepared additives for cements, mortars or concretes: other	Geotech
50	53109099	Woven fabrics of jute or of other textile base fibres of heading 5303: other: other (excluding product of bleached, dyed and printed)	Geotech
51	53110019	Woven fabrics of other vegetable textile fibres: other (excluding product of unbleached, bleached, dyed, printed and coir including log form and geotextiles)	Geotech
52	53110029	Woven fabrics of paper yarn: other (excluding product of unbleached, bleached, dyed and printed)	Geotech
53	39264059	Decorative sheets: other	Hometech
54	48182000	Handkerchiefs, cleaning or facial tissues and towels	Hometech
55	48189000	Toilet paper and similar paper, cellulose wadding or webs of cellulose fibres, of a kind used for household or sanitary purposes, in rolls of a width not exceeding 36 cm, or	Hometech

		cut to size or shape; handkerchiefs, cleansing tissues, towels, table cloths, serviettes, bed sheets and similar household, sanitary or hospital articles, articles of apparel and clothing accessories, of paper pulp, paper, cellulose wadding or webs of cellulose fibres: other (excluding toilet paper, handkerchiefs, cleaning or facial tissues and towels, tablecloths and serviettes, articles of apparel and clothing accessories)	
56	52083250	Woven fabrics of cotton, containing 85% or more by weight of cotton, weighing not more than 200 g/m2: dyed plain weave, weighing more than 100 g/m2 : bed ticking, domestic	Hometech
57	52084140	Woven fabrics of cotton, containing 85% or more by weight of cotton, weighing not more than 200 g/m2: of yarn of different colours: plain weave, weighing not more than 100 g/m2 : bed ticking, domestic	Hometech
58	52084250	Woven fabrics of cotton, containing 85% or more by weight of cotton, weighing not more than 200 g/m2: of yarn of different colours: plain weave, weighing more than 100 g/m2: bed ticking, domestic	Hometech
59	52084330	Woven fabrics of cotton, containing 85% or more by weight of cotton, weighing not more than 200 g/m2: of yarn of different colours: 3-thread or 4-thread twill, including cross twill: bed ticking, domestic	Hometech
60	53050010	Coir bristles fibre	Hometech
61	53050020	Coconut, abaca (manila hemp or musa textilis nee), ramie and other vegetable textile fibres, not elsewhere specified or included, raw or processed but not spun; tow, noils and waste of these fibres (including yarn waste and garneted stock): coir mattress fibre	Hometech
62	53050030	Coconut, abaca (manila hemp or musa textilis nee), ramie and other vegetable textile fibres, not elsewhere specified or included, raw or processed but not spun; tow, noils and waste of these fibres (including yarn waste and garneted stock): curled or machine twisted coir fibre	Hometech
63	54072010	Woven fabrics obtained from strip or the like: unbleached	Hometech
64	54072090	Woven fabrics obtained from strip or the like: other	Hometech
65	54073090	Fabrics specified in note 9 to section xi: other	Hometech
66	57011000	Carpets and other textile floor coverings, knotted, whether made up: of wool or fine animal hair	Hometech
67	57019090	Carpets and other textile floor coverings, knotted, whether made up: of other textile materials: other than cotton and coir	Hometech
68	57022020	Floor coverings of coconut fibres (coir): coir carpets and other rugs	Hometech
69	57023110	Other, of pile construction, not made up: of wool or fine animal hair: carpets	Hometech
70	57023210	Other, of pile construction, not made up: of man-made textile material: carpets, carpeting and rugs and the like	Hometech
71	57024110	Other, of pile construction, made up: of wool or fine animal hair: carpets	Hometech
72	57024290	Other, of pile construction, made up: of man-made textile materials: other	Hometech
73	57032020	Carpets and other textile floor coverings, tufted, whether made up: of nylon or other polyamides: 100% polyamide tufted velour, or cut pile loop pile carpet mats with jute, rubber latex or PU foam backing	Hometech
74	57033010	Carpets and other textile floor coverings, tufted, whether made up: of other man-made textile materials: carpets, carpeting & rugs	Hometech
75	57033020	Carpets and other textile floor coverings, tufted, whether made up: 100% polypropylene carpet mats with jute, rubber, latex or PU foam backing	Hometech
76	57033090	Carpets and other textile floor coverings, tufted, whether made up: of other man-made textile materials: other	Hometech
77	57039090	Carpets and other textile floor coverings, tufted, whether made up: of other textile materials: other than cotton and coir	Hometech
78	58061000	Woven pile fabrics (including terry towelling and similar terry fabrics) and chenille fabrics	Hometech
79	58110020	Quilted wadding	Hometech
80	58110090	Quilted textile products in the piece, composed of one or more layers of textile materials assembled with padding by stitching or otherwise	Hometech
81	59019020	Varnished cambric fabrics (empire fabrics) tapes	Hometech
82	63022200	Bed linen, table linen, toilet linen and kitchen linen: other bed linen, printed: man-made fibres	Hometech
83	63029900	Bed linen, table linen, toilet linen and kitchen linen: of other textile materials	Hometech
84	63031200	Curtains (including drapes) and interior blinds: curtain or bed valances: knitted or crocheted: of synthetic fibres	Hometech

85	63049270	Other furnishing articles, excluding those of heading 9404: not knitted or crocheted, of cotton: mosquito nets	Hometech
86	63049291	Other furnishing articles of handloom	Hometech
87	63049300	Other furnishing articles of synthetic fibres, not knitted or crocheted	Hometech
88	63071090	Floor-cloths, dish-cloths, dusters and similar cleaning cloths made of others- others	Hometech
89	95051000	Festive, carnival or other entertainment articles, including conjuring tricks and novelty jokes: articles for Christmas festivities	Hometech
90	48114100	Gummed or adhesive paper and paperboard: self-adhesive	Hometech
91	58063120	Narrow woven fabrics other than goods of heading 5807; narrow fabrics consisting of warp without weft assembled by means of an adhesive (bolducs): of cotton: newar cotton	Hometech
92	51121990	Woven fabrics of combed wool or of combed fine animal hair: containing 85% or more by weight of wool or of fine animal hair: of a weight not exceeding 200 g/m2: other than of unbleached, bleached, dyed and printed	Hometech
93	42050090	Other articles of leather or of composition leather: other than of leather sofa cover	Indutech
94	39269010	PVC belt conveyor	Indutech
95	40103110	Endless transmission belts of trapezoidal cross-section (v-belts), v-ribbed, of an outside circumference exceeding 180 cm but not exceeding 240 cm: where the rubber compound content is less than 25% by weight	Indutech
96	40103190	Endless transmission belts of trapezoidal cross-section (v-belts), v-ribbed, of an outside circumference exceeding 180 cm but not exceeding 240 cm: other	Indutech
97	40103210	Endless transmission belts of trapezoidal cross-section (v-belts), other than v-ribbed, of an outside circumference exceeding 60 cm but not exceeding 180 cm: where the rubber compound content is less than 25% by weight	Indutech
98	40103290	Endless transmission belts of trapezoidal cross-section (v-belts), other than v-ribbed, of an outside circumference exceeding 60 cm but not exceeding 180 cm: other	Indutech
99	40103310	Endless transmission belts of trapezoidal cross-section (v-belts), v-ribbed, of an outside circumference exceeding 60 cm but not exceeding 180 cm: where the rubber compound content is less than 25% by weight	Indutech
100	40103390	Endless transmission belts of trapezoidal cross-section (v-belts), v-ribbed, of an outside circumference exceeding 60 cm but not exceeding 180 cm: other	Indutech
101	40103410	Endless transmission belts of trapezoidal cross-section (v-belts), other than v-ribbed, of an outside circumference exceeding 180 cm but not exceeding 240 cm: where the rubber compound content is less than 25% by weight	Indutech
102	40103490	Endless transmission belts of trapezoidal cross-section (v-belts), other than v-ribbed, of an outside circumference exceeding 180 cm but not exceeding 240 cm: other	Indutech
103	40103510	Endless synchronous belts of an outside circumference exceeding 60 cm but not exceeding 150 cm: where the rubber compound content is less than 25% by weight	Indutech
104	40103590	Endless synchronous belts of an outside circumference exceeding 60 cm but not exceeding 150 cm: other	Indutech
105	48054000	Test liner (recycled liner board):filter paper and paperboard	Indutech
106	48232000	Filter paper and paperboard	Indutech
107	55031100	Synthetic staple fibres, not carded, combed or otherwise of aramids	Indutech
108	55032000	Synthetic staple fibres, not carded, combed or otherwise processed for spinning: of polyesters	Indutech
109	55121910	Containing 85% or more by weight of polyester staple fibres: dyed	Indutech
110	56072100	Binder or baler twine of sisal or other textile fibres of the genus agave	Indutech
111	56072900	Twine, cordage, ropes and cables, whether plaited or braided and whether impregnated, coated, covered or sheathed with rubber or plastics: of sisal or other textile fibres of the genus agave: other	Indutech
112	58064000	Fabrics consisting of warp without weft assembled by means of an adhesive (bolducs)	Indutech
113	59011010	Textile fabrics coated with gum or amylaceous substances, of a kind used for the outer covers of books or the like: of cotton	Indutech
114	59011090	Textile fabrics coated with gum or amylaceous substances, of a kind used for the outer covers of books or the like: other	Indutech
115	59019010	Textile fabrics coated with gum or amylaceous substances, of a kind used for the outer covers of books or the like; tracing cloth; prepared painting canvas; buckram and similar stiffened textile fabrics of a kind used for hat foundations: other: tracing cloth of cotton	Indutech
116	59019090	Textile fabrics coated with gum or amylaceous substances, of a kind used for the	Indutech

		outer covers of books or the like; tracing cloth; prepared painting canvas; buckram and similar stiffened textile fabrics of a kind used for hat foundations: other (excluding outer cover of books and painting canvas): other (excluding tracing cloth of cotton and varnished cambric fabrics (empire fabrics) tapes)	
117	68051090	Natural or artificial abrasive powder or grain, on a base of textile material, of paper, of paperboard or of other materials, whether or not cut to shape or sewn or otherwise made up: on a base of woven textile fabric only: other	Indutech
118	70199010	Glass fibres (including glass wool) and articles thereof (for example, yarn, woven fabrics): other: glass wool or glass fibre	Indutech
119	84219900	Filtering or purifying machinery and apparatus, for liquids or gases: parts	Indutech
120	85079010	Electric accumulators, including separators therefor, whether rectangular (including square): parts: accumulator cases made of hard rubber and separators	Indutech
121	85079090	Electric accumulators, including separators therefor, whether rectangular (including square): parts: other	Indutech
122	85340000	Printed circuits	Indutech
123	40169100	Other articles of vulcanised rubber other than hard rubber: floor coverings and mats	Indutech
124	30051090	Adhesive dressings and other articles having an adhesive layer: other than adhesive guaze and tape	Meditech
125	30059060	Micro pores surgical tapes	Meditech
126	30061010	Sterile surgical catgut, similar sterile suture materials (including sterile absorbable surgical or dental yarns) and sterile tissue adhesives for surgical wound closure	Meditech
127	30061020	Sterile laminaria and sterile laminaria tents; sterile absorbable surgical or dental haemostatics; sterile surgical or dental adhesion barriers, whether absorbable	Meditech
128	33062000	Yarn used to clean between the teeth (dental floss)	Meditech
129	40151100	Articles of apparel and clothing accessories (including gloves, mittens and mitts) for all purposes, or vulcanised rubber other than hard rubber: surgical gloves, mittens & mitts	Meditech
130	40159010	Articles of apparel and clothing accessories (including gloves, mittens and mitts) for all purposes, or vulcanised rubber other than hard rubber: other: rubber apron	Meditech
131	48030010	Toilet or facial tissue stock, towel or napkin stock and similar paper of a kind used for household or sanitary purposes, cellulose wadding and webs of cellulose fibres, whether or not creped, crinkled, embossed, perforated, surface-coloured, surface-decorated or printed, in rolls or sheets: in commercial size rolls of width size 36 cm and above	Meditech
132	54031090	Artificial filament yarn (other than sewing thread), not put for retail sale, including artificial mono filament of less than 67 decitex: high tenacity yarn of viscose rayon: other	Meditech
133	54049010	Synthetic monofilament of 67 decitex or more and of which no cross-sectional dimension exceeds 1 mm; strip and the like (for example, artificial straw) of synthetic textile materials of an apparent width not exceeding 5 mm: other: catgut imitation of synthetic yarn, non-sterile	Meditech
134	90213100	Artificial joints	Meditech
135	90213900	Other artificial parts of the body: other	Meditech
136	54034990	Artificial filament yarn (other than sewing thread), not put for retail sale, including artificial mono filament of less than 67 decitex: of cellulose acetate: other	Mobiltech
137	56011000	Needleloom felt and stitch-bonded fibre fabrics	Mobiltech
138	56029000	Felt, whether impregnated, coated, covered or laminated: other	Mobiltech
139	87082900	Parts and accessories of the motor vehicles of headings 8701 to 8705: other parts and accessories of bodies (including cabs): other	Mobiltech
140	87089900	Parts and accessories of the motor vehicles of headings 8701 to 8705: other parts and accessories: other	Mobiltech
141	94011000	Seats of a kind used for aircraft	Mobiltech
142	94012000	Seats of a kind used for motor vehicles	Mobiltech
143	94018000	Seats (other than those of heading 9402), whether convertible into beds, and parts thereof: other seats	Mobiltech
144	94019000	Seats (other than those of heading 9402), whether convertible into beds, and parts thereof: parts	Mobiltech
145	54071029	Woven fabrics obtained from high tenacity yarn of nylon or other polyamides or of polyesters: bleached: other	Mobiltech
146	54071039	Woven fabrics obtained from high tenacity yarn of nylon or other polyamides or of polyesters: dyed: other	Mobiltech

147	42021110	With outer surface of leather or of composition leather: or of patent leather: travel goods (trunks, suit-cases, sports bags and other similar items) of leather	Packtech
148	42021120	With outer surface of leather or of composition leather: or of patent leather: toilet-bags and cases, of leather	Packtech
149	42021130	With outer surface of leather or of composition leather: or of patent leather: satchels	Packtech
150	42021140	With outer surface of leather or of composition leather: or of patent leather: brief-cases	Packtech
151	42021150	With outer surface of leather or of composition leather: or of patent leather: executive-cases	Packtech
152	42021160	With outer surface of leather or of composition leather: or of patent leather: vanity-cases	Packtech
153	42021190	With outer surface of leather or of composition leather: or of patent leather: other	Packtech
154	42021210	With outer surface of plastic or of textile materials: toilet cases	Packtech
155	42021220	With outer surface of plastic or of textile materials: plastic moulded suit-cases	Packtech
156	42021230	With outer surface of plastic or of textile materials: plastic moulded brief-cases	Packtech
157	42021240	With outer surface of plastic or of textile materials: satchels	Packtech
158	42021250	With outer surface of plastic or of textile materials: other travel goods	Packtech
159	42021260	With outer surface of plastic or of textile materials: brief-cases	Packtech
160	42021280	With outer surface of leather or of composition leather: or of patent leather: vanity-cases	Packtech
161	42021290	With outer surface of leather or of composition leather: or of patent leather: other	Packtech
162	42021910	Other: travel goods (trunks, suit-cases, sports bags, and other similar items) of leather	Packtech
163	42021920	Other: toilet-cases	Packtech
164	42021930	Other: satchels	Packtech
165	42021940	Other: brief-cases (other than plastic moulded)	Packtech
166	42021960	Other: vanity-cases	Packtech
167	42021990	Trunks, suit-cases, vanity-cases, executive-cases, brief-cases, school satchels and similar containers: other: other	Packtech
168	42022110	With outer surface of leather or of composition leather: or of patent leather: hand-bags for ladies	Packtech
169	42022120	With outer surface of leather or of composition leather: or of patent leather: vanity-bags	Packtech
170	42022190	With outer surface of leather or of composition leather: or of patent leather: other	Packtech
171	42022210	With outer surface of sheeting of plastics or of textile materials: hand-bags and shopping bags, of artificial plastic material	Packtech
172	42022220	With outer surface of sheeting of plastics or of textile materials: hand-bags and shopping bags, of cotton	Packtech
173	42022230	With outer surface of sheeting of plastics or of textile materials: hand-bags and shopping bags, of jute	Packtech
174	42022290	With outer surface of sheeting of plastics or of textile materials: other	Packtech
175	42022910	Hand-bags, whether with shoulder strap, including those without handle: other: hand bags of other materials excluding wickerwork or basket work	Packtech
176	42022990	Hand-bags, whether with shoulder strap, including those without handle: other: other	Packtech
177	42023110	Articles of a kind normally carried in the pocket or in the handbag: with outer surface of leather or of composition leather: jewellery box	Packtech
178	42023120	Articles of a kind normally carried in the pocket or in the handbag: with outer surface of leather or of composition leather: wallets and purses, of leather	Packtech
179	42023190	Articles of a kind normally carried in the pocket or in the handbag: with outer surface of leather or of composition leather: other	Packtech
180	42023290	Articles of a kind normally carried in the pocket or in the handbag: with outer surface of sheeting of plastics or of textile materials: other than jewellery box	Packtech
181	42029200	Trunks, suit-cases, vanity-cases, executive-cases, brief-cases, school satchels and similar containers: other: with outer surface of sheeting of plastics or of textile materials	Packtech
182	42029900	Trunks, suit-cases, vanity-cases, executive-cases, brief-cases, school satchels and similar containers: other: other	Packtech

183	58063190	Narrow woven fabrics other than goods of heading 5807; narrow fabrics consisting of warp without weft assembled by means of an adhesive (bolducs): other woven fabrics: of cotton: other	Packtech
184	58063930	Narrow woven fabrics other than goods of heading 5807; narrow fabrics consisting of warp without weft assembled by means of an adhesive (bolducs): of other textile materials: other narrow fabrics of jute	Packtech
185	58063990	Narrow woven fabrics other than goods of heading 5807; narrow fabrics consisting of warp without weft assembled by means of an adhesive (bolducs): of other textile materials: other	Packtech
186	63051010	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303:jute bagging for raw cotton	Packtech
187	63051020	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303: jute corn (grains) sacks	Packtech
188	63051030	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303: jute hessian bags	Packtech
189	63051040	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303: jute sacking bags	Packtech
190	63051050	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303: jute wool sacks	Packtech
191	63051060	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303: plastic coated or paper cum polythene lined jute bags and sacks	Packtech
192	63051070	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303: paper laminated hessian jute	Packtech
193	63051080	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303: jute soil savers	Packtech
194	63051090	Sacks and bags, of a kind used for the packing of goods: of jute or of other textile bastfibres of heading 5303: other (excluding all types of jute bags)	Packtech
195	63052000	Sacks and bags, of a kind used for the packing of goods: of cotton	Packtech
196	63053300	Sacks and bags, of a kind used for the packing of goods: of man-made textile materials: other, of polyethylene or polypropylene strip or the like	Packtech
197	63053900	Sacks and bags, of a kind used for the packing of goods: of man-made textile materials: other	Packtech
198	63059000	Sacks and bags, of a kind used for the packing of goods: of other textile materials	Packtech
199	63062990	Sacks and bags, of a kind used for the packing of goods: of other textile materials	Packtech
200	39262029	Articles of apparel and clothing accessories (including gloves, mittens and mitts): aprons: other than of polyurethane foam	Protech
201	40159030	Articles of apparel and clothing accessories (including gloves, mittens and mitts) for all purposes, or vulcanised rubber other than hard rubber: other: industrial gloves	Protech
202	62011100	Overcoats, raincoats, car-coats, capes, cloaks and similar articles: of wool and fine animal hair	Protech
203	62011290	Men’s or boys' overcoats, raincoats, car-coats, capes, cloaks and similar articles: of cotton: other than raincoats	Protech
204	62011310	Men’s or boys' overcoats, raincoats, car-coats, capes, cloaks and similar articles: of man-made fibres: raincoats	Protech
205	62019990	Men's or boys' overcoats, carcoats, cloaks, anoraks (including ski-jackets), windcheaters, wind jackets and similar articles other than those of heading 6203: of other textile materials: other than silk	Protech
206	62021200	Women's or girls’ overcoats, raincoats, car-coats, capes, cloaks and similar articles: of cotton	Protech
207	62021300	Women's or girls’ overcoats, raincoats, car-coats, capes, cloaks and similar articles: of man-made fibres	Protech
208	62101000	Garments, made up of fabrics of heading 5602, 5603, 5903, 5906 or 5907: of fabrics of heading 5602 or 5603	Protech
209	62102090	Garments, made up of fabrics of heading 5602, 5603, 5903, 5906 or 5907: other garments, of the type described in subheadings 6201 11 to 6201 19: other (excluding outer garments of rubberised textile fabrics, impregnated, coated, covered or laminated and other artificial plastic materials)	Protech
210	62103030	Garments, made up of fabrics of heading 5602, 5603, 5903, 5906 or 5907: other garments, of the type described in subheadings 6202 11 to 6202 19: outer garments, of fabrics otherwise impregnated	Protech
211	63069010	Tarpaulins, awnings and sunblind; tents; sails for boats, sailboards or land craft; camping goods: other: of cotton	Sportech
212	51111990	Woven fabrics of carded wool or of carded fine animal hair: containing 85% or more by weight of wool or of fine animal hair: of a weight not exceeding 300 g/m2 : other	Sportech

		than of unbleached, bleached, dyed and printed	
213	51123090	Woven fabrics of combed wool or of combed fine animal hair: containing 85% or more by weight of wool or of fine animal hair: other, mixed mainly or solely with man-made staple fibres: other than of unbleached, bleached, dyed and printed	Sportech
214	61123100	Men's or boys' swimwear: of synthetic fibres	Sportech
215	61123920	Men's or boys' swimwear: of other textile materials: of artificial fibres	Sportech
216	61123990	Men's or boys' swimwear: of other textile materials: other than silk and artificial fibres	Sportech
217	61124100	Women’s or girls’ swimwear: of synthetic fibre	Sportech
218	61124910	Women’s or girls’ swimwear: of other textile materials: of silk	Sportech
219	61124920	Women’s or girls’ swimwear: of other textile materials: of artificial fibres	Sportech
220	61124990	Women’s or girls’ swimwear: of other textile materials: other than silk and artificial fibres	Sportech
221	62029110	Women's or girls' overcoats, car-coats, capes, cloaks, anoraks (including ski-jackets), windcheaters, wind-jackets and similar articles, other than those of heading 6204: other: of wool or fine animal hair: wind and ski-jackets, windcheaters	Sportech
222	62029210	Women's or girls' overcoats, car-coats, capes, cloaks, anoraks (including ski-jackets), windcheaters, wind-jackets and similar articles, other than those of heading 6204: other: of cotton: wind and ski-jackets, windcheaters	Sportech
223	62029310	Women's or girls' overcoats, car-coats, capes, cloaks, anoraks (including ski-jackets), windcheaters, wind-jackets and similar articles, other than those of heading 6204: other: of man-made fibres: wind and ski-jackets, windcheaters	Sportech
224	62029911	Women's or girls' overcoats, car-coats, capes, cloaks, anoraks (including ski-jackets), windcheaters, wind-jackets and similar articles, other than those of heading 6204: other: of other textile materials: wind and ski-jackets	Sportech
225	62111100	Swimwear: men's or boys'	Sportech
226	62111200	Swimwear: women's or girls'	Sportech
227	63061930	Tarpaulins, awnings and sunblinds; tents; sails for boats, sailboards or landcraft; camping goods: of other textile materials: venetian or Austrian blinds	Sportech
228	63064000	Tarpaulins, awnings and sunblinds; tents; sails for boats, sailboards or landcraft; camping goods: pneumatic mattresses	Sportech
229	63069090	Tarpaulins, awnings and sunblinds; tents; sails for boats, sailboards or landcraft; camping goods: other: of other textile materials	Sportech
230	88010020	Balloons and dirigibles; gliders, hang gliders and other non-powered aircraft: balloons	Sportech
231	95042000	Articles and accessories for billiards of all kinds	Sportech
232	95065100	Tennis, badminton or similar rackets, whether strung: lawn-tennis rackets, whether strung	Sportech
233	95065910	Other: squash or racquetball badminton rackets, whether strung	Sportech
234	95066210	Articles and equipment for general physical exercise, gymnastics, athletics, other sports (including table-tennis) or out-door games, not specified or included elsewhere in this chapter; swimming pools and paddling pools: inflatable: football	Sportech
235	95066220	Articles and equipment for general physical exercise, gymnastics, athletics, other sports (including table-tennis) or out-door games, not specified or included elsewhere in this chapter; swimming pools and paddling pools: inflatable: volley ball	Sportech
236	95066230	Articles and equipment for general physical exercise, gymnastics, athletics, other sports (including table-tennis) or out-door games, not specified or included elsewhere in this chapter; swimming pools and paddling pools: inflatable: basket ball	Sportech
237	95066290	Articles and equipment for general physical exercise, gymnastics, athletics, other sports (including table-tennis) or out-door games, not specified or included elsewhere in this chapter; swimming pools and paddling pools: inflatable: other	Sportech
238	95069110	Articles and equipment for general physical exercise, gymnastics or athletics: boxing equipment	Sportech
239	95069920	Leg pads and bats for cricket	Sportech
240	95069930	Shoulder pads for football	Sportech
241	95069970	Tennis and badminton racket pressures	Sportech
242	95069990	Articles and equipment for general physical exercise, gymnastics, athletics, other sports (including table-tennis) or out-door games, not specified or included elsewhere in this chapter; swimming pools and paddling pools: other: other	Sportech

Annexure 3

List of standards developed by BIS in Agrotech

	IS Number	Title
1.	IS 15351:2015	Agro textiles - Laminated high density polyethylene HDPE woven geomembrane for waterproof lining specification (second revision)
2.	IS 15907:2010	Agro textiles - High density polyethylene HDPE woven beds for vermiculture – Specification
3.	IS 16008: Part 1: 2016	Agro textiles - Shade nets for agriculture and horticulture purposes - Specification part 1 shade nets made from tape yarns first revision
4.	IS 16008: Part 2: 2016	Agro textiles - Shade nets for agriculture and horticulture purposes - Specification part 2 shade nets made from monofilament yarns first revision
5.	IS 16190:2014	Agro textiles - High density polyethylene HDPE laminated woven lay flat tube for irrigation purpose – Specification
6.	IS 16202:2014	Agro textiles - Woven ground covers for horticulture application – Specification
7.	IS 16390:2015	Agro textiles - Nylon knitted seamless gloves for tobacco harvesters – Specification
8.	IS 16513:2016	Agro textiles - Insect nets for agriculture and horticulture purposes - Specification
9.	IS 16627:2017	Agro textiles - High density polyethylene HDPE laminated woven lay flat tube for use in mains and sub mains of drip irrigation system - Specification
10.	IS 17355:2020	Agro textiles - Propylene spun bonded nonwoven mulch mat for agricultural and horticultural applications – Specification
11.	IS 17356:2020	Agro textiles - Windshield nets for agriculture and horticulture purposes – Specification
12.	IS 17357:2020	Agro textiles - Harvest nets for agriculture and horticulture purposes – Specification
13.	IS 17358: Part 1: 2020	Agro textiles - Fencing nets for agriculture and horticulture purposes - Specification part 1 fencing nets made from extruded polymer mesh
14.	IS 17358: Part 2: 2020	Agro textiles - Fencing nets for agriculture and horticulture purposes - Specification part 2 fencing nets made from monofilament yarns and combination of tape and monofilament yarns
15.	IS 17513:2020	Agro Textiles - Plant support nets for agriculture and horticulture purposes – Specification
16.	IS 16366:2015	Glossary of terms used in agrotextile
17.	IS 16089:2013	Jute agro-textile - Sapling bags for growth of seedling sapling – Specification
18.	IS 17070:2019	Jute agrotextiles for growth of plant and suppression of weeds - Specification
19.	IS 16718:2017	Textiles Polypropylene spun bonded nonwoven crop cover fabric for agricultural and horticultural applications - Specification

Annexure 4

List of standards developed by BIS in Buildtech

S No.	IS No.	Title
1.	IS 10321 (Part 1 to 3):1982	Specification for 50-kg tent
2.	IS 11057:1984	Specification for industrial safety nets
3.	IS 12989:2016	Camping tents (third revision)
4.	IS 12991:2005	Textiles - Camping tents and caravan awnings vocabulary and list of equivalent terms (first revision)
5.	IS 15272:2020	Textiles - Awnings for leisure accommodation vehicles requirements and test methods (second revision)
6.	IS 15566:2005	Textiles - Caravan awnings - Functional requirements and test methods
7.	IS 1648:2016	Textiles - Synthetic micro-fibres for use in cement-based matrix - Specification

Annexure 5

List of standards developed by BIS in Clothtech

S No	**IS Number**	**Title**
1.	IS 1718:1988	Specification for cotton spindle tapes (second revision)
2.	IS 1740:1977	Specification for flat cotton wicks (first revision)
3.	IS 1895:1982	Specification for cotton NEWAR (second revision)
4.	IS 1923:2003	Textiles - Cotton selvedge tapes for electrical insulation purposes - Specification (third revision)
5.	IS 1974:1982	Specification for cotton spindle tapes for jute industry (second revision)
6.	IS 2847:1964	Specification for cotton selvedge tape for electric cables
7.	IS 4778:1982	Specification for cotton laces for footwear (first revision)
8.	IS 5351:2001	Textiles - Polyester fibre woven tapes for electrical insulation purposes - Specification (second revision)
9.	IS 5352: Part 1:1999	Textile glass and glass-polyester fibre woven tapes part 1 specification (third revision)
10.	IS 5352: Part 2:1999	Textiles Glass and glass-polyester fibre woven tapes part 2 methods of test (third revision)
11.	IS 5354:1992	Textiles - Cotton stripping tape for electrical purposes - Specification (first revision)
12.	IS 5656:1970	Specification for cotton braid for sleeving
13.	IS 6117:1977	Specification for tapes cotton (first revision)
14.	IS 6487:1983	Specification for cotton tapes unproofed and proofed for ammunition purposes (first revision)
15.	IS 6488:1999	Textiles - Cotton webbing for personal web equipment - Specification (third revision)
16.	IS 6672:1989	Cotton tapes for berets mercerised - Specification (first revision)
17.	IS 6673:1972	Specification for waxed cotton selvedge tape
18.	IS 7298:1973	Specification for cotton webbing proofed and unproofed
19.	IS 7426:1989	Cotton webbing special - Specification (first revision)
20.	IS 7776:1975	Specification for silk webbing
21.	IS 7777:1987	Specification for cotton webbing rolled edges (first revision)
22.	IS 8302:1977	Specification for braided tape for berets
23.	IS 8894:1978	Specification for cotton tapes for slide fasteners
24.	IS 9675:1980	Specification for woven cotton tapes light medium and heavy qualities
25.	IS 9686:1980	Specification for elastic tape
26.	IS 10056:1982	Specification for silk viscose rayon ribbon tape
27.	IS 10057:1982	Specification for cotton tapes for wagon sealing
28.	IS 10415:1992	Textiles - Polyester fibreglass tapes - Specification (first revision)
29.	IS 10692:1983	Specification for high density polyethylene webbing
30.	IS 12111:1987	Glossary of terms relating to narrow fabrics
31.	IS 13597:1992	Textiles - Polypropylene braided tapes for berets - Specification
32.	IS 13598:1992	Textiles - High density polyethylene monofilament NEWAR - Specification
33.	IS 14358:1996	Textiles - Nylon laces for shoes and boots - Specification

Annexure 6

List of standards developed by BIS in Geotech

	IS Number	Title
1.	IS 13162 (Part 2):1991	Geotextiles - Methods of test part 2 determination of resistance to exposure of ultraviolet light and water xenon-arc type apparatus
2.	IS 13162 (Part 3):1992	Geotextiles - Methods of test part 3 determination of thickness at specified pressures
3.	IS 13162 (Part 4):1992	Geotextiles - Methods of test part 4 determination of puncture resistance by falling cone method
4.	IS 13321 (Part 1):1992	Glossary of terms for geo-synthetics part 1 Terms used in materials and properties
5.	IS 13325:1992	Determination of tensile properties of extruded polymer geogrids using the wide strip - Test method
6.	IS 13326 (Part 1):1992	Evaluation of interface friction between geosynthetics and soil method of test part 1 modified direct shear technique
7.	IS 14293:1995	Geotextiles - Method of test for trapezoid tearing strength
8.	IS 14294:1995	Geotextiles - Method for determination of apparent opening size by dry sieving technique
9.	IS 14324:1995	Geotextiles - Methods of test for determination of water permeability permittivity
10.	IS 14706:1999	Geotextiles - Sampling and preparation of test specimens
11.	IS 14714:1999	Geotextiles - Determination of abrasion resistance
12.	IS 14715 (Part 1):2016	Jute geotextiles part 1 strengthening of sub-grade in roads - Specification (second revision)
13.	IS 14715 (Part 2):2016	Jute geotextiles part 2 control of bank erosion in rivers and waterways - Specification second revision
14.	IS 14716:1999	Geotextiles - Determination of mass per unit area
15.	IS 14739:1999	Geotextiles - Method for determination of creep
16.	IS 14986:2001	Guidelines for application of jute geotextile for rainwater erosion control in road and railway embankments and hill slopes
17.	IS 15060:2018	Geosynthetics - Tensile test for joint seams by wide-width strip method first revision
18.	IS 15868 (Part 1 to 6): 2008	Natural fibre geotextiles - Jute geotextile and coir BHOOVASTRA - Methods of test
19.	IS 15869:2020	Textiles - Open weave coir Bhoovastra - Specification first revision
20.	IS 15871: 2009	Use of coir geotextiles coir BHOOVASTRA in unpaved roads Guidelines
21.	IS 15872: 2009	Application of coir geotextiles - Coir woven BHOOVASTRA for rain water erosion control in roads railway embankments and hill slopes - Guidelines
22.	IS 15891 (Part 1): 2011	Textiles - Test methods for non-wovens Part 1 - Determination of mass per unit area
23.	IS 15891 (Part 2):2011	Textiles - Test methods for non-wovens Part 2 - Determination of thickness
24.	IS 15891 (Part 3):2011	Textiles - Test methods for nonwovens Part 3 - Determination of tensile strength and elongation
25.	IS 15891: Part 4:2011	Textiles - Test methods for nonwovens Part 4 - Determination of tear resistance
26.	IS 15891: Part 6:2012	Textiles - Test methods for nonwovens Part 6 - Absorption
27.	IS 15891: Part 7:2012	Textiles - Test methods for nonwovens Part 7 - Determination of bending length
28.	IS 15891: Part 8:2012	Textiles - Test methods for nonwovens Part 8 - Determination of liquid strike-through time simulated urine
29.	IS 15891: Part 9:2012	Textiles - Test methods for non-wovens Part 9 - Determination of drapability including coefficient
30.	IS 15909:2020	PVC geomembranes for Lining - Specification (second revision)
31.	IS 15910:2010	Geo-synthetics for highways - Specification
32.	IS 16078:2013	Geosynthetics - Static puncture test CBR test
33.	IS 16090:2013	Geo-synthetics - Geo-textiles used as protection or cushioning materials - Specification
34.	IS 16237:2014	Geo-synthetics - Method for determination of apparent opening size by wet sieving
35.	IS 16341:2015	Geosynthetics - Standard practice for exposure and retrieval of samples to evaluate installation damage of geosynthetics

36.	IS 16342:2015	Geosynthetics - Method of test for grab breaking load and elongation of geotextiles
37.	IS 16343:2015	Geosynthetics - Guidelines for installation of geotextiles as pavement fabric
38.	IS 16344:2015	Geosynthetics - Guidelines for installation of geotextile for permanent erosion control in hard armour systems
39.	IS 16345:2020	Geosynthetics - Guidelines for installation of geotextile used in subgrade separation in pavement structures (first revision)
40.	IS 16346:2015	Geosynthetics - Method of test for evaluation of stress crack resistance of polyolefin geomembranes using notched constant tensile load test
41.	IS 16347:2015	Geosynthetics - Method of test for effects of temperature on stability of geotextile
42.	IS 16348:2015	Geosynthetics - Method of test for index puncture resistance of geomembranes and related products
43.	IS 16349:2015	Geosynthetics - Guidelines for installation of geogrids used as reinforcement of base and sub-base layers in pavement structures
44.	IS 16351:2015	Geosynthetics - Standard practice for laboratory immersion procedures for evaluating the chemical resistance of geosynthetics to liquids
45.	IS 16352:2020	Geosynthetics - High density polyethylene HDPE geomembranes for lining - Specification (first revision)
46.	IS 16355:2015	Geosynthetics - Guidelines for installation of geogrids used as soil reinforcement in mechanically stabilised earth MSE retaining structures
47.	IS 16356:2015	Geosynthetics - Method of test for pore size characteristics of geotextiles by capillary flow test
48.	IS 16362:2020	Geosynthetics - Geotextiles used in subgrade stabilisation in pavement structures - Specification (first revision)
49.	IS 16363:2015	Geosynthetics - Guidelines for installation of geotextile used in subsurface drainage application
50.	IS 16380:2020	Geosynthetics - Method of test for measuring pull-out resistance of geosynthetics in soil (first revision)
51.	IS 16389:2015	Geosynthetics - Method of test for biological clogging of geotextile or soil geotextile filters
52.	IS 16391:2015	Geosynthetics - Geotextiles used in sub-grade separation in pavement structures - Specification
53.	IS 16392:2015	Geosynthetics - Geotextiles for permanent erosion control in hard armour systems - Specification
54.	IS 16393:2015	Geosynthetics - Geotextiles used in subsurface drainage application - Specification
55.	IS 16474:2015	Geosynthetics - Method of test for tensile properties of geogrids by the single or multi-rib tensile method
56.	IS 16475:2015	Geosynthetics - Method of test for determination of 2% secant modulus for polyethylene geomembranes
57.	IS 16477:2015	Geosynthetics - Method of test for determination of 2 performance strength of geomembranes by the wide strip tensile method
58.	IS 16483:2017	Geosynthetics - Method for microscopic evaluation of the dispersion of carbon black in polyolefin geosynthetics
59.	IS 16493:2017	Geosynthetics - Method of test for determination of pyramid puncture resistance of unprotected and protected geomembranes
60.	IS 16635:2017	Geosynthetics - Wide - Width tensile test
61.	IS 16653:2017	Geosynthetics - Needle-punched nonwoven geobags for coastal and waterways protection - Specification
62.	IS 16654:2017	Geosynthetics - Polyprophylene multifilament woven geobags for coastal and waterways protection - Specification
63.	IS 17179:2019	Geotextiles and geotextile-related products - Determination of water flow capacity in their plane
64.	IS 17360:2020	Geosynthetics - Screening test method for determining the resistance of geotextiles and geotextile-related products to oxidation
65.	IS 17363:2020	Geotextiles and geotextile-related products - Screening test method for determining the resistance to liquids
66.	IS 17365:2020	Guidelines for the determination of the long-term strength of geosynthetics for soil reinforcement
67.	IS 17368:2020	Geosynthetics - Determination of damage to geosynthetic caused during installation
68.	IS 17369: Part 1:2020	Geotextiles and geotextile-related products - Strength of internal structural junctions Part 1 - Geocells
69.	IS 17369: Part 2:2020	Geotextiles and geotextile-related products - Strength of internal structural junctions Part 2 - Geocomposites

70.	IS 17371:2020	Geosynthetics - Geogrids for flexible pavements - Specification
71.	IS 17372:2020	Geosynthetics - Polymeric strip geostrip used as soil reinforcement in retaining structures - Specification
72.	IS 17373:2020	Geosynthetics - Geogrids used in reinforced soil retaining structures - Specification
73.	IS 17374:2020	Geosynthetics - Reinforced HDPE membrane for effluents and chemical resistance lining - Specification
74.	IS 17420:2020	Geosynthetics- Index test procedure for the evaluation of mechanical damage under repeated loading damage caused by granular materials laboratory test method
75.	IS 17421:2020	Geosynthetics - Identification on site
76.	IS 17483: Part 1:2020	Geosynthetics - Geocells - Specification Part 1 - Load bearing application
77.	IS 17483: Part 2:2020	Geosynthetics - Geocells - Specification Part 2 - Slope erosion protection application

Annexure 7

List of standards developed by BIS in Indutech

	IS Number	Title
1.	IS 1178:1986	Specification for cotton filter cloth (second revision)
2.	IS 1422:1983	Specification for cotton duck (third revision)
3.	IS 1424:1983	Specification for cotton canvas (third revision)
4.	IS 1719:2000	Industrial textiles - Pressed wool felts specification (fourth revision)
5.	IS 4388:1982	Specification for cotton fabrics for reinforcement of rubber hoses (first revision)
6.	IS 4399:1967	Specification for nylon fabrics for industrial and special purposes
7.	IS 5996:1984	Specification for cotton belting ducks (second revision)
8.	IS 6803:1972	Specification for special proofed canvas and duck
9.	IS 7610: Part 1:1975	Specification for machinery fabrics wool Part 1 - General
10.	IS 7610: Part 2:1975	Specification for machinery fabrics wool Part 2 - Clearer cloth
11.	IS 7610: Part 3:1975	Specification for machinery fabrics wool Part 3 - Sizing flannel
12.	IS 7610: Part 4:1982	Specification for machinery fabrics wool Part 4 - Plaiting cloth (first revision)
13.	IS 7610: Part 5:1976	Specification for machinery fabrics wool Part 5 - Lapping cloth
14.	IS 8995:1979	Specification for cotton cover fabrics for fan belts and V-belts
15.	IS 9230:1979	Specification for cotton chafer fabrics
16.	IS 9293:1991	Textiles Canvas flax - Specification (first revision)
17.	IS 9998:1981	Specification for cotton liner fabrics
18.	IS 10055:1982	Specification for jute needleloom felts
19.	IS 11574:1986	Specification for polyamide filter cloth
20.	IS 11575:1986	Specification for polyester filter cloth
21.	IS 11986:2003	Industrial textiles Cotton backing cloth for abrasives - Specification (first revision)
22.	IS 12020: Part 1:1987	Specification for polypropylene filter cloth - Part 1 - Filter cloth from spun polypropylene yarn
23.	IS 12384:1988	Specification for rayon duck for industrial use
24.	IS 12415:1988	Specification for polyamide duck for industrial use
25.	IS 12416:1988	Specification for polyester cotton belting duck
26.	IS 12806:1989	Nonwoven fusible interlinings - Specification
27.	IS 12809:1989	Nonwovens sew-in interlinings - Specification
28.	IS 13128: Part 1:1991	Textiles Fabric woven glass fibre for electrical insulation and plastic laminate - Specification Part 1 - Loomstate fabrics
29.	IS 13128: Part 2:1991	Textiles Fabric woven glass fibre for electrical insulation and plastic laminate - Specification Part 2 - Desized and finished fabrics
30.	IS 13362:1992	Textiles - Asbestos yarn - Specification
31.	IS 13510:2000	Textiles - Duck polyester cotton blended rip-stop - Specification first revision
32.	IS 14445:1997	Textiles - Fabrics for awnings and camping tents - Specification
33.	IS 15595:2005	Industrial textiles - Bonded fabrics for air filtration - Specification
34.	IS 15891: Part 5:2017	Textiles - Test methods for nonwovens - Part 5 - Determination of resistance to mechanical penetration Ball burst procedure
35.	IS 15891: Part 10:2017	Textiles - Test methods for nonwovens - Part 10 - Lint and other particle generation in the dry state
36.	IS 15891: Part 11:2017	Textiles - Test methods for nonwovens - Part 11 - Run-off
37.	IS 15891: Part 12:2017	Textiles - Test methods for nonwovens - Part 12 - Demand absorbency
38.	IS 15891: Part 13:2017	Textiles - Test methods for nonwovens - Part 13 - Repeated liquid strike-through time

39.	IS 15891: Part 14:2017	Textiles - Test methods for nonwovens - Part 14 - Coverstock wetback
40.	IS 15891: Part 1:2017	Textiles - Test methods for nonwovens - Part 15 - Determination of air permeability
41.	IS 15891: Part 16: 2017 ISO 9073-16:2007	Textiles - Test methods for nonwovens - Part 16 - Determination of resistance to penetration by water hydrostatic pressure
42.	IS 15891: Part 17:2017	Textiles - Test methods for nonwovens - Part 17 - Determination of water penetration spray impact
43.	IS 15891: Part 18:2017	Textiles - Test methods for nonwovens - Part 18 - Determination of breaking strength and elongation of nonwoven materials using the grab tensile test
44.	IS 16126:2013	Textiles - Waterproof tarpaulins made from woven polyester fabric - Specification

Annexure 8

List of standards developed by BIS in Meditech

	IS Number	Title
1.	IS 674:1987	Specification for flannel hospital grey (third revision)
2.	IS 757:1971	Specification for handloom cotton lint absorbent bleached non-sterilised (first revision)
3.	IS 758:1988	Specification for cotton gauze absorbent non-sterilised (fourth revision)
4.	IS 863:1988	Specification for cotton bandage cloth non-sterilised (second revision)
5.	IS 1681:1998	Textiles - Hospital blankets woollen dyed - Specification (third revision)
6.	IS 4605:2020	Crepe bandage - Specification (Second Revision)
7.	IS 4717:2020	Medical Textiles - Zinc Oxide self-adhesive plaster - Specification (second revision)
8.	IS 4738:2020	Medical Textiles - Bandage plaster of Paris - Specification (third revision)
9.	IS 4739:1986	Specification for zinc oxide elastic self-adhesive bandage (first revision)
10.	IS 5405:2019	Sanitary napkins - Specification (second revision)
11.	IS 6237:1971	Specification for handloom cotton cloth for plaster of Paris bandages and cut bandages
12.	IS 9751:1981	Specification for bandage suspensory
13.	IS 10829:1993	X-ray detectable gauze swabs and laparotomy sponges - Specification first revision
14.	IS 11046:1984	Specification for towel operating
15.	IS 11163:1985	Specification for first-aid dressings
16.	IS 12839:1989	Wool polyamide blended flannel hospital grey - Specification
17.	IS 14274:1995	Bandage T - Shaped calico - Specification
18.	IS 14306:1995	Bandage triangular calico - Specification
19.	IS 14316:1995	Swabs small in bag of 50 - Specification
20.	IS 14944:2020	Surgical dressings methods of test first revision
21.	IS 16111:2013	Elastic bandage
22.	IS 16288:2014	Medical textiles - Method for evaluation of the bacterial filtration efficiency of surgical face masks
23.	IS 16289:2014	Medical textiles - Surgical face masks - Specification
24.	IS 16290:2014	Medical textiles - Knitted viscose primary dressings - Specification
25.	IS 16291:2014	Medical textiles - Paraffin gauze dressings - Specification
26.	IS 16302:2020	Medical Textiles Orthopaedic Stockinet Specification First Revision
27.	IS 16303:2014	Medical textiles - Cast padding for orthopaedic plaster - Specification
28.	IS 16466:2020	Medical Textiles - Povidone iodine ointment based knitted dressing - Specification first revision
29.	IS 16467:2016	Medical textiles - Graduated medical compression stockings - Specification
30.	IS 16468:2016	Medical textiles - Absorbent cotton sterile and non-sterile - Specification
31.	IS 16469:2016	Medical textiles - Open weave bandages - Specification
32.	IS 16470:2016	Medical textiles - Elastic surgical adhesive tapes - Specification
33.	IS 16545:2016	Clothing for protection against contact with blood and body fluids Determination of resistance of protective clothing materials to penetration by blood-borne pathogens - Test method using Phi-X174 bacteriophage
34.	IS 16546:2016	Clothing for protection against contact with blood and body fluids - Determination of the resistance of protective clothing materials to penetration by blood and body fluids - Test method using synthetic blood
35.	IS 16548:2016	Clothing for protection against infectious agents - Test method for resistance to dry microbial penetration

36.	IS 16549:2020	Surgical drapes gowns and clean air suits used as medical devices for patients clinical staff and equipment - Test method to determine the resistance to wet bacterial penetration first revision
37.	IS 16660:2017	Medical textiles - Nonwoven bandage rolls - Specification
38.	IS 16668:2017	Medical textiles - Salicylic acid adhesive plaster - Specification
39.	IS 16669:2017	Medical textiles - Elastic adhesive dressing - Specification
40.	IS 16670:2017	Medical textiles - Absorbent cotton ribbon gauze - Specification
41.	IS 16671:2020	Medical Textiles - Belladonna adhesive plaster - Specification first revision
42.	IS 16946:2018	Medical textiles - Elasticated tubular bandages - Specification
43.	IS 16948:2018	Medical textile - Permeable nonwoven surgical adhesive tape - Specification
44.	IS 16949:2018	Medical textiles - Adhesive extension plaster - Specification
45.	IS 16950:2018	Medical textiles - X-Ray detectable absorbent cotton gauze - Specification
46.	IS 17243:2019	Medical textiles - Test methods for compresses for wound management and surgical procedures
47.	IS 17333: Part 1:2020	Textiles - Determination of antifungal activity of textile products - Part 1 - Luminescence method
48.	IS 17333: Part 2:2020	Textiles - Determination of antifungal activity of textile products - Part 2 - Plate count method
49.	IS 17334:2019	Medical textiles - Surgical gowns and surgical drapes - Specification
50.	IS 17347:2020	Textiles - Determination of antiviral activity of textile products
51.	IS 17348:2020	Medical textiles - Adhesive incise drape - Specification
52.	IS 17349:2020	Medical textiles - Shoe covers - Specification
53.	IS 17350:2020	Medical textiles - Abdominal binder - Specification
54.	IS 17351:2020	Medical textiles - Dressing shell compressed - Specification
55.	IS 17352:2020	Medical textiles - Foam dressing - Specification
56.	IS 17353:2020	Medical textiles - Pressure garment - Specification
57.	IS 17354:2020	Medical textiles - Dental bib napkins - Specification
58.	IS 17359:2020	Medical textiles - Anti-embolic stocking for Post-op use up to thigh medium - Specification
59.	IS 17423:2020	Medical textiles - Coveralls for COVID 19 - Specification
60.	IS 17506:2020	Medical Textiles - Hydrocolloid Dressing - Specification
61.	IS 17507:2020	Medical Textiles - Cellulose Wading - Specification
62.	IS 17508:2020	Disposable adult incontinence diaper - Specification
63.	IS/ISO 20645:2004	Textile fabrics - Determination of antibacterial activity - Agar diffusing plate test
64.	IS 17514:2021	Reusable sanitary pad/sanitary napkin /period panties – Specification
65.	IS 17528:2021	Medical textiles – Chlorhexidine gauze dressing – Specification
66.	IS/ISO 20743:2013	Textiles - Determination of antibacterial activity of textile products

Annexure 9

List of standards developed by BIS in Mobiltech

	IS Number	Title
1.	IS 4910: Part 1:1989	Methods of test for tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Part 1 - Definition of terms first revision
2.	IS 4910: Part 2:1989	Tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Method of test - Part 2 - Linear density first revision
3.	IS 4910: Part 3:1989	Tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Methods of test - Part 3 - Load and elongation characteristics first revision
4.	IS 4910: Part 4:1989	Tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Method of test - Part 4 - Dip pick-up first revision
5.	IS 4910: Part 5:1989	Tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Method of test - Part 5 - Heat shrinkage and heat shrinkage force first revision
6.	IS 4910: Part 6:1989	Tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Methods of test - Part 6 - Wet contraction and wet contractile force first revision
7.	IS 4910: Part 7:1989	Methods of test for tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Part 7 - Heat degradation first revision
8.	IS 4910: Part 8:1989	Tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Methods of tests - Part 8 - Thickness first revision
9.	IS 4910: Part 9:978	Methods of test for tyre yarns cords and tyre cord fabrics made from man-made fibres - Part 9 - Sampling for tyre yarns cords and tyre cord fabrics made from rayon
10.	IS 4910: Part 10:1989	Methods of test for tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Part 10 - Creep first revision
11.	IS 4910: Part 11:1989	Methods of test for tyre yarns cords and tyre cord warp-sheets made from man-made fibres Part 11 Commercial mass first revision
12.	IS 4910: Part 12:1981	Methods of test for tyre yarns cords and tyre cord fabrics made from man-made fibres - Part 12 - Sampling for tyre yarns cords and tyre cord fabrics made from polyamide
13.	IS 4910: Part 13:1989	Methods of test for tyre yarns cords and tyre cord warp-sheets made from man-made fibres - Method of test - Part 13 - Static adhesion of textile tyre cord to vulcanised rubber
14.	IS 7133:1985	Specification for cotton tyre cord and warp sheet for cycle and rickshaw first revision
15.	IS 11573:1986	Specification for polyamide yarn for cycle and rickshaw tyres
16.	IS 11926:1987	Specification for polyamide tyre cord warp sheet for automotive tyres
17.	IS 13137:2003	Textiles - Tyre cord warp-sheet - Polyamide dipped - Specification (first revision)

Annexure 10

List of standards developed by BIS in Packtech

	IS Number	Title
1.	IS 6192:1994	Textiles - Monoaxially oriented high density polyethylene tapes - Specification (second revision)
2.	IS 6193:1971	Methods of tests for monoaxially oriented high density polyethylene polypropylene tapes
3.	IS 6899:1997	Textiles - High density polyethylene HDPE woven fabrics - Specification (second revision)
4.	IS 7903:2017	Textiles - Tarpaulins made from high density polyethylene HDPE woven fabrics - Specification (fifth revision)
5.	IS 8069:1989	High density polyethylene HDPE woven sacks for packing pesticides - Specification (second revision)
6.	IS 9755:2021	Textiles - High density polyethylene HDPE polypropylene PP woven sacks for packing fertilisers - Specification (sixth revision)
7.	IS 11197:1985	Specification for monoaxially oriented polypropylene tapes
8.	IS 11652:2017	Textiles - High density polyethylene HDPE polypropylene PP woven sacks for packaging of 50 kg cement - Specification (third revision)
9.	IS 12100:1987	Specification for high density polyethylene HDPE woven sacks for packing flour
10.	IS 14252:2015	Textiles - High density polyethylene HDPE polypropylene PP woven sack for filling sand - Specification (second revision)
11.	IS 14887:2014	Textiles - High density polyethylene HDPE polypropylene PP woven sacks for packaging of 50 kg food grains - Specification (first revision)
12.	IS 14968:2015	Textiles - High density polyethylene HDPE polypropylene PP woven sacks for packing 50 Kg 25 kg sugar - Specification first revision
13.	IS 16187:2014	Textiles - High density polyethylene HDPE polypropylene PP leno woven sacks for packaging and storage of fruits and vegetables - Specification
14.	IS 16208:2015	Textiles - High density polyethylene HDPE polypropylene PP woven sacks for packaging 10 kg 15 kg 20 kg 25 kg and 30 kg food grains - Specification
15.	IS 16703:2017	Textiles - High density polyethylene HDPE polypropylene PP woven sacks for packaging of 25 kg polymer materials - Specification
16.	IS 16709:2017	Textiles - Polypropylene PP woven laminated block bottom valve sacks for packaging of 50 kg cement - Specification
17.	IS 17279:2019	Textiles - Polypropylene PP nonwoven sacks for packing bulk commodities - Specification
18.	IS 17399:2020	Textiles - Polypropylene PP high-density polyethylene HDPE laminated woven sacks for mail sorting storage transport and distribution - Specification
19.	IS 2873:1991	Textiles - Packaging of jute products in bales - Specification (second revision)
20.	IS 12650:2018	Textiles - Jute bags for packing 50 kg food grains - Specification (third revision)
21.	IS 13649:1993	Textiles - Polyethylene lined jute bags for packing tea - Specification
22.	IS 15138:2010	Textiles - Jute bags for packing 50 kg sugar - Specification (first revision)
23.	IS 16186:2014	Textiles - Lightweight jute sacking bags for packing 50 kg food grains - Specification
24.	IS 16371: 2015	Textiles - Lightweight jute sacking bags 600 g for packing 50 kg food grains - Specification
25.	IS 16372:2015	Textiles - Jute bags for packing up to 30 kg food grains - Specification

Annexure 11

List of standards developed by BIS in Protech

	IS Number	Title
1.	IS 1097:1979	Specification for handloom cotton mosquito netting first revision
2.	IS 1143:1973	Specification for cotton mosquito netting square mesh first revision
3.	IS 1431:1973	Specification for cotton mosquito netting round mesh first revision
4.	IS 4355:1977	Specification for fire-resistant brattice cloth first revision
5.	IS 6994: Part 1:1973	Specification for industrial safety gloves - Part 1 - Leather and cotton gloves
6.	IS 8990:1978	Code of practice for maintenance and care of industrial safety clothing
7.	IS 9886:1990	Mosquito nets - Specification first revision
8.	IS 10054:1996	Textiles - High density polyethylene HDPE monofilament mosquito netting round mesh - Specification first revision
9.	IS 11871:1986	Methods for determination of flammability and flame resistance of textile fabrics
10.	IS 12467: Part 1:2006	Textiles - Assessment of the ignitability of upholstered furniture - Part 1 - Ignition source smouldering cigarette first revision
11.	IS 12467: Part 2:2006	Textiles - Assessment of the ignitability of upholstered furniture - Part 2 - Ignition source match flame equivalent first revision
12.	IS 12722:1989	Textile floor coverings - Determination of flame resistance by tablet test
13.	IS 13501:1992	Textiles - Determination of flammability by oxygen index
14.	IS 14744:1999	Flame retardant protective hoods - Specification
15.	IS 14953:2006	Textiles - Polyester or polyamide mosquito nets - Specification first revision
16.	IS 15071:2002	Chemical protective clothing - Specification
17.	IS 15321:2003	Molten metal splash protective hoods - Specification
18.	IS 15589:2005	Textile fabrics - Burning behaviour - Determination of ease of ignition of vertically oriented specimens
19.	IS 15590:2005	Textile fabrics - Burning behaviour - Measurement of flame spread properties of vertically oriented specimens
20.	IS 15612: Part 1:2005	Textile - Burning behaviour of curtains and drapes - Part 1 - Classification scheme
21.	IS 15612: Part 2:2006	Textile - Burning behaviour of curtains and drapes - Part 2 - Measurement of flame spread of vertically oriented specimens with large ignition source
22.	IS 15612: Part 3:2005	Textiles - Burning behaviour of curtains and drapes - Part 3 - Method for determining the ignitability of vertically oriented specimens small flame
23.	IS 15612: Part 4:2005	Textiles - Burning behaviour of curtains and drapes - Part 4 - Method for determining the flame spread of vertically oriented specimens
24.	IS 15727: Part 1:2020	Textiles - Assessment of the ignitability of bedding items - Part 1 - Ignition source smouldering cigarette first revision
25.	IS 15727: Part 2:2020	Textiles - Assessment of the ignitability of bedding items - Part 2 - Ignition source - Match-flame equivalent first revision
26.	IS 15741:2007	Textiles - Resistance to ignition of curtains and drapes - Specification
27.	IS 15742:2007	Textiles - Requirements for clothing made of limited flame spread materials and material assemblies affording protection against heat and flame - Specification
28.	IS 15748:2007	Textiles - Protective clothing for industrial workers exposed to heat excluding firefighters and welders clothing
29.	IS 15758: Part 1:2020	Textiles - Protective clothing - Part 1 - Determination of heat transmission on exposure to flame first revision
30.	IS 15758: Part 2:2007	Textiles - Protective clothing - Part 2 - Assessment of material assemblies when exposed to source of radiant heat

31.	IS 15758: Part 3:2007	Textiles - Protective clothing - Part 3 - Test methods for resistance of materials to penetration by liquids
32.	IS 15758: Part 4:2020	Textiles - Protective clothing - Part 4 - Method of test for limited flame spread first revision
33.	IS 15758: Part 5:2020	Textiles - Protective clothing - Part 5 - Assessment of resistance of materials to molten metal splash first revision
34.	IS 15764:2008	Textiles - Determination of burning behaviour of textile floor coverings
35.	IS 15768:2008	Textiles - Resistance to ignition of upholstered composites used for non-domestic furniture - Specification
36.	IS 15781:2008	Textiles - Method for determination of flammability of blankets
37.	IS 15782:2008	Textiles - Method for determining deterioration of visibility due to smoke released on combustion of materials
38.	IS 15809:2017	High visibility warning clothes - Specification first revision
39.	IS 16655:2017	Textiles - Protective clothing for use in welding and allied processes
40.	IS 16725:2018	Textiles - Tactical 3 points sling universal - Specification
41.	IS 16726:2018	Textiles - Pouch for ammunition and grenades made of disruptive pattern nylon 6 6 - Specification
42.	IS 16874:2018	Textiles - Protective gloves for firefighters - Specification
43.	IS 16890:2018	Textiles - Protective clothing for firefighters - Specification
44.	IS 17051:2018	Textiles - Bullet resistant jackets - Performance requirements
45.	IS 17286:2019	Textiles - Waterproof multipurpose rain poncho with convertibility as bivouac - Specification
46.	IS 17291:2019	Textiles - Flame retardant jute based decorative and cover fabric for temporary structure - Specification
47.	IS 17377: Part 1:2020	Textiles - Nuclear biological chemical NBC permeable protective clothing - Part 1 - Qualitative method of determining breakthrough time on exposure to chemical warfare agent sulphur mustard HD
48.	IS 17377: Part 2:2020	Textiles - Nuclear biological chemical NBC permeable protective clothing - Part 2 - Quantitative method of determining permeation resistance on exposure to chemical warfare agent sulphur mustard HD
49.	IS 17380:2020	Textiles - Test method for permeation testing of protective ensembles with nerve agents or simulants
50.	IS 17462: Part 1:2020	Clothing for protection against heat and flame - Determination of contact heat transmission through protective clothing or constituent materials - Part 1 - Contact heat produced by heating cylinder
51.	IS 17462: Part 2:2020	Clothing for protection against heat and flame determination of contact heat transmission through protective clothing or constituent materials - Part 2 - Test method using contact heat produced by dropping small cylinders
52.	IS 17464:2020	Protective clothing - Mechanical properties - Test method for the determination of the resistance to puncture and dynamic
53.	IS 17465:2020	Protective clothing - Mechanical properties - Determination of resistance to puncture
54.	IS 17466:2020	Protective clothing - Mechanical properties - Determination of resistance to cutting by sharp objects
55.	IS 17467: Part 1:2020	Protective clothing - Test methods for clothing providing protection against chemicals - Part 1 - Determination of resistance to outward leakage of gases internal pressure test
56.	IS 17467: Part 2:2020	Protective clothing - Test methods for clothing providing protection against chemicals - Part 2 - Determination of resistance to inward leakage of aerosols and gases inward leakage test
57.	IS 17467: Part 3:2020	Protective clothing - Test methods for clothing providing protection against chemicals - Part 4 - Determination of resistance to penetration by a spray of liquid spray test
58.	IS 17467: Part 4:2020	Protective clothing - Test methods for clothing providing protection against chemicals - Part 4 - Determination of resistance to penetration by a spray of liquid spray test
59.	IS 17467: Part 5:2020	Protective clothing - Test methods for clothing providing protection against chemicals - Part 5 - Determination of resistance to penetration by a spray of liquid manikin spray test
60.	IS 17468:2020	Clothing and equipment for protection against heat - Test method for convective heat resistance using a hot air circulating oven

Annexure 12

List of standards developed by BIS in Sportech

	IS Number	Title
1.	IS 8430:1977	Specification for nylon fabrics for inflatable equipment
2.	IS 8991:1978	Specification for nylon fabric for sleeping bags
3.	IS 11915:1986	Specification for nylon fabric for making mountaineering equipment

Annexure 13

List of standards developed by BIS in Composites and Specialty Fibres

	IS Number	Title
1.	IS 17297:2019	Textile glass - Staple fibres or filaments - Determination of average diameter
2.	IS 17298 :2019	Reinforcement yarns - Determination of linear density
3.	IS 17299:2019	Reinforcement yarns - Determination of twist
4.	IS 17300:2019	Textile glass - Yarns designation
5.	IS 17301:2019	Textile glass - Yarns determination of breaking force and breaking elongation
6.	IS 17302:2019	Textile glass - Mats determination of tensile breaking force
7.	IS 17303:2019	Reinforcement yarns - Determination of twist balance index
8.	IS 17304:2019	Textile glass - Determination of stiffness of rovings
9.	IS 17305:2019	Reinforcements woven fabrics - Determination of number of yarns per unit length of warp and weft
10.	IS 17306:2019	Carbon fibre - Determination of density
11.	IS 17307:2019	Carbon fibre - Determination of filament diameter and cross-sectional area
12.	IS 17308:2019	Carbon fibre - Designation system for filament yarns
13.	IS 17309:2019	Reinforcement products - Mats and fabrics - Determination of mass per unit area
14.	IS 17311:2019	Carbon fibre - Determination of the tensile properties of single-filament specimens
15.	IS 17312:2019	Textile glass - Woven fabrics - Determination of thickness
16.	IS 17313:2019	Reinforcement products - Determination of moisture content

Annexure 14

List of standards developed by BIS in Ropes and Cordages

	IS Number	Title
1.	IS 1084:2005	Textiles – Manila ropes – Specification (fifth revision)
2.	IS 1321 (Part 1) :2003	Sisal ropes – Specification - Part 1 - Untarred varieties (fourth revision)
3.	IS 1321 (Part 2) :1982	Specification for sisal ropes - Part 2 - Tarred varieties (second revision)
4.	IS 1410:2019	Textiles – Coir ropes – Specification (fourth revision)
5.	IS 1804:2004	Steel wire ropes – Fibre main cores – Specification (fourth revision)
6.	IS 1857:1972	Specification for tarred hemp marline, two-ply (first revision)
7.	IS 1887:1985	Specification for spun jute yarn (second revision)
8.	IS 1912:1984	Specification for country jute twine (second revision)
9.	IS 1920:1987	Specification for hemp lines (second revision)
10.	IS 2452:1985	Specification for hawser-laid cotton rope (second revision)
11.	IS 2453:1989	Cable-laid cotton rope – Specification (second revision)
12.	IS 2807:1981	Specification for whipcords (first revision)
13.	IS 2819:1983	Specification for braided cotton cord (second revision)
14.	IS 3252:1987	Specification for shroud-laid cotton line (second revision)
15.	IS 3256:1980	Code for inland packaging of ropes and cordages (first revision)
16.	IS 3262:1987	Specification for pilot lead line (first revision)
17.	IS 3871:2013 ISO 1968:2004	Fibre ropes and cordage – Vocabulary (third revision)
18.	IS 4145:1987	Code of practice for storage of ropes (first revision)
19.	IS 4572:2014 ISO 1140:2012	Fibre ropes – Polyamide 3- 4- 8- and 12-Strand ropes
20.	IS 4575:1983	Code for handling of fibre ropes (second revision)
21.	IS 5175:2014 ISO 1346:2012	Fibre ropes – Polypropylene split film, monofilament, and multifilament (PP2) and polypropylene high- tenacity multifilament (PP3) – 3-, 4-, 8- and 12-strand ropes (third revision)
22.	IS 5176:1985	Specification for hawser-laid hemp ropes (first revision)
23.	IS 5177:1985	Specification for jute lines and ropes (first revision)
24.	IS 6587:1987	Specification for spun hemp yarn (first revision)
25.	IS 7082:1973	Specification for sisal lines
26.	IS 8674:2013 ISO 1969:2004	Fibre ropes – Polyethylene – 3- and 4 -strand ropes (third revision)
27.	IS 9536:1989	Polyamide cord – Specification (first revision)
28.	IS/ISO 9554:2010 ISO 9554:2010	Fibre ropes – General specifications
29.	IS 9560:1980	Colour code for identification of ropes and cordage
30.	IS 9936:1992	Manila, nylon, polyester, and polypropylene ropes for marine purpose – Guide on equivalence (first revision)
31.	IS 9944:1992	Natural and man-made fibre rope slings – Recommendations on safe working loads (first revision)
32.	IS 11058:1984	Specification for sisal agricultural twines
33.	IS 11066:2014 ISO 1141:2012	Fibre ropes - Polyester 3-, 4-, 8- and 12- strand ropes (second revision)
34.	IS 11199:1985	Specification for HDPE monofilament twine door nets
35.	IS 11521:1985	Specification for cargo handling nets
36.	IS 11927:1987	Specification for netting and fibre rope load restraint systems in surface transport
37.	IS 11928 (Part 1 and 2) : 1987	Specification for roundslings made of man-made fibres for general service

38.	IS 12733:1989	Polyamide double braided rope - Specification
39.	IS 12734:2002	Textiles – Polypropylene twine – Specification (first revision)
40.	IS 14928:2001	Textiles - Composite synthetic fibre ropes - Specification
41.	IS 14929:2001	Textiles - High strength polyolefins copolymer ropes - Specification
42.	IS 15041:2001	Textiles – Flat woven webbing slings made of man-made fibres for general services

Annexure 16

Important funded / sponsored projects undertaken by TRAs (2015-2020)

ATIRA

- Textile Reinforced Precast Panel (MT- 62)
- Setting up Focus Incubation Centre (Mini Mission II of Technology mission on technical textiles)
- Scheme for promoting usage of Geotechnical textiles in North Eastern region
- Execution of 20 projects on application of Geotextile related to roads, water reservoir and hill slopes in North east states (Manipur, Tripura, Mizoram, Meghalaya and Arunachal Pradesh)
- Development of nano fibres based water filter to get safe and pure drinking water for human beings (MT -63)

BTRA

- Studies on effect of plasma treatment for adhesion improvement of coated technical textiles
- Nano fibre application to enhance the anti-clogging properties of geotextiles
- Preparation of nano fibre based protecting clothing against chemical warfare agent
- Development of cotton waste based oil absorbent for oil spill clean-up
- Atmospheric pressure plasma treatment for enhancing the conducting properties of textiles doped with intrinsic conducted polymers
- Development of test method for analysing Hexavalent chromium content in dyes, pigment and textile auxiliaries
- Development of electronic servo control industrial TFO twister for heavy denier filament yarn
- Melt spinning of PVDF / ZnO nanostructure hybrid filament for wearable smart textile
- Analysis of eco-management in Indian textile processing industry
- Studies of radiation induced modification of textile materials

MANTRA

- Effect of structural parameter of fibres and fabrics on properties of nonwoven fabrics.
- Development of protective work wears (gloves, socks) for leptospirosis protection for farm & field workers.
- Development of highly electro-conductive non-metallic textile for sensing application and EMI shielding
- Development of infrared emitting therapeutic fabrics made from thermo- reactive minerals embedded PET filament yarn
- Development of new value added polypropylene spunbond fabrics by coating and finishing application to improve functionality and usage

NITRA

- Development of electronic drape meter based on image analysis technique
- Development of fabric smoothness tester
- Development of smart protective textiles for fire fighter, soldier and old-age people
- Development of protective work-wear for cement porters
- Development of multi layered flame & thermal resistant fabric for fire fighter clothing
- Development of value added products from different fibres in Himalayan region
- Development of improved version of body protector used for riots control
- Development of air cleaner as home textiles to reduce indoor air pollution
- Development of technical textile products in the field of feminine hygiene

SITRA

- Development of a heat and moisture exchange filter
- Development of testing instrument – splash resistance tester and fluid handling capacity tester
- Development of implantable product – anterior cruciate ligament & vascular graft
- Development of indigenous breathable viral barrier fabric
- Development of nanoparticle based transdermal patches of selected cardiovascular drugs
- Design and fabrication of an instrument to assess the puncture resistance of surgical material by using sharp edge puncture probe/syringe needles
- Development of novel bio – degradable adult incontinence device
- Development of total comfort index paradigm for textile structures (sportswear, surgical gown & hotel bed linen)
- Development of eco products – eco clothing & water repellent finishing device
- Development of reusable, biodegradable coverall and antioxidant cosmetotextiles

WRA

- Development of innovative sportech products such as sailing clothes, ballooning fabrics, high adventure sportswear etc. Using low energy, environment friendly hot melt application for new entrepreneurs in sportech sector
- Enhancement of moisture management properties of polyester, polyester/cellulose blend by surface modification using cellulose micro particles
- Design & development of evaporative cooling textiles
- Development of sports gears (inner wears, socks, bands, leggings etc.) with controlled release microencapsulated natural essential, herbal oils for therapeutic benefits including protection of health, skincare and recovery of injuries and hygiene of sportsperson.
- Synthesis of optical whiteners with good photostability and improvements in the bleaching processes to produce photostable bright white and pastel shades woollen casual fashion knitwear, sports and leisurewear products and carpets using indian and other cheaper imported qualities of wool
- Development of active fitness clothing like gym and yoga wear with infra-red thermal reflecting property to enhance body fitness
- Design and development of sportswear and sports accessories having thermo physiological comfort properties in order to enhance the performance assessed by using a sweating thermal manikin system under different environmental conditions
- Design and development of light weight and high impact resistance sports goods

SASMIRA

- Smart shade-net through auto-regulation of thermal and light radiation
- Development of multi-purpose shade net for water harvesting
- Design and development of an instrumental set up for measuring the wind blockage percentage of horticultural wind break nets
- Development of next generation thermo chromatic thermoregulatory agrotextiles for horticulture application
- Development of high strength cost effective seamless technical circular fabric from heavy denier multifilament yarn
- Design & development of a digital instrument for measuring the thermoregulatory properties of textiles
- PP/ /Jute hybrid mulch mat for moisture and temperature management in horticulture application
- Development of biodegradable agrotextile products for horticulture application using keratin based waste products
- Biological synthesis of bio-degradable textile polymer
- Biotransformation of naturally occurring phenolic compounds for development of eco-friendly flame retardants (FR) for imparting functionality to textiles
- Establishment of methodology for green processing of cotton using supercritical carbon dioxide technology
- Design and development of low cost reusable sanitary pads for Indian women

IJIRA

- Development of eco-friendly fibre lubricant in jute processing
- Production of jute-ramie blended fine yarns and fabrics
- Braided jute sapling bags as substitute of poly nursery sapling bags
- Low cost, light weight jute bags for packing food grains and sugar
- Development of moisture meter, autoleveller, sliver grist monitor, electronic jute yarn testing tester and brightness-cum-cover factor meter

Source: Primary survey by IIT Delhi
For SASMIRA and IJIRA, data has been extracted from secondary sources.

Annexure 17

Important In-house projects undertaken by TRAs (2015-2020)

Buildtech & Geotech

- Experimental investigation of strengthening of basalt fibre reinforcement polymer composite bars (Buildtech)
- Treatment of khadi cotton fabric with herbal extract for developing reusable baby diapers (Geotech)

Meditech

- Development of cellulose nanocrystals, bio composite, bacterial cellulose, keratin substrates, nano composite hydrogel, natural tannins for eco coloration & cellulose fibre for oil water separation
- Development of cellulose nano crystal films, cellulose and chitosan based sponges and eco mordant
- Design and fabrication of POSEAT, SIDS monitoring & TREMOR suppression system
- Characterisation of baby diapers and surgical gowns
- Development of eco-friendly natural dyes
- High performance laparotomy sponge, atraumatic wound dressings, cardiovascular drugs
- Design and fabrication of BFE, dry and wet bacterial penetration tester
- Development of testing method for disposable diaper, herbal incorporated sodium alginate nano membrane and biodegradable ADL
- Effect of antimicrobial coated medical textiles
- Characterisation of tea bags & natural dyes
- Development of metallic hydrogel, facial sheet mask
- Top sheet with improved moisture management property, and low lint generation property

Oekotech

- Development of cellulose nanocrystals, bio composite, bacterial cellulose, keratin substrates, nano composite hydrogel, natural tannins for eco coloration & cellulose fibre for oil water separation
- Development of Cellulose nano crystal films, Cellulose and chitosan based sponges and ECO mordant

Protech

- Development of work wear for electroplating workers
- Development of suitable workwear for workers of oil and gas industry

Sportech

- Synthesis of optical whiteners with good photo stability and improvements in the bleaching processes to produce photostable bright white and pastel shades woollen casual fashion knitwear, sports and leisurewear products and carpets using Indian and other cheaper imported qualities of wool
- Development of active fitness clothing like gym and yoga wear with infrared thermal reflecting property to enhance body fitness
- Design and development of sportswear and sports accessories having thermo physiological comfort properties in order to enhance the performance assessed by using a sweating thermal manikin system under different environmental conditions.
- Design and development of light weight and high impact resistance sports goods.

Source: Primary survey by IIT Delhi

Annexure 18

Important consultancy projects undertaken by TRAs (2015-2020)

ATIRA

- Develop quick dam flood barrier PP sand bags
- Develop polypropylene soil bag fabric development to use stacked soil bags to repair work of small earth dams
- Glass fabric lamination with aluminium foil
- Development of nanofibres based membrane for air filtration, thermal insulation fabric and antimicrobial fabric
- Design and fabrication of tools and die system

NITRA

- MDRS-14 (modernisation)
- Manpower assessment study
- TEV study & valuation of fixed assets
- Machinery maintenance audit
- Technical specification on sanitary napkin
- Quality optimisation of cotton wool roll
- Development of antimicrobial finish with microencapsulation technique
- Development of surgical facemask

WRA

- Developing conductive yarns on friction spinning system to provide thermal insulation.
- Developing the high altitude jackets
- Developing coating products using hot melt pressure sensitive adhesive on hot melt laminating and coating machine.
- Development of coated fabrics on hot melt laminating and coating machine.
- Development of a flame retardant fabric samples of 100% PBI filament
- Development of breathable coated textiles
- Development of coated fabrics on hot melt laminating and coating machine.
- Development of coating products with negative ion finishes
- Chemical finishing for friction less yarn
- Developing friction spun yarn from viscose waste

SASMIRA

- Consultancy for the laboratory set up for BIS accreditation of insect net product
- Consultancy for the laboratory set up for BIS accreditation of shade net product

Source: Primary survey by IIT Delhi
For SASMIRA, data has been extracted from secondary sources.

Annexure 19

List of some important training programmes/workshops organised by TRAs (2015-2020)

Composites

- Composite Training covering:
  - Non-destructive testing method
  - Composite testing mechanical properties
  - Training on composite and its application
  - Technical textiles
  - Interactive workshop on application of geotechnical textile in various constructions in the north east region of India
  - Importance of testing of geotechnical textile for designing
- Composite Training covering:
  - Pultrusion
  - Composite training
  - TRC modular toilet training
  - NDT training
  - Geotextile testing – hands on experience
- Composite Training covering:
  - Electrospinning for nanofibre production & its application
  - Processing of composites and testing
  - Textile processing
  - One day workshop on Geotextile in Civil Engineering
- Practical training programme in pultrusion process
  - Training in composites material
  - Application of geosynthetic textiles in the construction of roads, slopes & water reservoirs
  - Advance technologies to mitigate the issues of national highways, landslides & reservoirs in North-East region
  - Improvement of highway infrastructure and slope protection measures in NER with innovative concepts
  - Next frontiers in civil engineering: sustainable & resilient infrastructure for North East region
  - Sustainable construction materials and technologies for infrastructure development in North East region
  - Recent advances in engineering & technology for infrastructure development of North East Region
- Applications and testing facilities at ATIRA for Geotextiles in roads in Gujarat
- Application of Geotextiles in canals and dams

Indutech

- Opportunities for new entrant in technical textiles sector
- Product variants in technical textiles with special reference to small scale industrial sector
- Manufacturing, characterisation and application

Meditech

- EDP in medical textiles training programme
- Healthcare medical textiles training programme
- Hygiene textiles training programme
- Hands on training in medical textile products manufacturing & characterisation
- Awareness training programme on opportunities in medical textile segment
- Faculty development training programme on entrepreneurship in medical textiles
- Three days national workshop on hygiene products : raw material, product development and quality control
- Seven days short term course on medical textiles
- National level workshop on antimicrobial evaluation of medical textile products
- National level workshop on characterisation of medical textile products
- Nanofibres based wound healing bandages for Dr. L. H. Hiranandani College of Pharmacy – Ulhasnagar
- Coating of fire retardant materials on woollen fabric, for UDCT, Jalgaon students
- Protective gears for leptospirosis developed

Protech

- Workshop on "Protective Textiles: Present scenario and future prospect"

- Lecture on "Ballistic Textiles"
- Training programme for procurement officers of border security force on "QRS Specifications/Inspection procedure and Testing/Quality Control of textile materials"
- Workshop on " Cement work-wear, colour difference of work-wear and water vapor permeability study of coated material"
- Workshop on "Automotive textiles: conventional and value added products"
- Workshop on "The use of technical textiles in automotive industry"
- Training on technical textiles and CAD
- Presentation on "Personal protection textiles"

Sportech

- Five days faculty orientation, training and development programme for National Institute of Fashion Technology (NIFT)
- TiO2 nanoparticles finishes on cotton fabric for UV protection and antimicrobial activity for "SNDT Women's University, Mumbai
- Basic course on "knitting & textile testing"
- One week practical training on wool technology & testing
- Basic course on "knitting & textile testing"
- A two day workshop on sport technology was conducted at Shree Guru Gobind Singhji Institute of Engineering & Technology, Nanded, Maharashtra

Other Segments

- Three days training programme on "Textile testing & woollen carding"
- Training for Ethiopian staffs from Ethiopian textile industry development institute (ETIDI'S) on the sportech
- Two week training programme for ICT faculty at COE

Source: Primary survey by IIT Delhi

Annexure 20

List of some international and national conferences, seminars and symposiums organised by TRAs (2015-2020)

ATIRA

- PTFE Nano-fibre based filter media
- Textile Reinforced Concrete
- Importance of testing of geotechnical textiles selection for designing
- Activities in technical textiles & composites VASTRA – 2015
- PU pultrusion application in Indian market
- Technology & Global Benchmarking: Standards and testing of Geotextile
- Antibacterial & pollution face mask using silver coated nanofibre web
- Nano fibre based portable water filter bottle
- Nano electrospinning at ATIRA and its application

BTRA

- Disruptive innovation and textile future
- Joint Technology Conference (2017)
- Buyers / Sellers seminar with special reference to geotextile (2015)
- D35 meeting on testing standard & application of geosynthesis (2015)

NITRA

- Seminar on " Protective Textiles in India and its future"
- Seminar on "Ballistic Textiles and Fire Fighters' Suits"
- Seminar on "Personal Protection Textiles"
- 58 Joint Technological Conference
- Tech-Tex 2019

SITRA

- National level workshop on antimicrobial evaluation of medical textile products
- National level workshop on characterisation of medical textile products
- National level conference on medical device rule – 2017
- Three days national workshop on hygiene products : raw material , product development and quality control
- Workshop on emerging opportunities in medical textiles
- Technology gap assessment of surgical dressing manufacturing cluster
- Emerging opportunities in technical textiles for knitwear industries
- Workshop on investment opportunities in technical textiles with special focus on medical textiles
- Meditex – 2018 exhibition , Mumbai

WRA

- National Seminar on "New Trends in sportswear for improving performance of sport person" was organised by Wool Research Association, Thane COE in Sportech & LNIPE NERC, Guwahati at Guwahati on 27th June, 2017
- "Technological advancement in the "Sportwears and sport footwear" at Sports Authority of India, Bangalore on 28th June, 2017
- Wool Research Association organised a half day seminar titled "seminar on sportech" at Sports Authority of India, Gandhinagar on 29th June, 2017
- Q-Lab Corporation (USA) and Venture Technologies along with WRA's COE –Sportech had organised a seminar on "Colour Fastness to Light & the Importance of Standards in Textiles" at Ramada Powai Hotel & Convention Centre, Saki Vihar Road, Mumbai on Thursday, June 30, 2016
- National Conference organised by Wool Research Association & Institute of Chemical Technology at ICT, Matunga On "SPORTECH – An Ocean of Opportunities", in collaboration with office of The Textile Commissioner, Mumbai on March 15, 2016 at Institute of Chemical Technology, Mumbai
- Awareness programme on 'Sportech' at Textile Research & Application Development Centre (TRADC) Aditya Birla Science and Technology Company Pvt. Ltd. was conducted at Textile Research & Application Development Centre (TRADC) on 8th & 9th September 2015

SASMIRA

- Holistic alternative to enhance yield and profitability of Horticulture and Agriculture

- Management Perspectives to Agribusiness
- One day seminar on "Agro textiles: Holistic alternative to enhance yield and profitability of Horticulture and Agriculture" on 2014 April 2018 at Upper Shillong, Meghalaya
- One day seminar on "Agro textiles: Holistic alternative to enhance yield and profitability of Horticulture and Agriculture" on 23rd April 2018 at Tezpur, Assam
- Seminar on "Sustainable Textiles: A Way Forward" at SASMIRA, dated 16 November 2019
- One day conference on "Investor conclave manufacturing opportunities; challenges luggage; bags industry in India", dated 19 November 2019 in collaboration with UKSL

Source: Primary survey by IIT Delhi
For SASMIRA, data has been extracted from secondary sources.

Annexure 21

Some technology transfers related to technical textiles by TRAs (2015-2020)

ATIRA

- CFRP Triangular Core

BTRA

- TFO project

MANTRA

- Effect of structural parameter of fibres and fabrics on properties of nonwoven fabrics
- Development of protective work wears (gloves, socks) for leptospirosis protection for farm & field workers

NITRA

- License to manufacture "NITRA electronic drape meter"
- Development of protective work wear for cement porters
- License to manufacture "NITRA Smoothness Tester"
- Development of multi-layered flame & thermal resistance fabric for fire fighter clothing
- Technology on development of stab and impact resistant material for anti-rots body protector
- Synthetic blood penetration tester

SITRA

- Nano finished fabric for manufacturing surgical gown
- Collagen coated hernia mesh
- Nonwoven based laparotomy sponge
- SITRA splash resistance tester
- Technology of dry bacterial penetration resistance tester
- Technology of SITRA blood penetration resistance tester
- Viral penetration resistance tester

Source: Primary survey by IIT Delhi

Annexure 22

Important Instruments/ Machines/ Technology developed by TRAs (2015-2020)

Buildtech

- TRC modular toilet

Geotech

- Development of water permeability tester for nonwoven

Hometech

- Atmospheric pressure Plasma

Meditech

- Leukodepletion Blood Filter
- Anterior Cruciate Ligament
- Polyester Vascular Graft
- Honey based wound care products
- Breathable Viral Barrier (BVB) film
- Transdermal patch
- Development of N99 filter media for face mask using silver coated nanofibre web

Other Segments

- Development of CFRP based component for Satellite application
- Triangular Core Manufacturing Technology
- PP tough sheet development for sport gear application

Source: Primary survey by IIT Delhi

Annexure 25

Technical textiles testing facilities provided by COEs

S.No.	List of the products tested	List of the properties tested	Standard test methods used in testing
Sportech			
1	Sportswear, protective clothing, high altitude clothing	To measure thermal properties and water vapour resistance under steady state conditions using Sweating Guarded Hotplate	ISO 11092 ASTM F1868 GB 11048
2	General textile wear, Knit and non-woven textile fabrics, sportswear, protective, breathable fabrics	To measure the dynamic liquid transport properties of knitted and woven fabrics using Moisture Measurement Tester	AATCC 195
3	Coated fabrics such as sportswear, protective clothing, high altitude clothing etc. raincoats, tents etc	To measure the Water Vapour Transmission Rate Using Water Vapour Transmission Rate Tester	ISO 15496, BS 7209 ASTM 1868
4	Sportswear, protective clothing, high altitude clothing, sleeping bag	Scientific testing of thermal environments without the risk or inaccuracies inherent in human subject testing using Thermal Manikin	ASTM F1291 ASTM F 1720 ASTM F2370 EN 13537 ISO /DIS 15831
5	General Apparel fabrics, Vertically oriented fabrics such as curtains, drapes and blinds, night wear products, Personal Protective Clothing	Flammability resistance of vertically oriented fabrics using AutoFlamm Flammability Tester	BS 5438 ISO 6941 BS 5866 ISO 6940 DIN 66080
6	Textile materials, fabrics, plastic and polymer materials solid, laminated or cellular materials, flexible sheet or film materials	To determine minimum oxygen concentration, expressed as %, that will support for continues combustion of materials Using Limiting Oxygen Index Test Apparatus	IS 13501 ISO 4589-2 ASTM D 2863
7	Textile fabrics, non-woven, chemical coated fabrics, automotive textiles etc	To measure toxicity index of coated textiles & other materials using Toxicity Index Tester	NCD-1409
8	UV finished textile fabrics such as garments, swim wear, parachutes fabrics, sailing cloth, tent etc	To measure the UV Protection properties of fabric/textiles under UV Spectrum using UV -Spectrophotometer	AS/NZS 4399:1996 AATCC 183:2010 EN 13758-1:2002 GB/T18830:2009
9	Fabrics used in clothing, footwear and industrial applications	Determines the wear and abrasion resistance of fabrics used in clothing, footwear and industrial fabrics using Universal Wear Tester	AATCC 119 AATCC 120 ASTM D3514 ASTM D3885 ASTM D3886 FORD EFB15J2 FORD BN112-01 FTM S 191 FTM S 5300 FTM S 5302 WSP 020.1.R3 (12) WSP 020.2.R3 (12) IST 20.1 (01) 3.1 IST 20.2 (01) 3.9

10	Parachutes fabrics, Sailing cloth, Tent, Air bags, Active wear, untreated & treated fabrics materials such as woven, non-woven, blankets, and knitted fabrics.	To determine the resistance of fabrics (woven, knitted and non-woven textile materials) to the passage of air using Air Permeability Tester	ASTM D737 BS 5636 EDA NA 140.1 DIN 53887 JIS L 1096-A EN ISO 9237
Composites			
11	FRP composite products/sample	Tensile Test	ASTM D638 ASTM D3039 ISO 527 IS 1998
		Flexural Test	ASTM D790 ISO 178 ISO-14125
		Bending Test of complete section	UDL, LDL
		Bearing test	ASTM D953
		Compression test	ASTM D790 ISO-14126
		Izod Impact strength	ASTM D256 ISO-180
		Charpy Impact test	ISO-179
		Drop impact testing	ASTM D3763 ISO-6603
		Rockwell Hardness	ASTM D785 ISO-3039
		Barcol Hardness	ASTM D2583
		ILSS	ASTM D2344 ISO-14130
		Inplane shear	ASTM D3846
		Poisson's ratio	ASTM D3039 ISO-527-4
		Cross breaking strength	ASTM D1938
		HDT	ASTM D648 ISO-75
		Glass fiber content by volume fraction	ASTM D2584
		Density	ASTM D792
		Fire Resistance	ASTM D1525 ISO 306
		Horizontal/Vertical flammability	UL 94/ASTM D 635 IS 6746:1994 Clause 4.4, IS 11731 (Part 1 & 2), ASTM D4986, ISO 9772
		LOI	ASTM D 2863 ISO 4589-2 ISO 4589-3
		Toxicity Index	NES 713 NCD-1409
		NBS Smoke Density Chamber	BS 6401 ASTM E662 ASTM F814 NFPA 258 ISO 5659-2/IMO FTPC Par-2 ATS 1000.001/ ABD0031

			NES 711
		Flooring Radiant Panel	ASTM E 648 & ISO 9239-1, ASTM E 970, NFPA-253
		Cone Calorimeter	ISO 5660 & ASTM E 1354
		Spread of Flame	ISO 5658 Part 2 & 4, IMO Resolution A.653 (16); ASTM E 1317; ASTM E 132
		DSC	ASTM E1356
		Single flame Source test	EN ISO 11925-2, UIC-564-2, Appendix-5
		Limiting Oxygen Test	ISO-4569, ASTM D2863, IS 13501, IS 13660
		Elevated temperature oxygen test	ISO-4589-3
		Full section test Breaking strength	CTI-137
Jute Geotextile			
12	Jute geotextiles	Determining apparent opening size	ASTM D 4751
		Mass per unit area (weight)	ASTM D 3776
		Thickness	ASTM D 5199
		Water permeability	ASTM D 4491
		Wide width tensile strength	ASTM D 4595
13	Soil	Dynamic core penetrometer	ASTM D 6951
		California Bearing Ratio	ASTM D 1883
		Liquid limit, plastic limit and plasticity index of soil	ASTM D 4318
Nonwovens			
14	Thermal Insulator	Thermal Conductivity Test	ISO 8301: 2010
15	Nonwoven Geotextile	UV Accelerated Weathering Test Tensile Strength Bursting Strength	ASTM D 4355 ASTM D3786
16	Non-woven filters	Stiffness test	ASTM D 5732 -95.
17	Coated woven textile	Hydrostatic water head	EN ISO 20811
18	Mask fabric / Filter fabrics	Pore Size of fabrics	ASTM E 1294-89 ASTM F316-03
19	Textile material	Thickness Test	ISO 9073-2
20	Diaper cover stock	Liquid Strike-Through	Liq. strike-through time by EDANA/INDA-standards WSP70.3, Wet back by EDANA/INDA stds WSP 80.10
21	Nonwoven geo bag	Tensile Strength	ASTM D 4595
22	Flexible Heat-Sealed Packages	Water Vapor Transmission	ASTM D 4716-87
23	Spun bond non-woven fabric for different application	UV Accelerated Weathering Test Tensile Strength	ASTM D 4355- IS 15891 (Part 3): 2011
Agrotech & Packtech			
24	Shade-net	Breaking strength, Color fastness, Bursting Pressure, Haze Percentage	IS 16008 : Part 1 : 2016 IS 16008 : Part 2 : 2016
25	Woven Ground Cover/ Mulch Mat	Mass, Tensile strength, Tear strength, Air permeability, Index puncture resistance, UV accelerated exposure testing, Water permeability, Water vapour permeability	IS 16202 : 2014
26	Insect Protection Net	Mass, Cover factor, Breaking strength, Retention of breaking strength after UV exposure, Bursting Strength, Air permeability	IS 16513 : 2016

27	Anti-hail net		Standard Formulation in process In house method is being used
28	Bird protection net		Standard Formulation in process In house method is being used
29	Wind Shield		IS 17356 : 2020
30	Banana Bunch cover	Length, Mass, Width, Thickness, Tensile strength, Elongation, Trapezoid tear strength, Air permeability, UV Stability, Index puncture resistance, Water absorption capacity, Colour, Ash content, Water vapour permeability	IS 16718 : 2017
31	Pond Liner		IS 15351 : 2008
32	Vermicompost bed	Mass, Breaking strength, Elongation at break, Welded seam strength, Tear strength, Puncture strength, Environmental stress cracking test, Resistance to chemicals, Colour fastness and Bursting pressure	IS 15907 : 2010
33	Plant support net/rope		Standard Formulation in process In house method is being used
34	Harvest Net	Mass, Average breaking strength, Retention of breaking strength after UV exposure, Colour fastness to artificial light, Bursting pressure, Air permeability	IS 17357 : 2020
35	Crop Cover	Length, Mass, Width, Thickness, Tensile strength, Elongation, Trapezoid tear strength, Air permeability, UV Stability, Index puncture resistance, Water absorption capacity, Colour, Ash content, Water vapour permeability	IS 16718 : 2017
36	Jute Agrotextile mulch	Mass, Thickness, Tear strength, Bursting Strength, Index Puncture Resistance, Air and Water permeability	IS 17070 : 2019
37	PP Spun bonded Nonwoven Mulch		IS 17355 : 2020
38	Agrotextile Fencing Net Extruded Polymer Mesh		IS 17358 : Part 1 : 2020
39	Agrotextile Fencing Net Made from Mono Filament Yarns and Combination of Tape and Mono Filament Yarns		IS 17358 : Part 2 : 2020
40	Jute Agrotextile Sapling Bag	Mass, Thickness, Open area, Dimensions, Water holding capacity and Tensile strength	IS 16089 : 2013
41	High density polyethylene (HDPE) laminated woven lay flat tube		IS 16190 : 2014
Protech and Mobiltech			
42	Flame, Heat, Electric & Thermal Resistance	Pre-treatment after washes before FR test	IS 15370-2A/ISO 6330-2A
43		Heat resistance	ISO 17493 (180°C)
44		Flame spread — Face ignition	IS 15758 (Part 4)/ISO 15025: 2000 (A) /BS 5867/BS 5438-1A BS 5438-2A BS 5438-3A
45		Flame spread — Edge ignition	IS 15758 (Part 4)/ISO 15025: 2000 (B)/BS 5867/BS 5438-1B BS 5438-2B BS 5438-3B

46		Impact of spatter (up to class-2)	ISO 9150
47		Electrical resistance	EN 1149-2
48		Convective heat	IS 15758/(Part 1)/ISO 9151
49		Radiant heat	IS 15758 (Part 2)/ISO 6942
50		Molten Aluminium Splash - up to D1 -up to D2 -up to D3	ISO 9185
51		Molten Iron Splash -up to E1 -up to E2 -up to E3	ISO 9185
52		Contact Heat —Heating cylinder	ISO 12127
53		Sweating guard hot plate -Thermal Resistance (Rct) -Water vapour resistance (Ret)	ISO 11092 test (Ret can also be tested as per ASTM F 1868 Part B)
54		Limiting Oxygen Index -Fabric -Nonwoven, plastic, wood Etc	IS 13501/ASTM D 2863/ NCD 14510
55		Vertical Flammability test - IS 15061 - IS 11871/ BS 5438	IS 15061 Annex B/11871 Method A
56		Inclined Flammability Test	IS : 11871 Method-B/ASTM D1230/ AATCC-33
57		Horizontal Flammability Test	IS 15061 Annex AIFMVSS 701
58		Methenamine Tablet test	BS 6307/ASTM D 2859/NFPA 101
59		Cigarette test (Source zero)	BS 5852
60		Small Flame test (Source 1)	BS 5852
61		Fire test -NFPA 701 Method 1 -NFPA 701 Method 2	NFPA 701
62		Thermal Protective Performance Test (TPP / HTP)	NFPA-2112, ISO 17492, NFPA 1971, NFPA 1981, ASTM F 2700, ASTM 2703 (For contact & Space both)
63		Surface Flammability Test	ISO 5658-2/ IMO A 653
64		Heat resistance	Hot Air Oven
65		Humidity Resistance	Humidity chamber
66	High Visibility Clothing	Colour performance — Chromaticity coordinates and luminance factor (Normal state)	IS 15809/BS EN 20471
67		Colour performance — Chromaticity coordinates and luminance factor (After Xenon test)	IS 15809/BS EN 20471
68		Photometric for retro-reflective material (Normal state) -Chromo city -Retero reflection	IS 15809/BS EN 20471

69		Photometric for retro- reflective material (After exposure to Abrasion, Flexing, Temperature variation, Washing, Cold fold, Dry cleaning, Rainfall)	IS 15809/BS EN 20471
70	Automotive Textiles	Colour Fastness to Light (Xenon Arc) -One sample -For two samples -More than three samples	GME 60292/SAE J 1885/TSL 3600 G/ TSL 0601 G/MS —300-35/AATCC 16 H/JASO M 403-83/HES D 6601/JASO M 346/EDS-T-7415/GM 9538P
71		Colour definition (XYZ & L a b Values)	Using CCM
72		Abrasion Resistance (Taber Type) Abrader Wheel (CS-10, H-18, H-22 & H-38) Upto 1000 Cycles Upto 1500 Cycles Upto 2000 Cycles	SAE J1530 —A, SES N 3246, JASO 403, SAE J948, MS 300-32 SES N 3298
73		Flammability	SAE J 369, FMV SS 302, SES N 3245 HES D-6003, JASO M 313, GM 9070P MS 300-8
74		Smell (Dry & Wet Condition)	TSL 3505G, TSM 0505 G
75		Smell (40C- 95% RH X 400 HRS)	TSL 3505G
76		Odor property	HES D6507/MS 300-32/FMLT 131-01
77		Fog Test -Fog Number -Fog Percentage -Attached mass	TSL 3608G/MS 300-54/TSM 0503G/ EDS T 7694, FLTM BO 116-03/SAE J 1756
78		Colour Fastness to Crocking / Rubbing	FLTM BN 107-01/JASO M 313 EDS-T-7643
79		Dimensional change by Moisturing/ Immersion Shrinkage	HES D 6506/JASO M 313-83 MS 300-32/FLTM BN 105-01
80		Dimensional Stability against Humidity	MS 300-32
81		Dimensional Change by Heating	HES D 6506/FLTM-BN-105-01
82		Water Resistance/Repellency	HES D 6506/Ms 300-32
83		Resistance to Bleeding	AN 101 - 01
84		Resistance to Bleeding	AN 101 - 01
85		Resistance to Heat	(100°c for 8 hrs)
86		Resistance to Humidity	(40°C- 95% RH for 8 hrs)
87		Steaming in Autoclave	(100°C for 1 hr)
88		Colour fastness to Crocking	TSL 3600 G/BN 107-01/FLTM BN 107-01/MS 300-32
89		Soil Resistance (Oil, Water and drop)	Automotive standard
Geotech & Oekotech			
90	Geomembrane Conformance Tests	Carbon black content	ASTM D 1603
91		Environment stress cracking resistance	ASTM D 1693
92		Melt flow index	ASTM D 1238
93		Modulus of elasticity	ASTM D 638/ D 6693
94		Puncture resistance	ASTM D 4833
95		Tear resistance	ASTM D 1004

96		Thickness	ASTM D 5199/ D 5994
97		Tensile strength and elongation at yield and break	ASTM D 638/ 6693
98	Geonet & Geogrid Conformance	Carbon black content	ASTM D 1603
99		Junction (Node) Strength	ASTM D 6637
100		Melt flow index	ASTM D 1238
101		Puncture resistance-CBR	ASTM D 6241/ ISO 12236
102		Tensile strength	ASTM D 6637
103		Thickness	ASTM D 5199
104	Geotextile conformance tests	Apparent opening size (AOS)	ASTM D 4751
105		Grab strength & Elongation	ASTM D 4632
106		Mullen Brust Strength	ASTM D 3786
107		Permittivity	ASTM D 4491/ ISO 11058
108		Puncture Resistance (Index)	ASTM D 4833
109		Puncture Resistance (CBR)	ASTM D 6241
110		Thickness	ASTM D 5199
111		Trapezoid Tear Strength	ASTM D 4533
112		Unit weight (Mass/Unit Area)	ASTM D 5261/ ISO 9664
113		Wide-Width Strip Tensile Properties	ASTM D 4595/ ISO 10319
114		Pore Size	ASTM D 6767
115		Cone Drop Test	BS EN 918/ ISO 13433
116	Geosynthetic Clay Liner (GCL) Conformance Tests	Bentonite Swell Index	ASTM D 5890
117		Thickness	ASTM D 5199
118		Unit Weight (Mass/Unit area)	ASTM D 5993
Agrotech			
119	Non-woven And Coated fabric	Air permeability	i) ASTM D-737 ii) BS-5656
120	Tensile tester	Tensile Strength & Elongation	IS 7016 (Part-2):1981
121	Tensile tester	Tearing Strength	IS 7016 (Part-3):1981
122	Liquid Wicking Rate Test Kit	Vertical Permeability to liquid without load	EN ISO 11058
123	Water Vapour Transmission Rate Tester	Water Vapour Transmission Rate Tester	ASTM D-6701
124	WIRA Run-off Test Kit	Measures the amount of test liquid which runs down a non-woven test piece	AATCC TM 42-2000
125	Spray Rating Tester	Resistance of fabric to surface wetting	AATCC 22
126	Shower tester	Resistance of fabric to artificial shower	BS 5066:1974
127	Cover Stock Wetback	Measures rewetting properties of non-woven cover stock	EDANA 150.5-02 & EDANA 151.2-99
128	TOG Tester	Thermal Resistance of continental quilts	BS5335 Part 1
129	Taber Abrasion Tester	Measures abrasion resistance of fabric by weight loss	-
130	Vertical Flammability Tester	Vertical flammability of fabric	ASTM D 1230
131	Liquid Absorbency Time Test Kit	Time required for complete wetting	ISO 90736
132	Liquid Absorbency Capacity Test Kit	Amount of liquid that specimen can hold after a period of immersion and drainage	ISO 90736
133	Liquid Wicking Rate Test Kit	Determines the rate of vertical capillary rise in a specimen strip suspended in a liquid	ISO 5725
134	Surface Resistance Tester	Electrical Resistance	D 257
135	Film Thickness Tester	Measures thickness of synthetic films, metal foils and	DIN 53370 & DIN 55543

		paper	
136	Rheometer	Measures simple viscosity at a given speed or shear rate. Measures flow properties with a flow curve at a hear rate upto 1200 sec-1	-
137	Contact Angle Meter	Measures Static and Dynamic contact angle of any fluid with fabric by sessile and captive method. Measures surface free energy, surface & interfacial tension	-
138	Vibrodyne	Measures force, elongation, tenacity, preloading, tenacity at certain elongation, young modulus, work, NDR of fibres	DIN 51221 & DIN 53816
139	Photosynthetic Apparatus	Measurement of PAR Value and Rate of photosynthesis and related parameters	-
140	Dust Filter Test Rig	Dust filtration efficiency	-
141	Shear Tester	Measures the length of time it takes for the adhesive sample to fail in shear mode	ASTM D-3654
142	Flex Tester	Flexing of Fabric	-
143	Flex Tester	Flexing of Fabric in cold environment (-5°c to -60°c)	-
144	Computer Colour Matching (CCM)	Computer Colour Matching	-
145	Differential Scanning Calorimeter(DSC)	Differential Scanning Calorimetry	-
146	Hydrostatic Head Tester	Water resistance	ISO 811
Meditech			
148	Surgical gown/ drape	Impact penetration Hydrostatic resistance Synthetic Blood Penetration Resistance Particle release Moisture vapour transmission rate Tensile strength Bursting strength Viral Penetration Test Cleanliness–microbial (CFU/100 cm2) Resistance to microbial penetration - Dry Cytotoxicity Irritation and skin sensitisation	IS 17334 AAMI PB 70 EN 13795 EN 14126
149	Surgical facemask	Differential Pressure Splash Resistance Particulate Filtration Efficiency at 0.3 microns Bacterial Filtration Efficiency Flammability	IS 16289 ASTM F 2100 EN 14683
150	Sanitary Napkin	Length Width Thickness Absorbency Disposability pH	IS 5405
151	Baby diaper	For Top layer, liquid strike through time Wetback Run-off For Core Material, Free Swell Capacity Centrifuge Retention Capacity Absorption against Pressure pH	The tests are carried out in WSP, ISO 9073 standards

152	Incontinence diaper	Wicking rate Retention capacity Absorbency Absorbency before leakage liquid strike through time Wetback Run-off Free Swell Capacity Centrifuge Retention Capacity Absorption against Pressure pH	The test is carried out in WSP, ISO 9073 standards
153	Surgical dressings	Fibre identification Yarn numbers Threads per stated length Weight per unit area Minimum breaking load Elasticity Extensibility Adhesiveness Water Vapour Permeability Water Proofness Absorbency Water Soluble substances Ether Soluble substances Colour fastness X-ray opacity Sulphated ash of surgical dressings Water retention capacity	IS 14944, BP standards
154	Crepe bandage	Yarn count Warp yarn twist Threads/10cm Stretchability Breaking load and pH	IS, BP, ASTM standards
155	Sports wears	Moisture management test Moisture vapour Transmission Rate Air permeability Tensile Strength Tear Strength Bursting Strength	AATCC and ASTM standards
156	Coverall	Synthetic Blood Penetration Resistance Test Viral Penetration Resistance Test Resistance to Dry Microbial Penetration	IS, ISO, ASTM standards
157	Implantable products	Threads per inch Pore area Tensile strength Bursting strength Filament diameter Knot pull strength	IS, BP, ASTM standards
Hometech & Indutech			
158	Filter bag / Media	Tensile and elongation	ISO 9073-3
159	Filter bag / Media	Tensile and elongation	DIN EN ISO 29073-1992-08
160	Filter bag / Media	Taber Abrasion Resistance	ASTM D 3884
161	Filter bag / Media	Air permeability	ASTM D 737
162	Filter bag / Media	Capillary Flow Porometer	ASTM D 6767

163	Silicon Coated Glass Fabric	Tensile Strength	EN ISO 1421
164	Silicon Coated Glass Fabric	Tear Strength	EN ISO 4674-1
165	Composite Materials, Foams, Non-Wovens, Mordants	Thermal conductivity	ISO 8301: 2010
166	Sound Insulation Materials	SAC & Transmission loss	ISO 10534 – 2: 1998
167	Rubber, Plastic, and Coated Fabrics	Fogging characteristics	ISO 6452: 2007
168	Textiles with Water Repellent and Water Resistance Fabrics	Water Resistance: Hydrostatic Pressure Test	AATCC 127 ,Method A: 2017
169	Technical textiles	Flammability Testing, Impedance Tube, Surface Resistivity Tester, Moisture Management, FESEM, FTIR, UPF, XRD, Weatherometer	All relevant standards

Annexure 27

Key instruments and product development facilities at COEs

S.No.	List of the important instruments available	List of the product development facilities available	Applications of products developed
Sportech			
1	Atomic Force Microscopy (AFM)	Hot Melt Laminating & Coating machine	Develop conductive yarns on friction spinning system to provide thermal insulation
2	Kawabata Evaluation System	Evenness tester	Developed high altitude jackets
3	FTIR Spectrometer	Sweating Thermal Mannequin	Develop coating products using hot melt pressure sensitive adhesive on hot melt laminating and coating machine
4	ICP-OES	Warp Knitting Machine (Raschel)	Developed breathable coated textiles
5	Electrospinning system	Warp Knitting Machine (Tricot)	Developed Flame retardant fabric samples of 100% PBI filament
6	Surface Resistance tester-Electrostatic Resistance (EN 1149)	Rapier Weaving machine	Developed coating products with negative ion finishes
7	Universal weathering machine	Compression Moulding Machine	Developed Chemical finished frictionless yarn
8	De Matia flex tester	Ring frame	Developed friction spun yarn from viscose waste
9	UTM 100 kN Tester	Roving frame	Development of keratin-based Biocomposite films and Electrospun Nanofibrous mats from wool wastes
10	BAW abrasion tester	Circular Knitting Machine	Developed evaporative cooling jackets
11	Chemical Repellency Tester	Braiding machine	Developed sleeping bag
12	Precision winding machine for carbon	Zero grade Granite table	Developed active fitness clothing like gym and yoga wear
Composites			
13	Pultrusion Machine	Continuous different profile manufacturing by composites	Building, construction, and Engineering application
14	Braiding Machine	Composite preform	Space application
15	Dornear carbon weaving machine	Carbon Fabric	Composite manufacturing for engineering application
16	Hydraulic Press	Compression-molded sheet	Engineering application
17	Impregnation plant	Prepreg development	Composite manufacturing
18	Vacuum Infusion Laboratory	Composite Manufacturing	Engineering Application
Jute Geotextile			
19	Yarn and fabric property testing	Biological laboratory	-
20	Water permeability	Physical testing laboratory	-
21	AOS, CBO	Advanced physical testing Laboratory	-
22	DCP tester	Chemical testing laboratory	-
23	Merlin tester	Advanced chemical testing laboratory	-
24	Liquid and plastic limit tester	Analytical Laboratory	-
25	Road simulation apparatus	Composite testing Laboratory, Soil	-

		testing laboratory	
26	Soil burial testing facility	CCM lab, Ecological testing laboratory	-
Nonwovens			
27	Needle Punching Nonwoven Machine	Needle Punching Nonwoven Machine	Evaporation Membrane For Separation Of Ethanol- Water.
28	Thermal Bonding Machine	Thermal Bonding Machine	Solar Water Purifier For Rural India
29	Hot Calendering Machine	Hot Calendering Machine	Linen Based Non-Woven For Home Furnishing Market, For Example As Sun Shades
30	Coating And Lamination	Coating And Lamination	Accelerated Mileage Air Filter
31	Digital Bursting Strength Tester		Development Of Thermal Bonded Wadding
32	Water Repellency Tester		Development Of Linen Based Nonwovens For Various Technical textiles Applications
33	Microscope With Microtome		Development Nonwoven For Insulation
34	LOI Tester		Development of Silver Nano Particle-Based Nonwovens For Various Food Processing Industry. (Especially For Milk Filtration Application)
35	Pore Size Analyser		Development Of Insulating Layer For Defense Application
36	UV Accelerated Weathering Tester		Geo Bags
37	Linear Density & Fibre Crimp		Filter Fabric
38	Air Permeability Tester		
39	Water Vapour Transmitivity Tester		
40	Non-Woven Orientation System		
41	Liquid Strike Tr. Wet Back		
42	Thermal Conductivity Tester		
43	Digital Tearing Strength Tester		
44	Hydrostatic Water Head Tester		
45	Viscometer Brookfield		
Agrotech & Packtech			
46	Shade-o-meter	Raschel Warp Knitting Machine	Shade-o-meter: Shade percentage analysis for shade-nets
47	Wind Blockage Tester	Film Blowing System	Wind blockage tester: wind resistance of windshield
48	Water Vapor Permeability Tester	Needle Punch Nonwoven System	Smart Shade-net: Managing Thermal Energy especially in the Infrared Region
49	Water Permeability Tester	Beam Warping Machine	Reflective Ground Cover: To manage microclimate by managing reflection of thermal energy, also conserves moisture and controls weed growth
50	CBR Puncture	Spun-bond Machine	PP/Jute Ground Cover: Weed control, moisture-managing mulch mat. It brings the best of synthetic and natural in one product. It can address the significant challenge of reducing GSM in the Jute Mulch
51	Porometer	Monofilament Spinning System	Biodegradable PHB: Raw material for Mulching application
52	UV- Resistance Tester	Weaving Machine	UV Fluorescent yarn: Tracking counterfeiting in shade-net and other

			net-type Agrotextile products
53	Weathrometer	Circular Weaving Machine	Moisture-managing packaging: Packaging enhances the shelf life of the fruits and vegetables
54	Differential Scanning Calorimetry	Coating and Lamination System	Superabsorbent Mat: Floriculture, potted plants. Superabsorbent Mat can hold 5 to 8 times more water in comparison to its weight. This facilitates plant water needs for 8-10 days, thus eliminates the need for frequent watering
55	Thermogravimetric Analyzer	Twin Screw Compounder	Chicken feather based keratin material: Bio-degradable alternative raw material for the development of bio-degradable pots and other Agrotextile products
56	HPLC		Water harvesting net: This innovative product can harvest water from fog and meet daily water needs, especially in the hilly region where water is not available throughout the year
57	HPTLC, CHNS-O Analyzer, Nanoparticle size analyzer, GC-MS, AAS		Workwear gear: Designed for farmers, used during pesticide spray. Prevents leaching of harmful chemicals to the skin
Protech and Mobiltech			
58	Radiant heat tester	Testing/evaluation of technical textiles products	Cut-resistant gloves from composite metallic yarn
59	Heat transmission index	Testing of products such as personal protective Clothing, Textile used in automobile, railways, airplane, shipping industries, Floor Coverings	Fabric for the stab-resistant vest
60	Molten metal splash tester	Support as a resource center with IT infrastructure	Modified power loom to produce seamless jute bags/sacks
61	Automatic flammability tester for vertically oriented samples	Indigenous prototype development	Military and paramilitary uniforms from NYCO
62	Vertical flammability Tester	Training of personnel from the technical textiles industry	Seamless jute carry bags
63	Horizontal flammability Tester	Knowledge sharing with stakeholders and end-users	Protective workwear for cement porter
64	Inclined flammability Tester	Incubation center providing facilities for testing new ideas and technologies.	Multi-Layered Flame & Thermal Resistance Fabric for Fire Fighter Clothing
65	Automatic limiting oxygen index tester	Setting up standards that are at par with the global level.	
66	Impact of spatter tester		
67	Electrical resistivity tester		
68	IMO Tester, Hot air Oven, Gas Fume chamber		
69	Toxicity tester, Smoke visibility tester, Fire resistance tester		
Geotech & Oekotech			
70	Hydro entanglement non-woven m/c	Non-woven preparation by Hydro entanglement non-woven m/c	Crop cover, Separator
71	Electrospinning	Needle punch	Geotextile
72	Plasma atmospheric	Filter product by Electrospinning	Filtration, Drainage

73	Multi-station tensile tester	Melt spinning & Melt compounding for fiber preparation	Geotextile, Separator, composite preparation, drainage
74	Thermal conductivity		Geocomposite, Woven Geotextile
Agrotech			
75		Agro-net knitting machine	Agro-net
76		Pilot Coating machine	Coated fabric
77		Pilot Hot melt laminating machine	Laminated fabric
78		Plasma machine	Coated fabric
79		Needle punch machine	Non-woven fabric
80		Hydro entangle machine	Non-woven fabric
81		Spun bond machine	Non-woven fabric
82	Photosynthetic Apparatus	For Testing	
83	Contact Angle Meter	For Testing	
84	Gas Chromatography-Mass Spectrometry	For Testing	
85	Vibrodyne	For Testing	
86	Film Thickness Tester	For Testing	
87	Water Vapour Transmission Tester (Mocon)	For Testing	
88	Cold Crack Tester (COE Agrotech)	For Testing	
89	Taber Abrasion Tester	For Testing	
90	Shear Tester	For Testing	
Meditech			
91	Rieter perfojet	Spunlace	To produce Medical textile products such as wipes, surgical gowns, wound care products
92	Sanitary Napkin Making Machine	Sanitary Napkin	These products are worn to absorb menstrual discharge, thereby protect clothing and furnishings
93	Warp knitting machine – Tricot	Hernia mesh	The primary function of hernia mesh is to support prolapsed organs either temporarily or permanently
94	Warp knitting machine – Rachel	3D Compression bandage	Compression bandages are used to treat and prevent deep vein thrombosis (DVT), leg ulceration, and varicose veins. Moreover, a 3D compression bandage provides uniform pressure over the leg
95	Coating and Laminating machine	Antimicrobial / Liquid repellent finished products	The outcome of the product is used to produce surgical gowns
96	Tubular weaving loom	Vascular graft	Vascular grafts are used on damaged or diseased blood vessels when surgeons need to redirect blood flow by replacing the blood vessel, often using synthetic grafts
97	Facemask making machine	Loop type mask and Tie type mask	Healthcare professionals wear this product during the operation procedure
98	Narrow width loom	Crepe bandage, Compression bandage	Compression bandages are used to treat and prevent deep vein thrombosis (DVT), leg ulceration, and varicose veins
99	Cotton Wool roll making machine	Cotton Wool Roll	This product is used for wound management in the healthcare segment
100	Wipes manufacturing machine	Dry wipes, Wet wipes, Medicated	Wipes are used either to remove the dirt

		wipes, Industrial wipes	particles or apply the cosmetic/ medicated agents over the skin
101	Ultrasonic sewing machine, Ultrasonic Spot Welding Machine, Chain stitch machineQ	Surgical gown, drape, instrument covers	A surgical gown is a personal protective garment intended to be worn by health care personnel during surgical procedures to protect both the patient and health care personnel from the transfer of microorganisms, body fluids, and particulate matter
Hometech & Indutech			
102	Needle Punching Machine	Non-woven, Filter	Filtration, Thermal and sound Insulation
103	Wet wipes	Skin contact and non-skin contact any wipes	Multi-surface cleaning wipes, Disinfectant wipes, Moisturising wipes, Leather cleaning wipes
104	Hot melt lamination machine	Laminating any flexible substrates	Baby dry sheets, Ironing pads, Waterproof jackets
105	Spun cartridges, Wound filter	PP spun cartridge filter	ETP Filtration
106	Thermal bonding machine	Wadding, High loft non-woven	Thermal insulation, sound insulation
107	Hot Press	Coir composites, Nonwoven reinforced composites	Furniture, Thermal insulation, Decorative products
108	Coir Needle-punched non-woven	Coir Nonwoven	Coir Mattress, Coir Gardening Articles, Sound Insulation