



**SMART INDUSTRIAL INNOVATION AS
ENABLER TO DRIVE NEW VALUE CHAINS
FOR TEXTILES AND AEROSPACE**

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1. INTRODUCTION

The textile and clothing (TC) industry covers a complex range of activities: from the transformation of natural or synthetic fibres into yarns and fabrics, to the production of a wide variety of products such as:

- first of all, **clothing** for the Fashion segment of the TC Industry
- **Home furnishing** products
- and **Technical textile** products as hi-tech synthetic yarns, bed-linens, industrial filters; the most innovative segment of the TC Industry (explored in detail in Section 3 of the current report)

The TC sector is one of the most important in the European manufacturing industry in terms of size, quality, competitiveness, and it has a huge story to tell. The sector has faced serious challenges in recent years (e.g. financial crisis 2007-2008).

And now, even if the impact of the COVID-19 was felt hard across textile, apparel, and fashion industries, the economic and social experts refer to the TC sector as the one that could create new jobs and spur further industrialization in countries recovering from COVID-19.

However, to capitalize on this opportunity, countries will need to embrace **new partnerships** and **new approaches** [1].

2. GLOBAL TEXTILE AND CLOTHING MARKET OVERVIEW AND INDUSTRY OUTLOOK

General overview of the TC sector, including all its segments and sub-segments: apparel/Fashion, Technical textiles, Home Furnishing, Industrial base of the sector (spinning, weaving, knitting, fabrics finishing, tailoring, ...), Non-woven, Yarns, Underwear, Workwear, ...

The TC sector plays a leading role in the European manufacturing industry. The sector includes ca. 160,000 companies (of which 99.8% are micro & small companies), employing 1.5 million people and generating a turnover of €162 billion. [2].

The TC industry comprises all the complex value chain that starts from the textile fibres manufacturing and production (natural fibres and man-made fibres), goes through the production of knitted and woven fabrics; the finishing activities aimed at providing fabrics the visual, physical, functional and aesthetic properties; the transformation of those fabrics into products through manufacturing processes (clothes, household textiles or technical textiles); up to the retail/application phase.

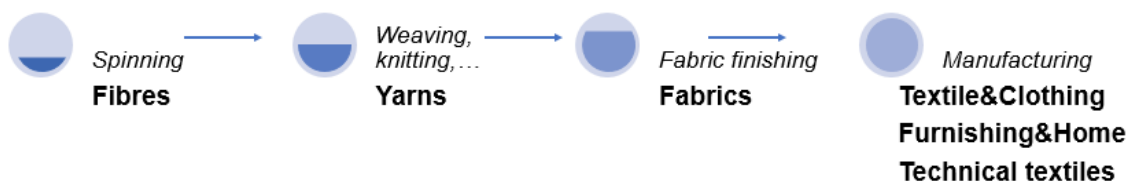


Figure 1 - TC Value chain scheme

The clothing manufacturing is the main contributor to the total production of TC sector, and Technical textiles segment is growing in importance, as shown in the following graphs of the Euratex report “Facts and key figures 2020” [2].

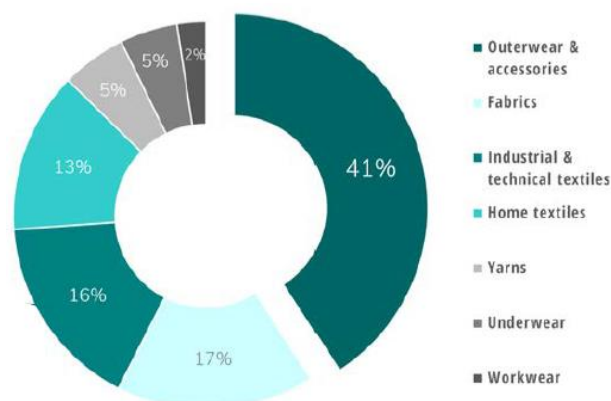


Figure 2 - Production for sub-segments of TC sector Source: Facts & key figures of the European Textile and Clothing sector, 2020)

This partition is substantially in line with the end-market demand (pull-demand). In 2018, Households in the European Union spent almost €269 billion on clothing articles: Europeans spend on average €600 per year per their clothes.

Three distinct companies' profile can be identified in the TC industry:

1. Medium-large sized companies with a well-known brand
2. Medium-large sized companies with no brand, which produce for large distribution compartment stores or as providers of the first group
3. Small firms specialised in one single textile production phase, whose customers are one or more of the other companies of the sector (façonist).

2.1 KEY FACTS AND FIGURES OF GLOBAL TC SECTOR

According to the data obtained from World Trade Statistical Review 2020 [3], the global textile market size was valued at **USD 961.5 billion in 2019** and is estimated to exhibit a **CAGR of 4.3% from 2020 to 2027**. It is estimated that anywhere between **20 million and 60 million people are employed** in the textile industry worldwide. The industry accounts for approximately **2% of global Gross Domestic Product** and accounts for an even greater portion of GDP for the world's leading producers and exporters of textiles and garments.

From a global perspective, the textile industry is an ever-growing market, with key competitors being China, the European Union, the United States, and India.



Figure 3 - Top ten exporters of Textile, 2019 (Source:WTO 2020)

China is the world's leading producer and exporter of both raw textiles and garments. The textile industry of the European Union comprises **Germany, Spain, France, Italy, and Portugal** at the forefront, with a value of more than **1/5th of the global textile industry**, and it is currently valued at **more than USD 160 billion**.

The TC sector had been in difficulty for the past decade since the Financial crisis of 2007-2008, that has split in half all sectors numbers: the numbers of European TC companies, employment, turnover, import/export value, etc. But, in the last few years we have

witnessed a strong return of business confidence across the entire European TC industry. Over the last 5 years, the industry's turnover has grown to € 178 billion and extra-EU exports have gone up to a record of € 50 billion, while employment and the total number of companies have been maintained. This industrial revitalization would not have been possible without investments in modern manufacturing plants and technologies. [4]

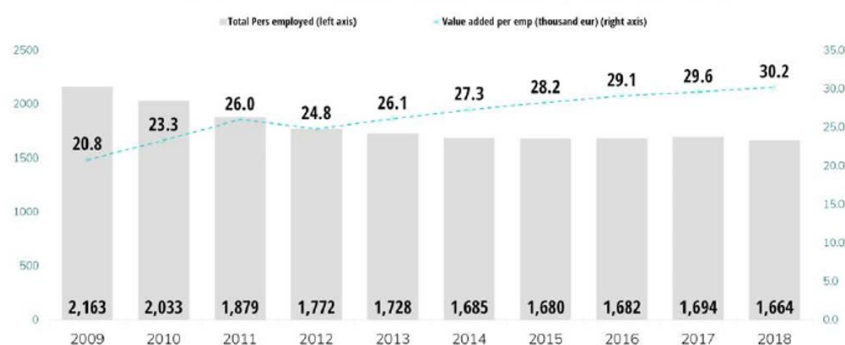


Figure 4- Evolution 2009-2018 of productivity for employee (Source: Facts & key figures of the European Textile and Clothing sector, 2020)

The sector has been subject to a series of radical transformations over recent decades, due to a combination of technological changes, the evolution of production costs, the emergence of important international competitors, and the elimination of imports quotas after 2004.

European TC companies have improved their competitiveness by reducing the mass production of simple products, and concentrating instead, on a wider variety of products with higher value-added: European producers are world leaders in high-quality garments with a high design content. The trend towards higher value-added products needs to be continued in order to strengthen the competitiveness of the textile and clothing sector.

According to the European Commission, the EU textile and clothing industry is a leader in world markets. EU exports to the rest of the world represent more than 30% of the whole world market while the EU Single Market is also one of **the most important in terms of size, quality and design**.

Top priorities for European TC sector in these last years are: fight against climate change with sustainability issues and circular economy vision (to bring a large chemicals restriction; to reduce the TC waste with new recycling solutions; to reduce the microplastics use), better healthcare, security, energy, advanced manufacturing and digital transitions (I4.0 paradigma), significant investments in research, innovation and new skills.

Despite good retail sales and export performances, the textile and clothing manufacturing *remained under pressure during 2019*. Employment in the textile & clothing sector further declined, stemming from an accelerated drop in industrial production. *EU27 turnover evolution turned negative in 2019*, following a constant

deterioration throughout the year. During 2019, EU production of synthetic and artificial fibres went down after five years of positive evolution (-5.2% compared with 2018).



Figure 5 – EU27 production, yearly evolution. % change compared to same period in previous year from 2009 – 2019 (Source: EURATEX based on EUROSTAT)

Then, 2020 and the coronavirus outbreak, that represent a very large shock for all the global and EU economies, with serious economic and social consequences. After a projected GDP decline of 7½ per cent in 2020 for TC sector, growth of 3½ and 3¼ per cent in 2021 and 2022, respectively, will bring output back the sector, to its pre-pandemic level, only at the end of 2022. Persistent virus outbreaks and accompanying containment measures will continue to hamper activity until a vaccine is widely implemented. Private consumption and investment are affected the most by pervasive uncertainty and low confidence.

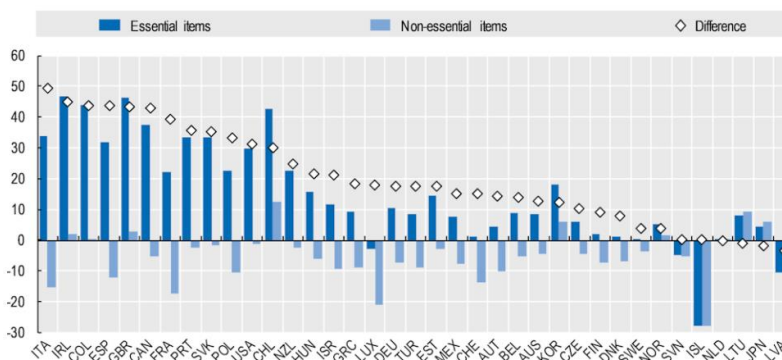


Figure 6 - Change in demand for essential versus non-essential retail goods. Growth of Google searches for retail items between April 2019 and April 2020 (%) (Source: Google Trends and OECD computations)

2.2 THE NEW TEXTILE MARKET/INDUSTRY FRAMEWORK IN THE POST COVID-19 ERA

The coronavirus pandemic triggered the sharpest economic contraction since the 2008-2009 financial crisis. As described above, the outbreak has resulted in the shutdown of major economic activities across the EU, particularly the manufacturing and textile-using sectors as the clothing, furnishing and automotive industries. Both the textile and clothing

sectors experienced a steep decline during the 1st half of the year with the steepest drop recorded during the 2nd quarter 2020.

The overall impact on turnover in 2020 for the T&C industry is estimated at -50 Billion Euro and the major concerns about the pandemic are reported and quantified in the following graph that synthesizes Euratex analysis [2].

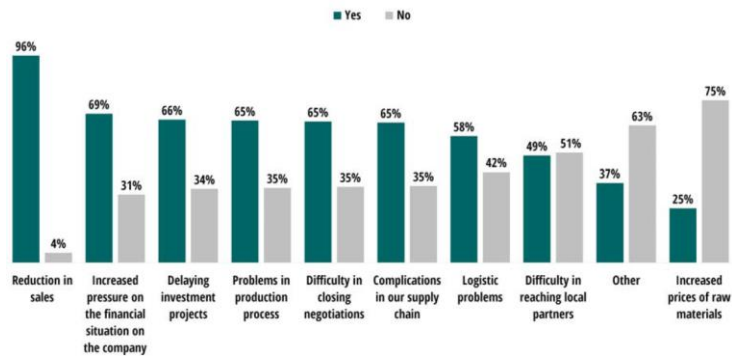


Figure 7 - Major concerns about the pandemic (Source: Euratex, 2020)

The EU27 production fell severely during the first 7 months of 2020, a slump reaching -17.3% in textiles and -26.5% in clothing.

This two-digit negative rates can be seen in almost all T&C subsectors with some exceptions. The **manufacture of non-woven** was more resilient, as the needs and capacities for nonwoven-based **face masks** and **medical supplies** were promptly increasing during the pandemic period.

The COVID-19 pandemic is an unprecedented public health crisis that has exerted an external shock on the global economy. But now, it's the time to think and make in force the recovery actions. For the TC sector, Euratex (the European Apparel and Textile confederation) has already presented **strategic proposals for TC recovery**, that in points are:

- ▶ Sustainable supply chains
- ▶ Recycling hubs
- ▶ Innovation & Digitalisation
- ▶ Access to markets
- ▶ Skills and sector profile

These strategic actions will be possible if the TC sector and the Fashion system will approach **new business models**, **new cross-sectoral collaborations** and **new partnerships**.

2.3 THE R&D AND INNOVATION POTENTIAL OF TC INDUSTRY

Centuries of protection have delayed sound innovation in the textile industry. As these protections elapse, the industry must contend with increasing international competition from abroad. Additionally, in the last years, the textile and Fashion sector have faced with a strong and continuous Customers shift process. So, the innovation-driven research and development for the sustainable growth of the textile and clothing industry started playing a leader role in the sector.

Despite these strong R&D needs to enhance the sector competitiveness, the TC industry is still a **low-to-medium research intensive sector** dominated by small-to-medium-sized companies disposes of relatively few internal research and development capacities compared to other more concentrated or research-intensive industries. The smaller firms are typically said to have 'behavioural advantages' in terms of rapid decision making and flexibility. However, they also face constraints in internal resources and external resources [5].

Rarely, in the TC SMEs is structured a continuous investment in research and technological development and in the maintenance of extensive research laboratories or equipment apart some design tools, small-scale prototype production or testing equipment. The more common innovation strategy for textile and clothing companies is to maintain privileged collaborations with external knowledge and research or technology service providers such as research and technology institutes and universities, or suppliers of chemicals, machines and equipment. R&D outsourcing allows SMEs to benefit from risk sharing and to overcome internal resource constraints (Love and Roper, 2015), while large firms gain better access to talent/expertise and increased flexibility (Narula, 2004) [5].

In general, the European TC industry's knowledge base and innovation capacity are supported by an unparalleled network of competence providers such as Textile research e technology centres; Textile departments at Technical universities; Universities of applied sciences and fashion colleges; up to the new Textile innovation clusters [2].

It is possible to represent the innovation actions in the TC sector in three large categories:

- ▶ Product - innovation
- ▶ Process/system - innovation
- ▶ Materials - innovation

The sector is intensifying its efforts to:

- conquer high-tech niches with high-value products
- generate new textiles, new textile-based products and new applications for TC products
- increase its flexibility and time to market
- use its production resources in an ever more efficient and waste-free way.
- organize a short-run on-demand production
- structure a digital manufacturing and supply chain management
- create and adopt customization and service-based business models

- design and adopt sustainable business operations and the extension of application areas for highly engineered and smartly functionalized textile materials

In general, the main challenges that TC companies have to face to undertake R&D and innovation activities are [5]:

- lack of internal and/or external funds
- high cost of undertaking R&S activities
- lack of required skills
- lack of financial support
- it is easier to acquire innovation from external providers
- IPR costs
- R&D activities are not seen relevant for the business activities of the companies (mainly SMEs)
- Lack of collaboration partners

2.3.1 INDUSTRY NEEDS FOR BUSINESS RESILIENCE/SCALING-UP

The real needs for the Textile system to consolidate a good place in the global competitive scenario are stand up during the actual Covid-19 market disruption. Many TC companies have dedicated time during the crisis to **reshape their business models**, streamline their operations, and sharpen their customer propositions. The crisis has visited a devastating impact on businesses and jobs, but it may also have accelerated responses that can lead to positive outcomes in the TC sector [6].

In the new paradigm, many of the old rules are not working longer. Now the TC companies know that have to “change”, think digital-first and achieve ever-faster speed to market. Across the TC industry and the Fashion system, speed-to-market and responsiveness to consumer needs are becoming critical success factors.

The TC firms want to (and have to) go through actions that allowing to build a Resilient organisation: *Resilience, in an organizational sense, meaning the ability to withstand crises and disturbances. It is associated with established activities like risk and crisis management and business continuity planning, but it allows for new perspectives and insights into the conditions for doing business. Applied to the whole TC supply chain, it also provides tools for managing and aligning the logistics flows in an appropriate way* [7].

This resilience research in the TC systems, value chains and single companies has started since many years, as results or response to the Financial crisis of 2007-2008. In these last years, many enterprises failed and disappeared, while several others prospered. A prosperous and resilient development taken place for lots of TC companies, while others collapsed.

In fact, the European TC industry in these last months, *appeared far more resilient and competitive than it was in 2007-2009*, making it better placed for a recovery thanks to the stabilization of the European textile and apparel trade balance; the dynamic growth

across segments where European manufacturers are the most competitive; the progress in productivity and mainly for the clear definition of the real pillars for the new TC industry growth, such as sustainability, circular economy and digital, I4.0 [8].

2.4 MARKET OPPORTUNITIES, FUTURE TRENDS, MAIN CHALLENGES

As state in the report “State of Fashion 2021” [6], the Covid-19 pandemic will accelerate industry trends in TC sector.

The primary driver will continue to be the “**digital**”, reflecting the trend established before the COVID-19 crisis; recent data show that we have vaulted five years forward in consumer and business adoption of digital in a matter of months.

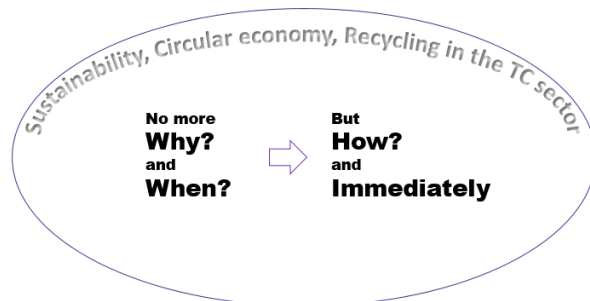
Other positive trajectories will include the growing renewed appetite among both companies and consumers for **local engagement**; of course, the importance of **sustainability through the value chain**: consumers and investors will reward companies that treat their workers and the environment with respect; the **rethinking store formats** and **leveraging data and analytics** to predict footfall, manage assortments, and built personalized offerings. [6].

2.4.1 SUSTAINABILITY, CIRCULAR ECONOMY, RECYCLING

The global environmental impact of the fashion industry shows important values and the circularity and textile waste management will be the main pillars to reduce these negative impacts. EU-28 set a household consumption of €520 billion and registered a textile waste generation for 16 million tons per year.

In the past decade, the concept of circular economy been extensively deepened and disseminated by key actors, including the Ellen MacArthur Foundation. Today, all global initiatives, commitments and policies confirm that the transition to a circular economy is inevitable for many Industries, but mainly for the TC sector. This trend has been investigated since last years, and the Covid-19 outbreak represents the global event that has reinforces the green need in the TC sector.

The question today is not whether the economy will become predominantly circular, but how will this transition be made. In this concrete field all TC sector have to focus their efforts.



2.4.2 ADVANCED MANUFACTURING, I4.0

The pandemic will accelerate trends that were in motion prior to the crisis: the primary driver of growth in the coming year for TC sector will continue to be the digital solutions

for new models in manufacturing processes, in logistics processes, in the supply chain management, in selling channels. Many textile companies have taken till now a *fragmented approach to digital transformation*, focusing on digitising processes or isolated functions. Digital transformation is often restricted to individual programmes or projects that affect only a small number of departments: for example just one area, such as Marketing or Sales, with limited or very slow encouraging returns.

But now it is important to ride the whole change, *starting from behind the digital transformation*: building up organisations re-imagine, reshape and retool for an era in which traditional boundaries are broken, that are ready to introduce digital technology solutions as natural tools [9].

Where the digital transformation will bring the most important results across the TC value chain?

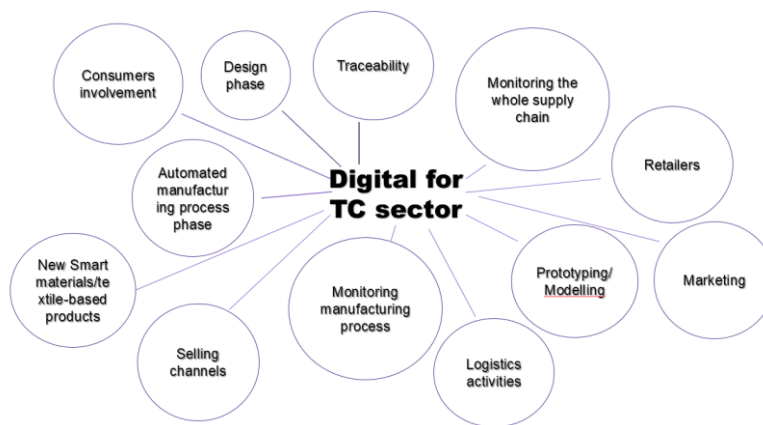


Figure 8 – Main TC areas for Digital impact

The advanced technologies innovation in the TC sector will have the potential to make manufacturing more precise, as well as more local and sustainable, combining production automation, product technology, big data, etc. Potential benefits include higher speed, faster delivery times and lower cost than currently, as a result of reduced shipping times and lower stocks.

But, as described above, the advanced technologies solutions are ready to enter in several phases of the TC value-chain [10]:

- **Design technologies** for delivering more digital data and presentation material along with your product. 3D design allows adjusting the fashion product design and creating the best fit in real time. Or AI in fashion design where neural network is able to understand colours, textures, style preferences and other aesthetic parameters derived from Fashion trend data from different sources and using an algorithm to create designs based on users' interests.
- **Technology for sustainability:** European TC companies are looking for materials, fibres and techniques that are sustainable and functional. These

materials must be natural or synthetic, as well as renewable or recycled. The biggest change might come from shifting to a circular or closed-loop supply chain, involving a recycling model where unused or discarded items are fed back into the chain to minimise waste; some advanced manufacturing technologies are already available to make the garment supply chain more sustainable, but now it is important to focus on them the effort to scale up this kind of cleaner technologies.

- **Smart and Wearable technologies:** among the results of innovation in advanced technologies, there are computers which can now be so small that they can be integrated into clothing, complete with sensors and a battery. This presents more opportunities for the development of smart clothes that can collect different data from who wears them. The Wearable technology market growth rates have come down in the years, but is not due to a slowing interest in wearables, but rather a result of a maturing market. A large part of potential consumers believes that most available wearable technology products have poor and unappealing designs.

So, the smart technologies and wearable apparel are in need of good and attractive designs in the future years.

- **Blockchain technology:** the use of blockchain technology is already changing the apparel industry, offering new ways of implementing transparency in a supply chain. Using blockchain, a chip or a tag added to a product can be used to store all the relevant data about that product. The main application in TC sector is in the product traceability process and in preventing the sale of counterfeit goods.
- **Big Data:** Companies must start taking advantages of online shopping and direct-to-consumer (D2C) sales because allowing companies to forge direct relationships with consumers and, collecting and elaborating these data, it is possible to generate enables businesses to improve their performance.
- **Augmented Reality:** is helping online shoppers with buying the right look and size by a smart blended reality mirror overlaying clothes on to users.
- **Artificial intelligence:** is the advanced technology can help to spread digital showrooms and virtual design in the Fashion system.

2.4.3 NEW MATERIALS/NEW APPLICATIONS

The textile technology has served in the past mainly the basic clothing requirements: the high complexity of the processes and the great diversification of the raw materials obliged the textile technologists to remain focused on the tasks of their core issues.

Slowly, the interaction of the textile technology with the other fields of engineering increased in the use and application of the technological improvements of the other sectors in it. Over the years the textile industry became an excellent application field of the mechanical, electrical, electronics, chemical and engineering [11].

At now the research of textile materials, conventional, protective, smart, and intelligent textiles have had an acceleration in terms of result and many segments of TC sector are taking advantage of them: from the fashion sector, for new aesthetic functions, up to the

technical textiles applications for innovative technical functions (described in detail in the following section of the current study).

Some examples of New materials and new applications [12] :

- **High-performance fibres and textiles**, carbon, glass, basalt, ceramics or metals can exhibit astonishing strength and durability despite their rather fragile appearance, flexibility and lightweight. *These fibres have been invented many decades ago and have been used since then primarily in niche applications in the aerospace, defence, construction, protection and sports markets.* These new fibres are a key player in several emerging markets for technical textiles and fibre-reinforced thermoplastic composites. Lightweight, high-strength and high-stiffness composite materials have been identified as a *key cross-technology between the textile sector and several large industrial sectors such as automotive, aerospace, industrial equipment, energy infrastructure or construction.*
- **Functional solutions**: processing fibres and textiles in specific ways to reach a highly purpose-targeted material property and new material functions are now one the main target of the innovative segment of TC sector.
- **Smart materials and products**: Sensing, actuation, power generation or storage, communication and a host of other functions have already been successfully integrated into many textile materials and products. The addition of intelligence to a textile-based product can start at fibre level and also at any subsequent stage of processing, manufacturing or assembly of the final product.
- **New materials/products/applications with re-use and recycling**: one the main future challenge is the development of textile-based products and materials in a circular economy vision, with eco-friendly methods and recovery of useful materials.

3. TECHNICAL TEXTILE INDUSTRY & MARKET

Technical textiles can be defined as all textile products that cannot be fitted within the traditional sectors of clothing or furnishing, particularly the textile products in which functionality is as much or more important than aesthetics.

3.1 SECTOR AND MARKET CHARACTERISTICS, HISTORIC GROWTH/FORECAST GROWTH

The global technical textiles' market size was estimated at **USD 176.6 billion in 2019** globally, growing at a compound annual growth rate (CAGR) of 4.5% from 2020 to 2027.

Some of the factors influencing the growth of the market are:

1. Rising demand from new application areas
2. Varying consumer preferences
3. Useful physical properties of technical textiles
4. Innovation and R&D
5. Government regulations
6. Climate change and global warming

Technical textiles segment has been growing over the past decades in the total share within the textile industry, currently accounting about 27% of turnover in the overall textile sector (figure 9). In Europe, this currently accounts to 24 billion €.

In total production, technical textiles manufacturing is concentrated in **Italy** and **Germany**, each with about 4,5 - 5 billion € in production, followed by France with 2 billion €, Spain with about 1 billion € and Czech Republic with 800 M€.

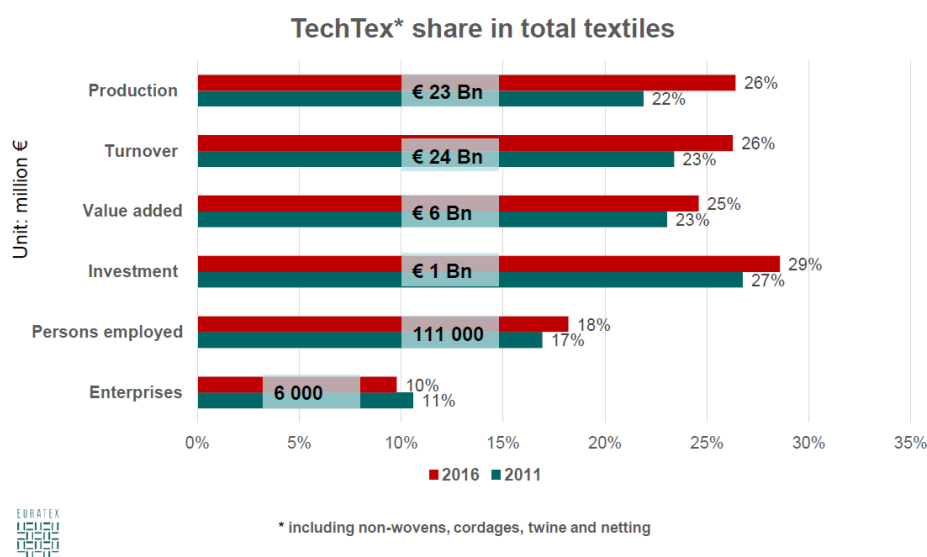


Figure 9 - Evolution of technical textiles in Europe (Source: Euratex)

The sector currently accounts for over **111.000 persons employed** in Europe, while the number of companies has been decreasing steadily over the past decades particularly due to the lower production costs overseas.

In terms of trade, exports of technical textiles predominantly go to the **United States** (~2billion €) followed by China and Switzerland (both with ~1 b€). Exports of technical textiles products have doubled during the last decade, from ~500 M€ in 2010 to ~1 B€ in 2018 and show strong growth potential.

*Europe is still leader and has positive trade surplus in highly specialized products such as **medical textiles** (+758 M€ trade surplus), **nonwovens** (+555 M€ trade surplus), **coated fabrics** (+637 M€ trade surplus), and other textiles for technical use (+451 M€ trade surplus) [13].*

The global trend of trade for technical textiles had a reversal on 2015, where the historical positive trade balance shifted towards a deficit even though the exports level have been growing steadily at around 3% annually for the past 15 years with only a minor decrease during the 2009 crisis.

In terms of raw materials used in technical textiles, the natural fiber segment is expected to grow at the fastest growth rate during the period 2019-2027. This is attributed to an increase in awareness of environmental pollution caused by synthetic materials. This has resulted in the development and adoption of environment-friendly materials in the technical textiles production, which in turn drives the growth of the market globally [14].

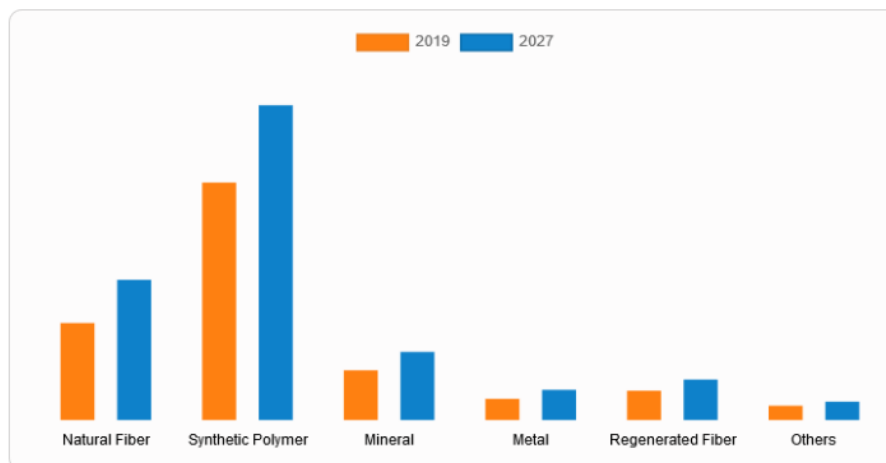


Figure 10 - Technical textile by market (worldwide) (Source: Allied Market Research)

By process, the non-woven segment is anticipated to grow at the fastest growth rate during the projection period. It is expected to grow at a growth rate of 5.7% during the forecast period, in terms of revenue. This process improves the properties of material, which results in enhanced performance of the textile material. Moreover, the properties of the non-woven textiles are cushioning, absorbency, softness, strength, and others [14].

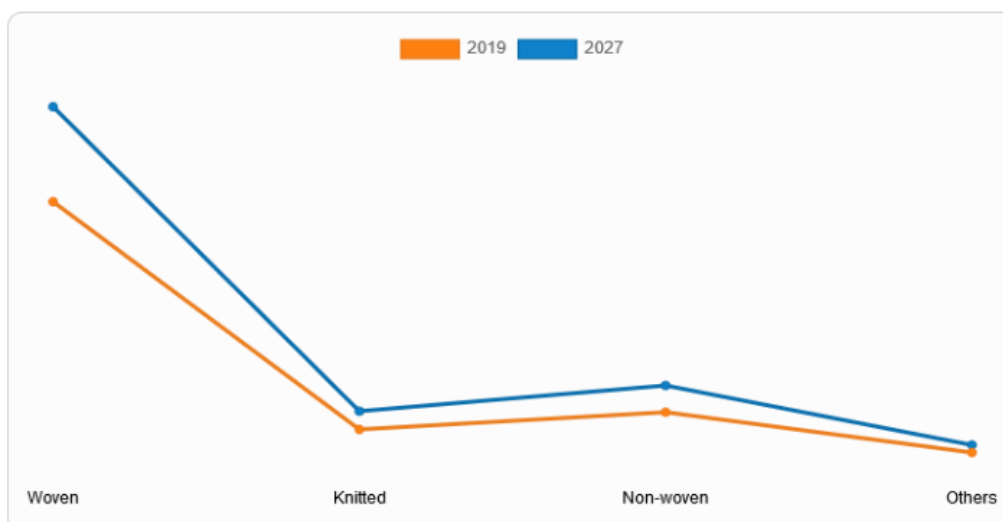


Figure 11 - Technical textile by process (worldwide) (Source: Allied Market Research)

New and improved applications of technical textiles can project to propel its demand across various end-use industries including **agriculture**, **construction**, **aerospace**, **medical**, and **packaging**, where these textiles can fit better than other solutions, and they may facilitate some functions and increase the performance of the processes [15].

Nevertheless, it is important to mention that other sectors like **security forces**, **firefighters** or **foundry workers**, for example, depend on the technical textiles, so its demand is unlikely to decrease.

The COVID-19 pandemic disrupted the value chain of the technical textiles' market by halting the manufacturing operations of the end-user segment in major countries such as the U.S., India, and others.

3.2 MARKET SEGMENTATION OF TECHNICAL TEXTILES (APPLICATION TYPE)

The specific value chain of technical textiles, which alike the regular textiles production begins with natural fibers or the production of fibers by extrusion. Next, it follows (if applicable) spinning and yarn transformation in order to produce the fabric with yarns or directly from fibers; or the elaboration of plaited structures, webs, tapes or other types of laminar or even tridimensional textile structures that can be finished in order to give them new functional properties for specific applications.

The resulting products can be finished or assembled for their final use, or go through a stage of semi-finished products, such as pre-impregnated materials or adhesive materials or those used for the manufacture of composites.

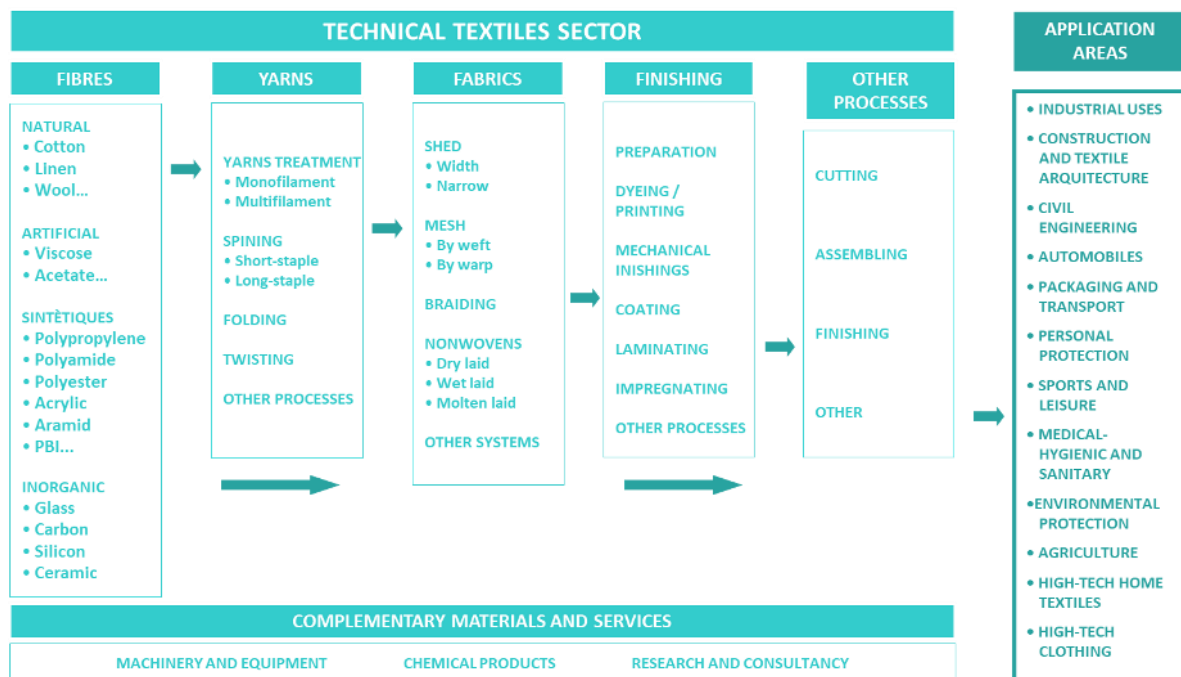


Figure 12 - Technical textiles value chain (Source: AEI TÈXTILS)

Therefore, all natural, artificial or synthetic textile fibers can be used in the field of technical textiles. However, *the arrival of new fiber families with high mechanical, thermal and chemical resistance, among others, is one of the factors that has essentially contributed to the structure of the current sector of technical textiles*: being able to satisfy needs that some decades ago would have never been related to textile materials.

The most usual classification of technical textiles is the one defined by the trade fair Techtextil, from Messe Frankfurt, first celebrated in 1986, and which is being used since 1997: **Agrotech**, **Buildtech**, **Clothtech**, **Geotech**, **Homotech**, **Indutech**, **Medtech**, **Mobiltech**, **Oekotech**, **Packtech**, **Protech** and **Sportech**.

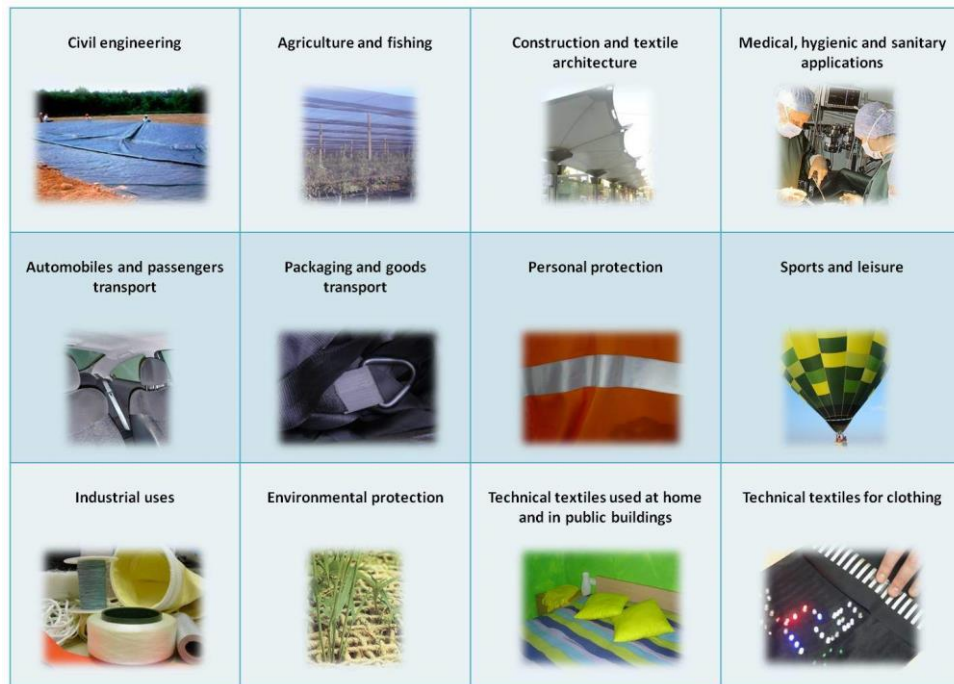


Figure 13 - Applications areas of technical textiles

MobilTech garnered the highest market share in 2019, in terms of volume and revenue (Figure 14). This is attributed to an established consumer base in developed regions such as North America and Europe. This industry is anticipated to exhibit remarkable growth in future, majorly due to the remarkable rise in **demand for cars** with high-quality technological aspects.

Region-wise, **Asia-Pacific** is expected to be the fastest growing region in terms of volume as well as revenue. This is attributed to factors such as rising access to health infrastructure in developing countries such as India, China, and others. *The increase in access to health infrastructure in coming years will propel healthcare and pharmaceutical industry. This will consequently upsurge the demand for medical textile during the forecast period*[14].

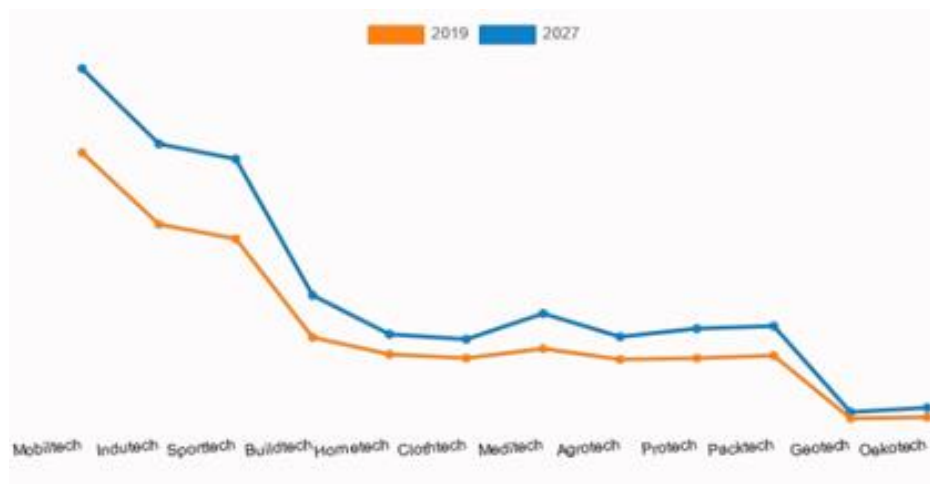


Figure 14 - Technical textile markets by segment (worldwide) (Source: Allied Market Research)

3.3 TECHNICAL TEXTILES MARKET AND INDUSTRY OPPORTUNITIES

3.3.1 SWOT

STRENGTHS:	WEAKNESSES:
<ul style="list-style-type: none"> - Strong representation of the whole manufacturing value chain in Europe - Sophisticated information systems focused on technical and traditional textiles. - Availability of high level infrastructures and technical centers dedicated to technical textiles. - Close relationship and cooperation with universities and research centers. - Increased product quality and improved capability to respond to highly-specific consumer demands - Flexibility of the companies to adapt to the market needs - Transversal industries which allow establishing synergies with other sectors 	<ul style="list-style-type: none"> - Lack of knowledge in new technologies - Necessary investment in new equipment - Very different skills and industry standards are needed - Lack of international experiences and skills (language). - Lack of marketing and branding skills and strategy. - The size of the companies is small, which difficult to compete in the global market - An industrial innovation culture is not generally established in textile SMEs
OPPORTUNITIES:	THREATS:
<ul style="list-style-type: none"> - New technologies can help to take advantage of resources and waste reduction - Academic and technological institutions of interface with the industry that allow the rapid application of new technologies 	<ul style="list-style-type: none"> - Loss of competitive advantage for the European advanced textile materials sector. - Reduced opportunities to develop new high added value products. - High cost for the introduction of new technologies by SMEs - Loss of knowledge in the sector due to the lack of textile training offer

Figure 15 - SWOT analysis of the European technical textiles' sector

3.3.2 FUTURE TRENDS

The Joint Research Center (JRC) of the European Commission, in its Industrial Landscape Vision Study 2025, estimates that by 2025, the Textile industry, including fiber-based materials, clothing, home and technical textiles, will be a strategic sector of the industry, for the European Union. *The sector is expected to offer innovative and competitive products that enable customized, adaptable and attractive solutions, integrating services for very diverse, informed and demanding consumers.* This sector will have a business model based on a globalized and efficient circular economy that maximizes the use of local resources, exploits advanced manufacturing techniques and participates in intersectoral collaborations and strategic groupings. It is estimated that the industry will implement profitable and inclusive business models and attract skilled and talented employers and workers [16].

The European Commission and the JRC have defined the main research topics and priorities until 2026, concerning the following topics as described before, in general for all TC sector:

- **High performance and functional materials**
- **Advanced manufacturing, value chains and business models**
- **Circular economy and resource efficiency**

In the following sub-sections, these topics are analyzed in particular by the Technical textile sector view.

High performance and functional materials

In the 60s, the fundamental advances in the field of textile fibres were based on the improvement of primary functions of already known fibrous materials (high tensile strength, improved feel, etc.). From the 1970s to the present, there has been remarkable progress in the **design of new fibres**, developing **polymers with improved properties** (high toughness, non-flammability, fibres with functional additives, breathability, etc.). Microfibres, waterproof and breathable laminates lyocel-type viscose fibres, organic fibres or inorganic heat-resistant, the use of elastomeric yarns, etc., are some examples of the milestones achieved during this period.

In the fibre market, innovative solutions appear thanks to the development of **bio-component fibres**, formed by two different polymers that take advantage of the qualities of both and allow get differentiated threads in their behavior.

Knowledge of the science of textile materials, coupled with the progress of industrialization, has allowed the manufacturers to obtain fibres with dazzling optical effects or hollow fibres with heat-insulating properties, etc. On the other hand, the different shape of the fibres sections promotes the evacuation of sweat perspiration to the outside of the garments.

Also, the rising ecological sensitivity of the consumers is increasingly considered, and fibre-producing companies are directing their research towards the development of **fibre that doesn't harm the environment**. New fibres appear, such as so-called organic fibres, which belong to the family of synthetic, artificial fibres (protein or cellulosic) or natural, such as milk protein fibres, soy protein fibres and bamboo fibres, among others.

Finally, it is worthy to mention the introduction of **graphene** as new material in the textile sector, for its properties excellent (hardness, lightness, thermal conductivity, etc.). Several research projects are currently underway focusing on the transformation of insulating tissues into fabrics with conductive properties or obtaining **electronic textiles**, among others [17].

Thus, the main innovations in the field of materials, in recent years, have been based on:

- Provide new properties and functionalities
- New and improved polymers and additives
- Multicomponent fibres and multifilament
- New fibre surfaces
- Multifunctional textile surfaces
- New shapes/dimensions of the fibres (micro / nanofibres)
- New or improved fibre blends
- Innovative uses for conventional fibres
- Improving the sustainability of fibres (recyclable, renewable fibres/biopolymers)

Advanced manufacturing, value chains and business models

- ⇒ New manufacturing technologies for the development of complex textiles and composite structures.
- ⇒ Digitization and flexibility of production processes and factories.
- ⇒ Virtual modeling, design of materials and products based on fibers.

Circular economy and resource efficiency

- ⇒ New flexible process technologies to save water, energy and chemicals.
- ⇒ High-tech textile recycling for circular economy concepts.
- ⇒ Sustainable substitutes for hazardous textile processing chemicals or biochemistry based textile processing.
- ⇒ Concepts of bio-refinery that use biomass or European waste for textile fibers.
- ⇒ Greater use of natural fibers of European origin.

3.3.3 KEY TECHNOLOGICAL CHALLENGES

Textile technology is an *enabling technology* for numerous fields and can make important contributions to new solutions for effective and affordable health care, highly functional sportswear and goods and smart personal protection. All these are rapidly growing markets and targeted by the European societal challenges of active ageing and safety and security. CONTEXT Cost Action [18] proposers defined *the following main technological challenges for textile materials in the healthcare and medical, automotive and aeronautic, sports, personal protection and building and living sectors.*

Table 1. Technological challenges for textile materials

Sector	Key challenges
Healthcare and medical	<ul style="list-style-type: none"> • development of controlled drug release fibre and textile structures for therapeutics of different skin conditions • development of garments and home textile products with fully integrated bio-monitoring, active systems to improve life quality and ICT systems enabling remote monitoring of patients and assisted living services for “better ageing concepts” • development of fibre and textile structures with enhanced thermal/breathability electro-active properties with integration of new surface functionalities for improving barrier (antiviral and antibacterial) properties
Automotive and aeronautics	<ul style="list-style-type: none"> • integration of fully integrated and printed electroactive and interactive sensors and actuators that enable the development of ubiquitous sensing and interactive surfaces, while also integrating fully embedded (or printed and/or fibre and yarn integrated) haptic feedback systems via both lighting integration and mechanical stimuli responses • integration of fully customizable self- lighting materials based on active fibres and yarns, and integration or programmable textile matrixes for interactive sensing
Sports	<ul style="list-style-type: none"> • development of lightweight performance garments having new textile surface coatings enhancing thermal management (insulation), controlled drug release for muscle care, and also proving optimized comfort, low pill, low shrink and fast drying • integration of low power/autonomous bio-monitoring and/or integrated ICT and IoT communication systems for training monitoring and performance assistance and integration concepts of training analytics, always connected and data sharing for garment/textile structures “peripherals”
Personal protection	<ul style="list-style-type: none"> • the integration of geo tracking and personal GPS systems (Global Positioning Systems), physiological and biometric monitoring, embedded and integrated communications and energy harvesting, with all data monitoring systems sharing data in real-time • integration of cooling/heating systems into garments
Building and living	<ul style="list-style-type: none"> • development of new functional textile materials using nano-materials and industrial waste, eco-friendly technologies (like ultrasonic deposition, bi/tri-component fibres, UV curing coatings), considering multilayer approaches • focus on high thermal performance (applying eco-efficient heating and cooling systems, together with low thermal conductivity and diffusivity coatings and additives, infrared reflective and phase change materials), in order to achieve Net Zero Energy Buildings (NZEB) • textile functionalization with smart and efficient systems like sensorization, communication systems and actuators, considering printing electronics approaches, in order to maximize comfort, well-being • develop interoperability between connected devices

4. OUTCOMES OF THE GALACTICA SURVEY

Within the Preparatory Activities of the GALACTICA project has been lead a TC market analysis with surveys distribution through all partnership clusters, to collect also new inputs about companies needs that the state-of-the-art does not identify yet and/or to test the strategic directions that experts, stakeholders and clusters have drafted for the recovery of TC Industry and market.

The survey has been structured to identify the different actors and competences across the geography of TC sector and to detect and analyse the need of TC sector for **cross-sectoral collaborations**, in particular towards the **aerospace sector**, and the need of the **advanced manufacturing solutions** concrete application.

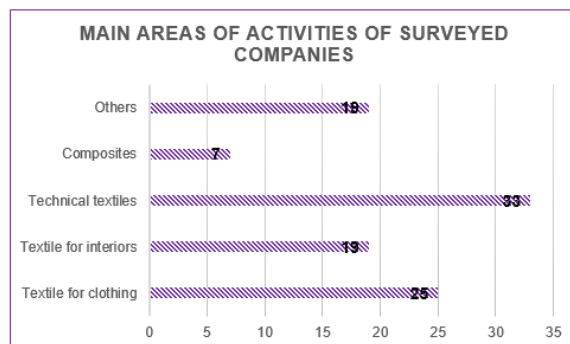
From the mapping and the market analysis, GALACTICA partners will also identify “hot” topics to promote during the calls for proposals and hackathons challenges, which are core activities for the project.

4.1 PARTICIPANTS' PROFILE

The survey, designed for SMEs from the Textile sector, collected **43** responses. The companies analysed in the survey on the TC sector are identified **39** as SMEs according to the EU definition¹, except **4** companies under scrutiny which have more than 250 employees. Only **4** companies under scrutiny have been identified as Start-up companies.

The main areas of activities of the companies analysed are textile for clothing, textile for interiors, technical textile and composites.

While there are additional areas of activities for some companies (“others”), namely flame retardant fabrics; bags and accessories for aviation, military sector, sport, travel, home; functional fabrics; footwear, toy, healthcare; laminated coatings for car interiors; textile production management software; workwear, medical, special performances; thermal and acoustic insulators; non-woven; production of textile finishing machinery.

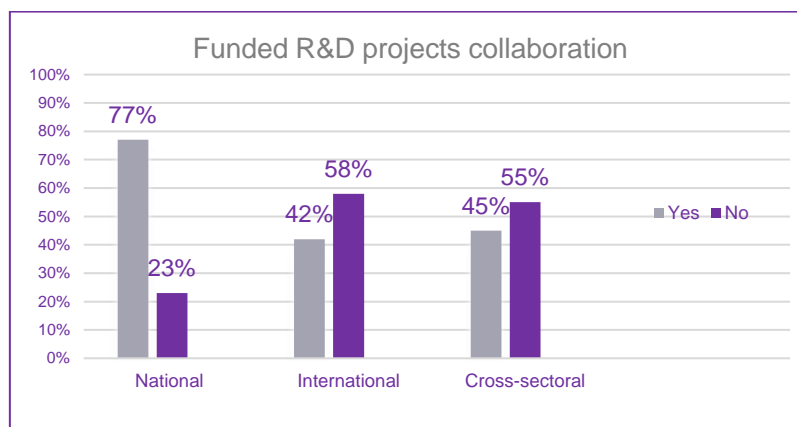


¹ Small and medium-sized enterprises (SMEs) are defined in the EU recommendation 2003/361: “The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million.”

In the Annex 1 are reported the main competences and expertise that companies point out.

Considering the segments of TC sector, the larger number of surveyed companies belong to the Technical Textiles segment. In order of classification, then, we have companies of the Fashion sector, Home furnishing segment and in the last position, companies specialised in Textile-based Composites.

The companies' inclination and experience in financed national, international and cross-sectoral projects results low to medium:



The figures highlight a relevant difficulty for SMEs with respect to the involvement and participation to funded R&D project collaboration, especially in the international environment and in the cross-sectoral projects.

Further important factors, when analysing the position of the company, especially with respect to R&D projects, are their high commitment towards Industry 4.0 strategy and digitalisation strategy and their strong effort in the implementation of automation or advanced manufacturing tools in their production or system.

Therefore, the questionnaire has examined these two aspects and as a result, the **55% has an I 4.0 and a digitalisation strategy** in place (24 companies) while the **49% has an automation tool or the utilisation of advanced manufacturing** in their production system (21 companies).

The Annex 1 includes the list of the I4.0 and digital strategy implemented by the surveyed companies and the list of automation tools/advanced manufacturing technologies implemented in their plants.

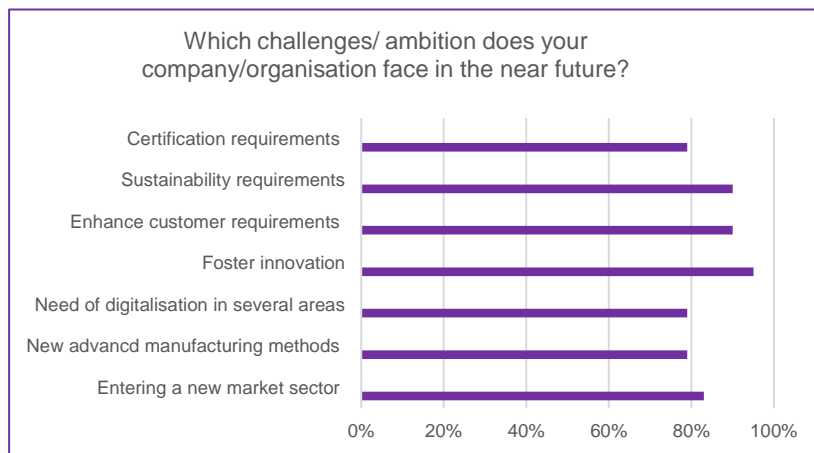
4.2 SMES CURRENT AND FUTURE CHALLENGES

The survey explored core issues for Textile companies about their competitiveness level, their resilience in the current global framework and their key drivers to enhance their business.

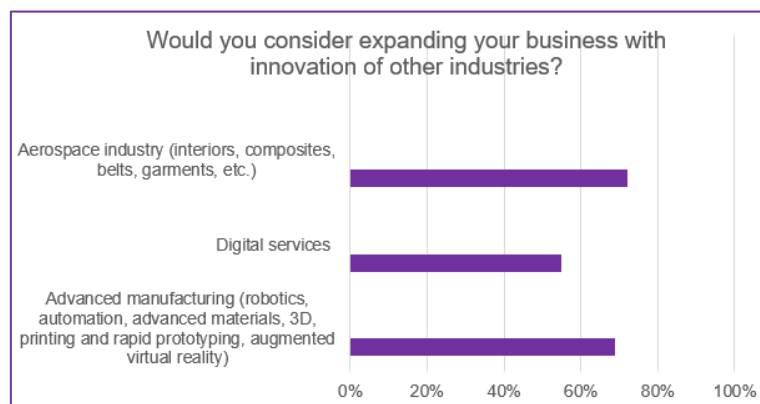
- What are your current major pain points?
 - (1) International competition > 79%
 - (2) Dependence on only one industry sector > 44%
 - (3) Loss of business due to Covid-19 > 75%

The “Others” major pain points are listed in Annex 1.

- Which challenges/ ambition does your company/organisation face in the near future?



- Does your company/ organisation consider to tackle those challenges through the following opportunities?
 - (1) R&D activities 100%
 - (2) Cross-sectoral collaboration 100%
 - (3) International networking/collaboration >93%
 - (4) Cooperation with start-up companies >76%
- Would you consider expanding your business with innovation of other industries?



- What would you consider the main challenges expanding your business with innovation of other industries?

- (1) Unknown market/industry > 69%
- (2) Lack of contact/entry point > 74%
- (3) Lack of knowhow and guidance > 67%
- (4) Need to adapt the production/process to the new market > 74%

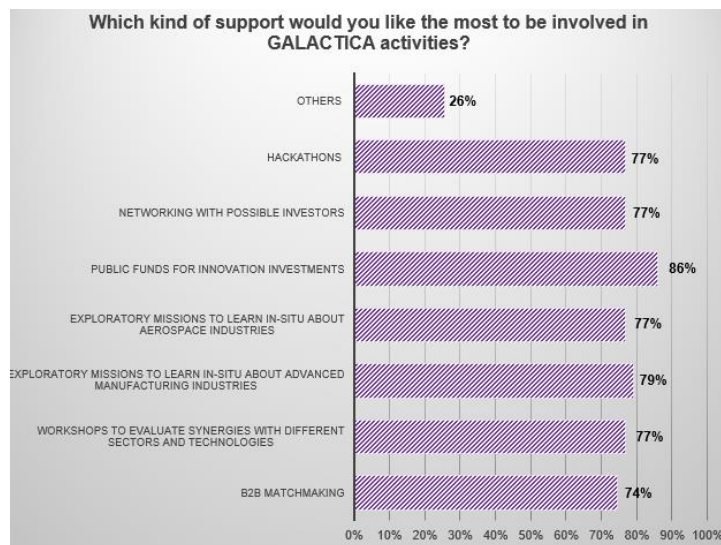
4.3 SURVEY RESULTS LINKED TO GALACTICA SCOPE/ACTIVITIES

The 79% of surveyed companies affirm the interest in the aerospace sector as an innovative market for a possible expansion.

In the following a list of what attracts most of the aerospace sector and, on the other side, which are the main barriers to consider attractive the sector:

what attracts most of the aerospace sector		the main barriers to consider attractive the aerospace sector
application of flame retardant textiles at aerospace products	for the aerospace sector innovative capacity and level of demand, it could facilitate new textiles application also in other areas.	lacking of competences and equipments for materials FR characteristics
to diversify finishing processes for a new different technical sector	<i>I see the aerospace sector in the same way that the automobile sector was at the beginning of the sec. XX. It has showed an exponential growth potential during the sec. XXI. In addition to the market potential, the demand for products in this segment enables supplier companies (among which, textiles companies) to grow technically and technologically.</i>	very complicated sector
to develop new composites from yarns and plasma technology application	increasing ability and competences to integrate technology and strict requirements in textile-based products	specific regulations and certifications
new advanced technical applications for textiles	the aerospace sector shows a respectable financial capabilities	lack of market knowledge
new technical and quality requirements could promote innovative textile products	the high-value products and system of aerospace sector are a productive land to generate innovations	potential orders characterized by small batches with complex requirements
transfer skills and competences of technical clothing sub-segment to aerospace sector to generate new products and applications		focalized on the Fashion system

The 88% confirmed a general interest in taking part of virtual or personal activities of GALACTICA (tools, learning, training courses, workshops, site visits...). B2B matchmaking, public funds for innovation investments and in-situ missions about aerospace and advanced manufacturing are the most attractive activities for the subjects under scrutiny.



4.4 SURVEY CONCLUSIONS

Summing up the survey results, it is evident that there is a high potential in GALACTICA activities for textiles companies: there is an important correlation between the textile and the aerospace sector and a strong interest in Advanced manufacturing, so that that the larger part of surveyed companies have already an advanced technology/4.0 strategy and started its implementation.

This factor, together with the willingness to create cross-sectoral collaboration and international collaboration, could enable them to overcome current and future challenges namely the entrance to new market sectors, the fostering of innovation, the international competition and the loss of business due to COVID-19.

The expansion towards the aerospace industry is considered as a potential area for application of new innovative solutions of the textile industry.

Nevertheless, aerospace presents some barriers to entry and they are composed by different factors mainly the technical difficulties, the lack of contacts and information, the lack of knowhow, the specific regulations and certifications needed.

As derived by the survey there are **main tendencies**/hot topics for the textile sector with respect to the GALACTICA project:

- **the attraction towards the aerospace industry** is medium to high value among the companies that belong to the Technical textiles segment. It is quite moderate for the few companies coming from the Fashion sector, hence they do not have a direct and obvious connection to the aerospace sector. Lots of companies detect many barriers and challenges to overcome to enter in the new sector.

On the other side, they appear already entered in the advanced manufacturing sector and related opportunities. Nevertheless, the aerospace would be a new area of

application in which textile and especially technical textile is required. Hence, it is an important potential sector for expansion also for the investment and employment of new innovative solutions.

The aerospace can be viewed as the automobile sector of the 20th century with exponential growth, and it enables companies to grow technologically and technically.

- **the main resistance towards the aerospace sector** is produced by several factors because of the technical difficulties of the activity, the specific regulations and certification needed to enter the sector, the lack of knowhow and experience, and the perception of the aerospace sector as a very far reality from the textile one.

- **the needs to enter in collaboration with the aerospace sector** are numerous mainly the need for specific knowledge, information, contacts. Moreover, TC SMEs need technical and specialised support and materials in order to reach the aerospace sector. Training for companies will be essential.

- the application and participation to **funded R&D projects**, the building of cross-sectoral collaboration networking is still considered complex and time-consuming activities. It is demonstrated by the low rate of SMEs involved in international and cross-sectoral collaborative projects. It is necessary to reinforce and enhance these opportunities through support and guidance to SMEs.

All GALACTICA activities throughout the **GALACTICA Space** could help companies overcome these difficulties, for example, through the cascade funding system, in order to trigger new cross-sectoral collaboration. GALACTICA project can provide the supporting activities necessary to overcome these challenges aiming at the creation of new cross-sectoral collaboration.

5. CONCLUSIONS

The analysis of Textile and clothing sector and the results of the survey come to the same conclusions: everybody knows - included the entrepreneurs - that the TC industry now has come to a turning point for progressing and aligning with the new Economy post-Covid-19.

The main topics to investigate:

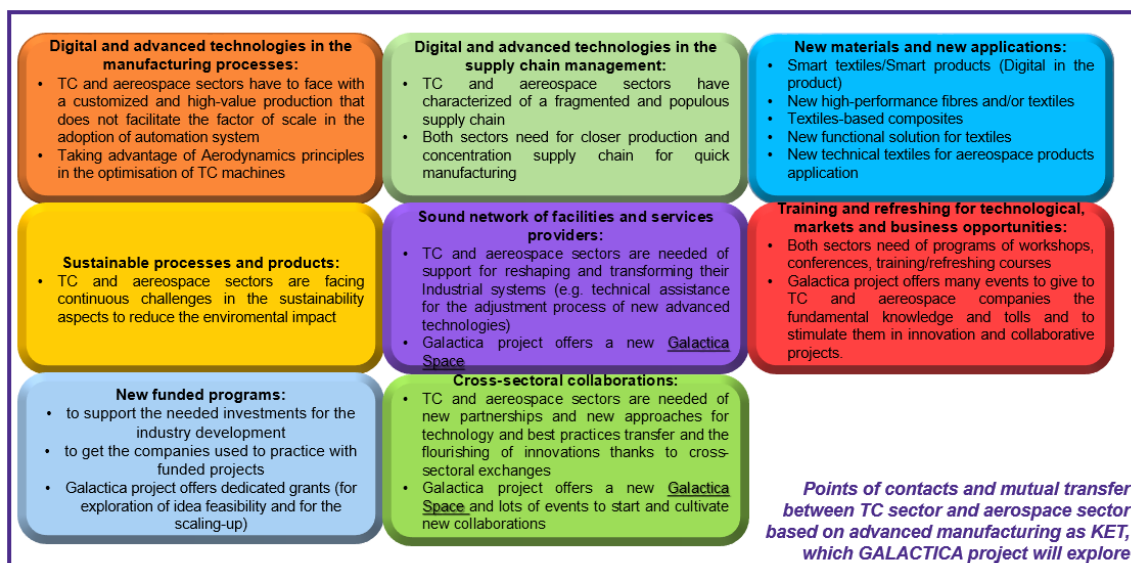
- The “Digital” in the processes, in the supply chain management (e.g. IIoT) and in the products (Smart textiles and Smart products).
- Advanced technologies for a manufacturing value chain that produces customized, high-value products
- Sustainable process and products to reduce the TC sector impact
- R&D and Innovation, above all for new functions in Technical textiles to spread even more the textiles application opportunities.

The main tools and methodologies-key enablers to enter the new technological approaches and new business models in the TC companies are:

- Training to know and stay updated about **all technological opportunities for TC sector**
- Training to know and stay updated about **all new potential markets**
- Taking part periodically to workshops, conferences to *enhance own competencies and skills in technological and business fields interesting for TC sector*
- **New partnerships/alliances** both among TC companies and among TC companies and other sectors companies, facilitating the technology and best practices transfer and the flourishing of innovations thanks to cross-sectoral collaborations.
- **Technical assistance** for the adjustment process of new advanced technologies in the value chain/supply chain.
- **A sound network of facilities and services providers**, like Clusters, RTO, research institutes, platforms to support the continuous linkage between new academics topics and entrepreneurial fabric.
- **New dedicated funded programmes for TC sector** to support the needed investments for the industry development and to get the TC companies used to practice with funded projects.

The GALACTICA project encloses all the above points set out as the fundamentals for the TC industry real change. The project aims to give an innovative growth opportunity to the textile sector:

- putting the TC sector in contact with the aerospace sector because it could be a new important final market for the textiles applications; a sector that has similar TC Industry characteristics, key drivers and challenges to deal with, and the cross-sectoral collaborations could give new high-value and unexplored solutions to bring the two sectors towards excellence levels in the global economy.
- Supporting the advanced manufacturing solutions deployment in TC plants, whole value chain and the supply chain



ANNEX 1

SURVEY DETAILS

MAIN COMPETENCES AND EXPERTISE OF TC SURVEYED COMPANIES

Non-woven innovative textile
 Technical socks for sports and for specific work (fireproof, medical ...)
 Personal Protection Equipment (PPE)
 Flame retardant fabrics, fabrics for high temperatures and thermoplastic textile composites
 Energy costs and sewage treatments
 Specialized manufacturing for leisure (mattresses, protectors, pillows, ...)
 Yarns/fabrics
 Technologies for drying, washing, softening
 Technical textile and advanced textile
 Textile machineries
 Clothing and uniforms for sport teams
 Product line, Fashion, Sport / Outdoor, Technical Textiles, work wear and circular economy / Sustainability
 Yarns, sewing threads, yarn dyeing and finishing
 Development and manufacture of professional clothing
 Development and manufacture of medical devices
 Laminated coatings for the interior of the car
 Synthetic fibres and fabrics
 Defect detection system for circular looms
 Edging and accessories for the production of the textile industry
 Product development, design
 Jacquard fabrics, in Rayon, cotton, PES, and mainly silk

14.0 AND DIGITAL STRATEGY IMPLEMENTED BY THE SURVEYED COMPANIES

Digitization of processes and data analysis for automation of decision making (supply chain and process planning)
 Online sales to the end customer
 ERP for the whole company
 Production management
 Digitalization of all the production
 Product, commercial and management
 Product quality controlling
 Digitization of all process and integration of all departments
 Roadmap for digitizing the company with a 10-year time horizon. Roadmap based on 5 fundamental pillars: "Creating the Organization of the Future"; "Products and Business Models in Digital"; "Ecosystem Experience"; "Digital Infrastructures" and "People and Skills in Digital". Each macro pillars has at least three actions each for the implementation within next 10 years.
 Dematerialize and automate production processes
 New productive system for technical needle punched
 Improving of the company informatic system
 Looms managed remotely; interface allowing the dialogue with the management program.
 Strong connection between design process/company system/production management

AUTOMATION TOOLS/ADVANCED MANUFACTURING TECHNOLOGIES IMPLEMENTED IN COMPANIES PLANTS

Quality control and defects control through Uster Technologies
Cutting machineries computerized
Automation in the fabrics production phase and in the finishing phase
Automation in finishing processes
New 4.0 digitalization plant for production data detection
CNC machineries and ERP management system
Automation in machineries and equipments for production-phase and tailoring-phase
2D and 3D modelling

“OTHERS” MAJOR PAIN POINTS FOR TC COMPANIES

Lack of support to R&D
Being under Asia dependency
Cut in revenues due to COVID
Equal criteria for certification requirements to sell products in the EU
Company taxes
Lack of financial support
Impossibility to promote and develop new solutions due to the Covid-19
The difficulty of finding business opportunities in a very "closed" sector
Lack of qualified workers
Global economic slowdown
Management of digital transformation
Uncertainty and economic situation
Textile companies have reduced their investments in information systems
Difficulty to finance patents and new projects
Low visibility
Necessity to propose highly innovative products
Uncertainty in the short / medium term

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Table 1. Technological challenges for textile materials

LIST OF REFERENCES

- [1] WORLD ECONOMIC FORUM, "How the textile industry can help countries recover from COVID-19" 2020. [Online]. Available: <https://www.weforum.org/agenda/2020/08/how-the-textile-industry-can-help-countries-recover-from-covid-19/>.
- [2] EURATEX, "FACTS & KEY FIGURES OF THE EUROPEAN TEXTILE AND CLOTHING SECTOR," 2020.
- [3] WORLD TRADE ORGANISATION, "WORLD TRADE STATISTICAL REVIEW 2020", 2020.
- [4] EURATEX, "ANNUAL REPORT 2018" 2018.
- [5] EASME (EUROPEAN COMMISSION), "ANNUAL REPORT ON EUROPEAN SMEs 2018/2019. Research & Development and Innovation by SMEs," 2019.
- [6] MC KINSEY & COMPANY, "The State of Fashion 2021", 2020.
- [7] S. S. o. T. U. o. B. Håkan Torstensson & Rudrajeet Pal, "Resilience in textile enterprises and supply chains," 2013.
- [8] Allianz and Euler Hermes, "BRUISED BUT NOT BEATEN, EUROPE'S TEXTILE INDUSTRY IS A PERFECT CANDIDATE FOR A GREENER AND DIGITAL RECOVERY," 2020.
- [9] D. M. L. D. D. S. Roger Lay, "Digital transformation - the ultimate challenge for the fashion industry," 2018.
- [10] CBI Ministry of Foreign Affairs, "Technology trends in the apparel industry," [Online]. Available: <https://www.cbi.eu/market-information/apparel/how-apply-new-technologies-apparel#technology-for-manufacturing>.
- [11] S. M. P. (. o. W. A. S. M. (. o. W. A. N. S. (. o. W. A. M. R. (. o. W. A. K. P. Savvas Vassiliadis (University of West Attica), "NEW TEXTILE MATERIALS AND STRUCTURES: AN

- IGNITION FOR CHANGES IN THE NEIGHBORING FIELDS OF ENGINEERING,” in *International Conference on Technics, Technology and Education* At, Bulgaria, 2013.
- [12] ETP FIBRES TEXTILES CLOTHING EUROPEAN TECHNOLOGY PLATFORM, “Towards a 4th Industrial Revolution of Textiles and Clothing A Strategic Innovation and Research Agenda for the European Textile and Clothing Industry,” 2016.
- [13] EURATEX, “EURATEX PRESS CONFERENCE TECHTEXTIL/TEXPROCESS,” FRANKFURT, 2019.
- [14] ALLIED MARKET RESEARCH , “TECHNICAL TEXTILE MARKET OUTLOOK 2027,” 2020.
- [15] GRAND VIEW RESEARCH, “MARKET ANALYSIS REPORT,” [Online]. Available: <https://www.grandviewresearch.com/industry-analysis/technical-textiles-market>.
- [16] Projecte d'Especialització i competitivitat territorial (PECT) de Mataró. Ajuntament de Mataró, “Benchmarking Indústria Tèxtil Internacional.,” 2020.
- [17] S. A. Ariadna Detrell, “Innovation and Development in the textile sector: Current situation and trends. Catàleg “Tot plegat”, “ 2016.
- [18] “CONTEXT Project,” [Online]. Available: <http://www.context-cost.eu/>.
- [19] CBI Ministry of foreign affairs, “What is the demand for apparel on the European market?,” 2020.
- [20] DHL GROUP, “Fashion technology and innovation shape the future of fashion,” 2018.
- [21] EURATEX , “Study on Innovation and Technology in the European and Mediterranean Textile and Clothing Industry for Monastir El Fejja Competitiveness Pole,” 2014.
- [22] Aalto University, “Solving the systemic challenges in textile and fashion industry,” 2020.
- [23] EURATEX, “EURATEX AUTUMN REPORT 2020,” 2020.
- [24] OECD , “EA and EU Economic Snapshot Economic Forecast Summary (December 2020),” 2020. [Online]. Available: <http://www.oecd.org/economy/euro-area-and-european-union-economic-snapshot/>.