The Future is...
... Textiles!

Strategic Research Agenda

of the European Technology Platform for the future of textiles and clothing

June 2006

EURATEX
The European Apparel and Textile Organisation

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Executive Summary

The European Technology Platform for the Future of Textiles and Clothing is a stakeholder forum that brings together the European textile and clothing industry, its research and education community, representatives of related industrial sectors and scientific disciplines as well as public authorities. The aim of the platform is develop and implement long-term industry visions and a ***Strategic Research Agenda (SRA)*** to improve innovation, competitiveness and growth potential for this key industrial sector in Europe.

The present SRA document is the result of a collective scenario development and technology roadmapping exercise by more than 400 individual experts representing all the above stakeholder groups carried out during the last 12 months. The document outlines the current situation as well as major economic, scientific-technological, political and societal trends which should directly impact upon the development of this industry in Europe. It highlights major areas for innovation and identifies crucial research priorities to be tackled to unlock industrial growth potential or to improve the competitive position of this industry on the global market.

The Strategic Research Agenda builds on the concept outlined in the document *"The European Technology Platform for the Future of Textiles and Clothing - a Vision for 2020"* published in 2004. In this document, the following three major development trends for this industry in Europe were identified:

(1) A move from commodities towards specialty products from flexible high-tech processes along the entire fibre-textile-clothing value chain.
(2) The establishment and expansion of textiles as the material of choice in many industrial sectors and new application fields.
(3) The end of the era of mass manufacture of textile products, and move towards a new industrial era of customisation and personalisation of products coupled with intelligent production, logistics, distribution and service concepts.

These three major trends constitute the principal focus areas of the platform and three dedicated Thematic Expert Groups have been set up in each area to develop concrete research priorities. This total of nine expert groups brought together the bulk of the information which was condensed and structured in the present Strategic Research Agenda.

In the first area ***'From Commodities towards Specialties'*** key research priorities were identified for 'new speciality fibres and fibre-composites for innovative textile products', 'functionalisation of textile materials and related processes' and 'bio-based materials, biotechnologies and environmentally friendly textile processing'.
In the second area ***'New Textile Applications'*** research must prioritise scientific-technological solutions enabling 'new textile products for improved human performance', 'new textile products for innovative technical applications' and 'smart textiles and clothing'.
Research in the third area ***'Towards Customisation'*** should focus on 'mass customisation for clothing and fashion', 'new design and product development concepts and technologies' and 'integrated quality and life cycle management concepts'.
All identified research priorities, concisely described in chapter 3 and fully detailed in nine separate documents provided in the appendix, have been identified by industrial and academic experts alike as

being of crucial importance to drive innovation and competitiveness in the European textile and clothing industry in the coming years.

Successful advances in research and technological development across all these areas can enable the industry to innovate in its products and services, processes and organisational procedures in countless ways. As described in chapter 2, it will be able to open new textile application areas in major growth markets by offering revolutionary solutions for mobility, health care, safety, energy and resource efficiency; allow it to compete more successfully on global markets through radically enhanced productivity, quality, flexibility and time-to-market; and finally continue to attract end consumers with diverse, imaginative, emotive and at the same time comfortable and safe textile and clothing products.

On the basis of this Strategic Research Agenda the stakeholders organised in the platform will now enter the Implementation Phase, during which the research priorities identified will be tackled through targeted R&D projects bringing together the best scientific and industrial capacities in the respective fields. A major part of this implementation work as briefly outlined in chapter 4 is expected to be carried out under the 7th EU Research Framework Programme (FP7) currently in preparation by the European Commission. However, (cross-)national and (cross-)regional research and innovation schemes should play a crucial role too during the implementation phase. The platform urges public authorities in charge of all such programmes and schemes to provide ample opportunities for textile and clothing-related research and to continue to work closely with the platform stakeholders in the definition of relevant research policy measures. In areas where textile innovation crucially depends on advances in other scientific-technological fields or where textiles themselves act as a key enabler for innovation by downstream users, collaboration with other European Technology Platforms will be pro-actively developed.

The document however also emphasises that research and development work alone will not be enough to make the European textile and clothing industry more innovation driven and competitive. Very important preconditions for more innovation intensity in this industry highlighted in chapter 5 are:

- An innovation-friendly regulatory framework
- An educational system to support industrial transformation
- A financial system to accommodate textile innovation
- Innovation-supporting standardisation
- Capacities for effective management of innovation and technological change

During the implementation phase the Technology Platform will seek to advance all these horizontal innovation-related subjects through dedicated Horizontal Task Groups which will each collaborate closely with relevant public authorities and other interested stakeholders.

Overall the European Technology Platform for the Future of Textiles and Clothing will remain focussed on an allocation of its resources to the most promising fields of R&D and innovation action to ensure long-term industry competitiveness to the benefit of economic growth, employment and sustainable development in Europe. It will continue to operate in an open and transparent way inviting every organisation and individual interested in research, development and innovation across Europe to join its activities.

Contents

Appendix

Thematic Research Agendas

1. New speciality fibres and fibre-composites for innovative textile products
2. Functionalisation of textile materials and related processes
3. Bio-based materials, biotechnologies and environmentally friendly textile processing
4. New textile products for improved human performance
5. New textile products for innovative technical applications
6. Smart textiles and clothing
7. Mass customisation
8. New design and product development concepts and technologies
9. Integrated quality and life cycle management concepts

General Documents

The European Technology Platform for the Future of Textiles and Clothing - A Vision for 2020

Terms of Reference

Note: The complete appendix is available for download at www.textile-platform.org

1 Introduction: Textiles & Clothing - a bright Future built on a strong Tradition

1.1 Societal Role - Textiles Everywhere

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Clothing and Fashion

Clothing has acted as our second skin since pre-historic times. Since the very beginning it fulfilled functional, essentially protective and insulating, as well as cultural requirements. Clothing kept us warm and protected the vulnerable fur-less human body from its outside environment impact, but it was also used to enhance our appearance, to communicate our societal status or belonging to a specific group (e.g. uniforms) or our ability to follow (or reject) certain societal trends (fashion).

Clothing and fashion are one of the worlds biggest consumer goods categories with a global market estimated to be worth well over 1 trillion Euros. While some consumer goods categories like electronics or automobiles today are growing faster than clothing, the apparel and fashion market will remain a huge and globally growing market for decades to come.

Particular fashion products may today become obsolete within months or even weeks, clothing differs from many other of today's "hot" consumer products in that it is not expected to become obsolete in any foreseeable future. A quick review of science fiction literature and films seems to indicate that while we may lose many of today's everyday goods like cars, telephones or computers over the next century or two, clothing in one form or other is expected to be used as long as human-like creatures continue to populate this planet (or galaxy).

Looking - a little more realistically - into the near future, demand for clothing, including European-made fashion brands is expected to grow significantly in the densely populated fast growing economies of Asia and Latin America as well as parts of Africa and Eastern Europe. Clothing consumption in the highly developed countries of Europe, North America and other parts of the world is expected to be slower growing or even stagnant, although at a high absolute level. Some significant innovations like mass customised or industrial made-to-measure clothing as well as functional and smart garments may however provide an additional growth stimulus in more mature markets in the future.

Overall the business of designing, producing and globally distributing clothing is expected to become more complex, sophisticated and fast moving. Recent technological advances in areas as diverse as human body scanning, 3D CAD technology, automated spherical sewing systems, RFID technology, supply chain management, on-line retail etc. could combine to change the logic in today's labour cost driven clothing industry and make it more dependent on companies' abilities to efficiently and accurately satisfy individual end consumer demands, to profitably manage expensive retail space in prime locations or to couple the core clothing product with value-enhancing customer services.

Home and Interior Textiles

Much as humans like to wear textiles in the form of clothing on their body they also like to use textiles to make their homes, offices, hotels, restaurants, cinemas, airports and many other private and public buildings more comfortable and aesthetically acceptable. Most carpets, furniture's upholsteries, bedding elements, curtains, table cloths as well as tapestry are made of textiles. Textiles are flexible, soft, relatively light, easy to install and use, durable and easily produced in all possible shapes, forms, colours and designs. Textiles decorate interiors, make furniture more comfortable to sit in or lay upon (upholstery & bedding), they help insulate houses against heat, cold, noise or unwanted light (curtains), they help reduce noise levels within the house (carpets), increase safety in the home (upholsteries and carpets) and serve many more purposes.

While the "textile content" inside houses differs across cultural and climatic regions and fluctuates with interior decoration trends, interior textiles have been known and used in all human cultures and civilisations.

In most European countries relative expenditures on clothing as a percentage of total disposable income

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ahas been falling for more than 20 years. Consumer spending has been reoriented towards previously non-existent product categories, especially those related to modern information and communication technologies as well as towards services-related expenditure for travel, recreation, health care and entertainment. However consumers continue to spend a significant part of their income on the maintenance and modernisation of their houses and homes, including a growing number of secondary residences, a trend that has also benefited the home textiles industry.

Globally, increased housing space per capita coupled with a growing use of temporary accommodations like hotels for professional and recreational purposes are expected to favourably underpin European and worldwide demand for all types of interior textiles in the coming decades.

New applications

While there are no serious substitutes for textiles in sight in the conventional application fields of clothing and interior decoration, textiles or textile-based composites are predicted to replace many of today's metallic and plastic materials used in the automotive industry, ship building or aeronautics, in the construction sector, in the machinery and machine tools industry, in the electronics, electro-technical and medical devices sector, and, to a lesser extent, wood, leather and other natural materials in furniture, sports goods and turfs and many other smaller application areas.

With a growing world population and its increasing need for housing, water, food and energy, protection and health care to be provided in a sustainable and cost efficient way, a whole range of new application areas for textiles are being created in areas such as agri- and horticulture, fishing and aquaculture, land reclamation, hydraulic works, environmental protection, energy generation, transportation and storage, personal protection, sports and leisure, medical and beauty care, hygiene etc.

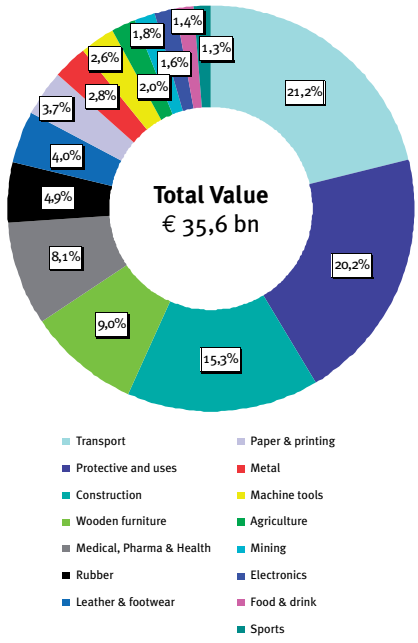

Figure 4: Western Europe's consumption of technical textiles by application (Source: Euratex estimate for 2004 based on Eurostat, 2004 and OETH, 2000)

Growth rates for such textile products and new applications are generally higher than those for clothing and home textiles. Their markets on the other hand are frequently specialised niches requiring lower volumes but high levels of quality and performance characteristics which have to correspond to precise standards and specifications and must undergo complex and lengthy accreditation and approval procedures. Product innovation rates in these markets are rapid and successful new developments require extensive know-how in materials, processing options, customer requirements and use scenarios.

Key Message
Textile products are ubiquitous in the modern society. They fulfill countless societal and individual needs. No significant substitution of textiles by other materials/products is expected. Global production of textiles and market value for textile products will grow in the foreseeable future.

1.2 The role of the Textile and Clothing Industry in Europe

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The European Textiles and Clothing industry has a longstanding tradition of leadership in terms of innovation, fashion and creativity, and despite increasingly fierce global competition and significant relocation of manufacturing to low-wage countries, it continues to represent one of Europe's major industrial sectors with an annual turnover of more than € 200 billion Euro and a total workforce of 2.3 million in 2005[1]. It is a major player in world trade, the first in textile exports and the third in clothing. With a total of more than 170,000 companies in the enlarged EU, of which some 96 % are SMEs, it covers a fascinating industrial landscape, producing a myriad of different consumer and industrial products, using countless knowledge-intensive and highly specialised production processes and related technologies.

Unlike certain industries in Europe, the textile and clothing industry is a world leader and regular first mover in technology usage, process and product innovation, including fashion creation and other "non-technological" innovation activities. In this context too, it is fortunate that European textile machinery manufacturers themselves lead the world, that Europe's fashion industry enjoys world pre-dominance, and that the "technical" textiles sector of production is equally recognized for its pioneering role. In the textiles

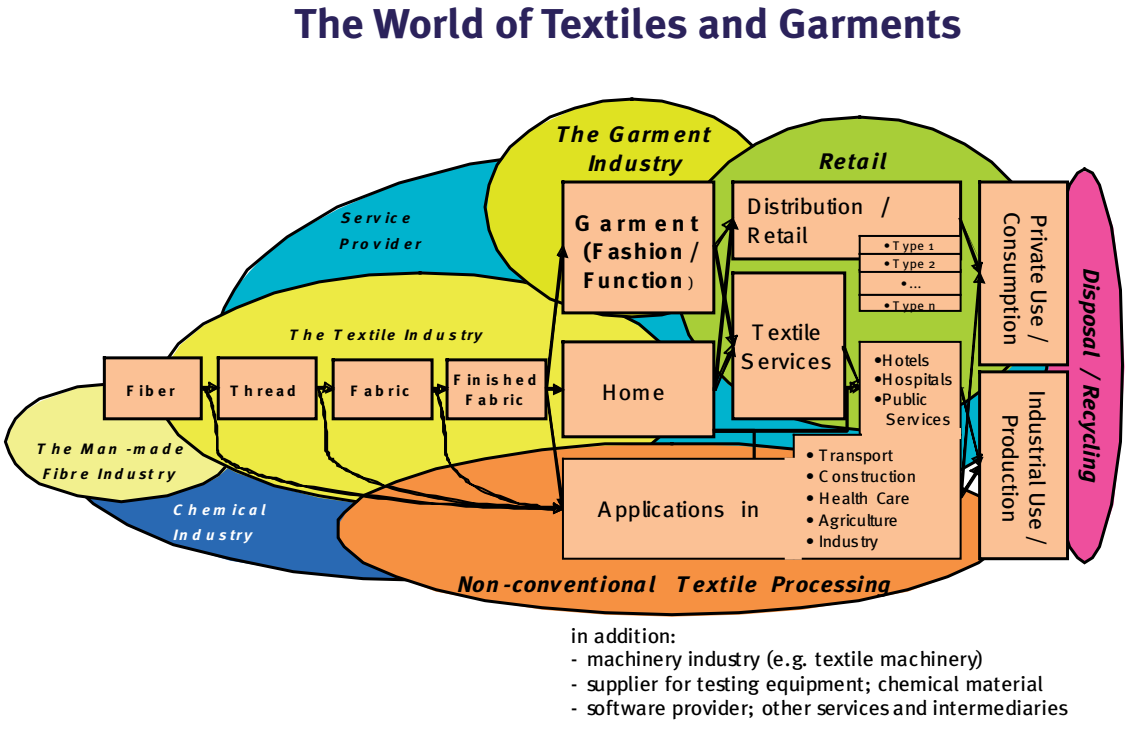

Figure 1: overview of the complexity and variety of actors in the textile-clothing business, source: Tex-Map project

1 Euratex estimated figures for EU-25

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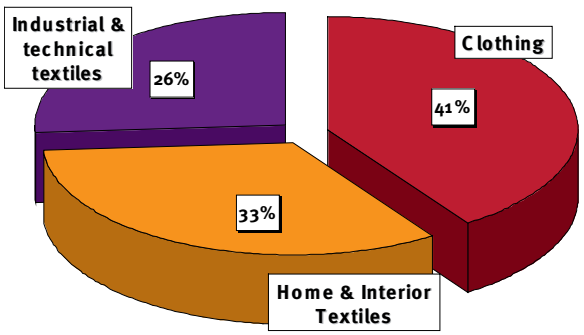
area, which enjoys an export surplus with the rest of the world rapid productivity gains have maintained a degree of competitiveness, which has been enhanced by innovative products and processes in particular in the growing field of technical textiles, covering end-uses in transportation, road-building, land-reclamation, housing, sporting equipment, protective wear, surgical and medical devices and others, as described under item 1.1 above.

The major end-use however still remains apparel where European manufacturers have led the world in terms of fashion and creativity, across all forms of clothing. Nonetheless, in comparison to the spinning or weaving of textiles, clothing manufacturing is highly labour-intensive, and steps are urgently needed to overcome this disadvantage as compared to lower wage countries.

EU-25 Breakdown of textile production into 3 sub-sectors by volume of fibre usage - 2003



While labour cost disadvantages are the most notable challenge to be overcome by the European industry if it is to retain its leading edge in global competition, there are a great number of other equally challenging conditions that the industry currently faces. These include trade barriers in certain important export markets, strict environmental and safety legislation imposed by European political will but not adequately rewarded by European consumer choice; a growing shortage of qualified human resources which is most acute in higher education graduates in textile engineering; the theft of the fruit of European industrial creativity and intellectual property through rampant illegal copying of designs and brands.

The strengths and reputation of the European textile and clothing industry with regard to product quality, productivity, creativity and innovation continue to constitute a sound foundation from which to pursue successful industrial activity in the future. However, they will need to be accompanied by a faster and more effective translation of scientific results into innovative commercial products, more flexible, small batch oriented, resource efficient manufacturing processes, more customer orientation and value chain cooperation in product development, better development and exploitation of multidisciplinary knowledge and skills especially in the new application fields of textiles, a more strategic development of private and public research and higher education capacities, more customer value creation through individualised product-service offerings and a better protection of intellectual property - all areas in which European industry still has a long way to go.

The vision of the future of the European textile and clothing industry can therefore only be built around the concept of dynamic, innovative, multidisciplinary knowledge-based, flexibly integrated and customer oriented networks of businesses.

Key Message
Research and innovation have been important tools for the European textile and clothing industry to assert its leading position on global markets. The importance of research and innovation for continued industrial competitiveness will increase.

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1.3 Textile Research and Education in Europe

A world-class research infrastructure

The European textile and clothing industry might not appear to be a particularly research intensive sector and its companies statistically spend a relatively small percentage of their turnover on research. Nevertheless this industry, in its more than two centuries' existence, has managed to achieve tremendous and uninterrupted increases in productivity and product quality, a trend that is ongoing and has even accelerated over recent decades.
This has been achieved by continuous improvements in production technology and innovation in symbiosis with machine developers and the most innovative user companies, in most cases European companies in geographical proximity to the machinery manufacturers.

In product innovation too, European companies are in many areas recognised world leaders and have carved out this leadership by creative application and combination of textile materials and chemicals, by skilful selection and combination of materials and processing options and by unabated creation of new designs, styles or product functionalities. A major part of these types of innovation activities would not be considered as research "per se", but rather as non-technological innovation in which textile and especially clothing companies invest heavily.

However, due to the structure of the industry, which is dominated by a vast majority of very small to small or medium-sized companies, research and innovation activities, with the exception of a handful of larger groups, often lack continuity, strategic direction, human and knowledge resources and, above all, funds. Hence most textile and clothing companies have no permanent R&D personnel or departments and no regular R&D budgets. Traditionally this void has been filled by national or regional, mainly publicly or part-publicly funded research and technology centres or university departments dedicated to textiles and clothing. These structures exist in almost all European countries and may often play the role of temporary R&D department, research advisor or technology consultant for companies that lack such capacities in-house.

The manifest fragmentation of the industry is directly reflected in the European textile and clothing research landscape. With few exceptions textile research centres and university departments are themselves relatively small structures with insufficient resources to carry out long-term cutting-edge research work. Their missions include services to the regional or national industries where they seek to cover a broad spectrum of activities, sometimes dominated by material testing and technology support services rather than fully-fledged research. Due to the regional or national focus of research operators, arising from the origin of the major proportion of their funding, duplication of research efforts with corresponding waste of resources is a common phenomenon in European textile and clothing research.

Trends to consolidation within the industry, rising demand for complex knowledge-based high-tech processes and technologies, faster innovation cycles and growing competition even in advanced products from previously low-tech producers outside Europe, make existing research structures and capacities in Europe appear increasingly inadequate. Consolidation of existing research structures and targeted development of newly required expertise and services seems inevitable.

Therefore a clear need exists for a strategy and capacity development effort at European level. Based on industry requirements, innovation targets need to be set and corresponding research programmes and projects implemented to bring together the highest level of scientific excellence and the necessary industrial capacities for a rapid exploitation of research results.

A pre-requisite for better research co-ordination is a scientific excellence "mapping" across Europe.

Companies need to be able to easily find their most suitable research and innovation partners even beyond national borders. In the medium term this should lead to the pooling of resources and the emergence of real European centres of excellence with a sharply defined profile and a world-class long-term research agenda.

Key Message
Europe disposes of a world-class textile research infrastructure able to carry out the research work put forward in this Strategic Research Agenda. However, existing structures must be strengthened, better networked across Europe and more focussed on effective transfer of research results to industry.

An education system of global attractiveness

The last decade especially has seen a significant change in the structure of the textile and clothing industries, as the manufacture of commodity goods has transferred from Europe to low-wage economy countries, primarily in Asia. The decline in the traditional textile and clothing manufacturing industries has in turn reduced the attractiveness of a career in these industries, so demand by school leavers for traditional courses in textile and clothing manufacturing technologies has reduced substantially. The funding models in most universities, colleges and other educational establishments require them to act increasingly like businesses, and whilst some textile education providers have been able to adapt successfully by concentrating on textile design, clothing fashion and textile management types of courses that remain popular with students, others face the strong possibility of closure. The emergence of the technical textiles sector and the shift from a resource-based to a knowledge-based textiles industry has placed new demands on the education providers to adapt course curricula to produce a suitably qualified supply of personnel. However, changes in curricula alone are not enough and an essential component of the strategy of the Technology Platform is to boost the public image of the textile and clothing industries as the future will see them.

As the European textile and clothing industry transforms itself, the qualifications and skills required of (potential) employees must to evolve too. Industrial reality will be increasingly characterised by:

- Agile operations on international markets as global niche players;
- Accelerated innovation cycles and increased research/product development/design intensity;
- High-tech manufacturing facilities for the production of a highly, diversified product range

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- Closer collaboration with suppliers and customers;
- Use of a wider range of materials (textile & non-textile);
- Dealing with different end markets and marketing and distribution models.

In order to succeed in this transformation, industry requires first class human resources. It therefore has to ensure that the high-calibre knowledge worker and well qualified young professional find in textiles and clothing the attractive working conditions and competitive remuneration packages they expect. Universities and other providers of higher education and advanced technological know-how need to prepare their graduates with the right combination of scientific-technological excellence and industrial application capabilities. The industry is in acute need of qualified personnel, as the higher education graduate looks and moves elsewhere. This paradox has to be overcome. The sharply declining number of graduates in almost all textile-related education courses can only be reversed if industry and education providers move in lock-step to provid clear and promising career paths.

Key Message
Higher textile education is of excellent quality and broad diversity in Europe. The number of young people attracted to textile education programmes however is largely insufficient and must be urgently increased. Education programmes must reflect changing qualification requirements of the industry.

1.4 The European Technology Platform

The European Technology Platform for the Future of Textiles and Clothing, launched in December 2004, is an industry-led initiative which brings together all interested stakeholders: the textile and clothing industry itself, related industries and service providers, the research and education community and public authorities at all levels. In a joint effort it will identify long-term trends and visions and develop and implement a Strategic Research Agenda to support the transformation of this industry into a knowledge-based innovation driven sector. The work of this platform is being implemented according to general guidelines for the functioning of European Technology Platforms defined by the European Commission, in close collaboration with related Technology Platforms and in a general spirit of openness and transparency in order to enable all interested stakeholders to make an active and meaningful contribution towards the achievement of its goals.

Objectives

In order to ensure the long-term competitiveness of the European Textile and Clothing industry and to reinforce the position of Europe as a leading global player in the development and manufacture of fibres, textiles, textile-based products and apparel, the Technology Platform will pursue the following key objectives:

- Establishment of an effective European-wide expert network involving industry, research organisations, public authorities, financial institutions and other stakeholders to join forces and coordinate their efforts in the field of research, development and innovation to the benefit of the European Textile and Clothing industry.
- Definition of a common strategic vision for this industry in Europe and development and implementation of a Strategic Research Agenda (SRA) to realise this vision through targeted and coordinated research, technology development and innovation efforts.
- Development of structures and measures to improve the overall research, development and innovation framework conditions of this industrial sector focussing specifically but not exclusively on the removal of financial, educational and regulatory obstacles.

Vision

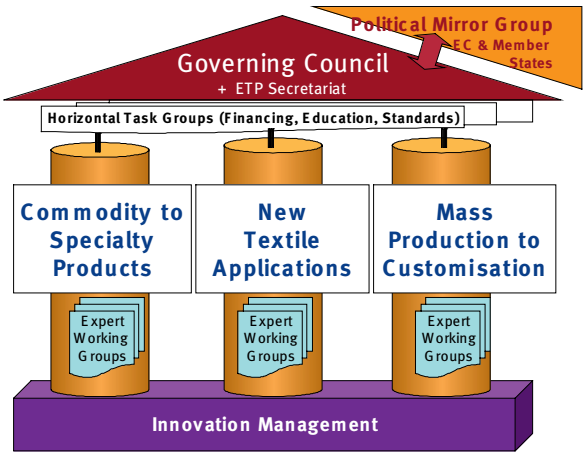
The Technology Platform has defined a common vision built around 3 major long-term industrial trends that are expected to shape the structure, activities and global competitive situation of the European Textile and Clothing industry over the coming years.

(1) A move from commodity fibres, filaments and fabrics, towards specialty products from flexible high-tech processes.

(2) The establishment and expansion of textiles as the material of choice in many industrial sectors and new application fields.

(3) The end of the era of mass manufacture of textile products, and move towards a new era of customisation and personalisation of products coupled with intelligent production, logistics, distribution and service concepts.

The Technology Platform will implement its Strategic Research Agenda with a constant focus on the realisation of this vision.



Structures and procedures

The three above-described focus areas constitute the founding pillars of the platform. Within each pillar a number of permanent thematic expert working groups led by industry, but also animated by representatives of research, higher education, public authorities or other relevant stakeholders have developed and will implement specific parts of the overall Strategic Research Agenda.

In addition to the thematic working groups, a limited number of horizontal task groups are being established to deal with issues related to framework conditions for effective research and industrial innovation that cut across several or all thematic pillars and expert groups. Such horizontal issues include the mobilisation of financial resources, the development of adequate education and training structures as well as standardisation and innovation management issues.

A high-level Governing Council oversees the strategic direction of the Technology Platform. This Council is comprised of representatives of industry as well as representatives of the three main European organisations involved in research for the textile and clothing industry, i.e. EURATEX - the European Apparel and Textile Organisation, TEXTRANET - the European Network of Textile Research Organisations, and AUTEX - the Association of Universities for Textiles. The work of the Governing Council is supported by a permanent secretariat.

The European Textile and Clothing High Level Group in which high level representatives of European institutions and member state governments participate has so far acted as a Political Mirror Group to the Technology Platform. Steps are being taken to complete the mirror group with further representatives of public authorities from European, national and regional levels.

Key Message
The European Technology Platform has been eagerly embraced by all stakeholders as a crucial tool to drive more research and innovation activity as key factor for sustained competitiveness of this industrial sector.

2 Textile Innovations for a better Europe - a Vision for 2020

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Textiles are everywhere in modern society; worn as protection and self expression on the human body, used as decoration and comfort elements in homes, offices, hotels or public buildings, as functional products in hospitals and homes for the elderly as interior components in cars, buses, trains, ships and airplanes, as structural elements for tents, roofs or bridges, as reinforcements for roads, dams, dikes or ditches, as bags, nets or artificial turf in sports and outdoor activities and much more. As our society as a whole undergoes constant change so does our daily life. These changes are reflected in the textile products serving us.

Textile innovations, like all other product or service innovations, happen when societal trends, needs or wishes combine with new scientific, technological or organisational capacities develops by creative open minds and implemented by knowledgeable and skilful operators and visionary risk-taking entrepreneurs.
Europe is well placed to spur textile innovation thanks to a unique set of economic, scientific-technological and human and knowledge-based assets. These include:

- a dynamic society with constantly evolving needs and demands,
- a strong and sophisticated home market for both consumer and industrial goods,
- an extremely diversified and advanced textile and clothing industry,
- a rich textile knowledge base,
- a world-class textile research and education infrastructure,
- a global reputation for innovation and quality.

All these assets can be combined to drive textile innovation faster and more successfully than in any other region of the world where some of the above capacities have either been lost or are only in the process of emerging. The following pages will give a broad but non-exhaustive overview of areas where evolving societal needs combined with scientific and industrial capacities can unlock huge textile innovation potential and ensure continued European leadership in the global textile and clothing innovation arena.

2.1 A safe and comfortable environment around us

Traditionally textiles have been an important part of the interior of human habitations involving all types of buildings such as homes, offices, hotels and hospitals, as well as human transportation systems such as cars, buses, passenger trains, cruise ships or airplanes. In that respect textile served three basic purposes:

- Decoration (carpets, wall coverings, curtains & drapes, table cloths, etc.)
- Comfort (Upholstery, seat covers, mattresses, bed sheets, blankets, carpets etc.)
- Safety (Safety belts and nets, airbags)

While demand for these basic uses is unlikely to reduce in the foreseeable future, the increasing complexity and functionality of human construction have started to provide significant potential for the growing use of textiles both in terms of applications and functionality.

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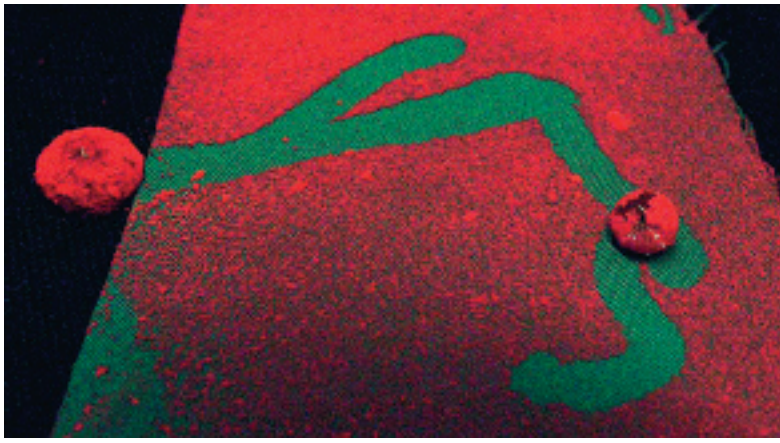

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Textile Structures

Textiles have in the past been predominantly confined to the interior decoration of human constructions; they are now increasingly becoming part of these constructions themselves. Thanks to better performance characteristics of fibre and textile-based engineered materials in terms of their strength-weight ratio, durability, flexibility, insulating and absorption properties, and fire and heat resistance, they are in a position to replace more traditional construction materials such as steel and other metals, wood and plastics. Examples of such innovative uses of textiles as structural materials today and potentially in the future include:

- Light-weight textile roofing
- Textile-reinforced concrete
- Fibre- and textile-based bridging cables and elements
- Erosion and landslide protection systems
- Textile reinforcement of dykes and other water management systems
- Fibre-based light, flexible and durable piping and canalisation
- Artificial islands and floating platforms

Multifunctional and Intelligent Materials

While the basic functions of decoration, comfort and safety remain unchanged, increased user and regulatory requirements for textile interiors have already made such products more complex, multi-functional or even “intelligent”. These will become even more essential in the future. The following table provides a non-exhaustive overview of required functionalities and their current or future areas of application.

Functionality	Application
Stain or water repellence	Table cloth, curtains, furniture, car, bus, train, airplane seats
Flame retardance	All possible textile interiors of buildings and transportation systems
Abrasion resistance	Carpets, all types of seat covers
Anti-static behaviour	Upholstery and seat covers
Anti-bacterial behaviour	Bedding, medical textiles
UV-protection	Roofs, tents, awnings, blinds, curtains
Insect repellence	Tents, nets
Odour absorption	Bedding, furniture, car, bus, train, airplane seats

2.2 Effective protection and health care for Europe's citizens

Smart Clothing - a second skin more protective and functional than our own

The skin is the principal element that separates and protects the human body from the environment around it and the impact this environment may have on the body. It is also acts as a major exchange system of energy (e.g. heat) and matter (fluids and gases such as water, oxygen etc.) between body and environment.

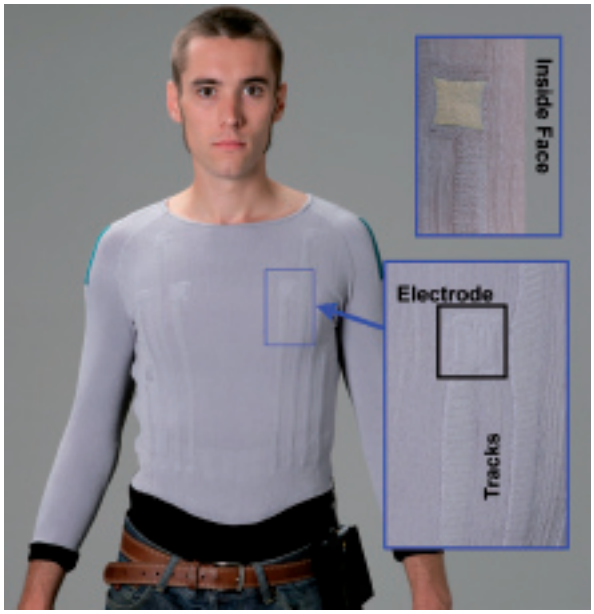
Clothing as an artificial second skin has always been used by humans to enhance the protective function of their own skin especially in situations and environments in which the body's own protective mechanism proved insufficient to maintain all vital functions. However such additional protection often has a negative effect upon the exchange functionality of the human skin, in certain cases very severely like in the case of full body armour, fire-fighters, uniforms or diving suits.

Functional and even smart or intelligent clothing are the innovative response to such limitations. While all types of clothing have some basic decorative or protective effects, *functional clothing* refers to products in which one or several specific functionalities are emphasised like strong insulation, water or fire resistance, breathability, wear resistance etc. *Smart or intelligent clothing* takes (multi)functionality one step further as it refers to products that can offer their functions in a more adaptive way in response to stimuli from the environment or the wearer. Smart garments can for instance:

- adapt their insulation function according to temperature changes,
- (through integrated sensors and actuators) detect vital signals of the wearer's body and react to them,
- change colour or emit light upon defined stimuli
- (through integrated sensors and actuators) detect and signal significant changes in the wearer's environment (absence of oxygen, presence of toxic gases or chemicals, radiation, strong electromagnetic fields etc.)
- generate or accumulate electric energy to power medical and other electronic devices

Better healthcare solutions on the basis of innovative textiles

Textile products are omnipresent in the field of human hygiene and medical practice. Traditional applications include wound care products, diapers, braces, proth-eses and orthoses, wipes, breathing masks, bedding and covers, ropes and belts etc. Their use is based on a number of typical basic textile properties like softness and lightness, flexibility, absorption, filtering etc.



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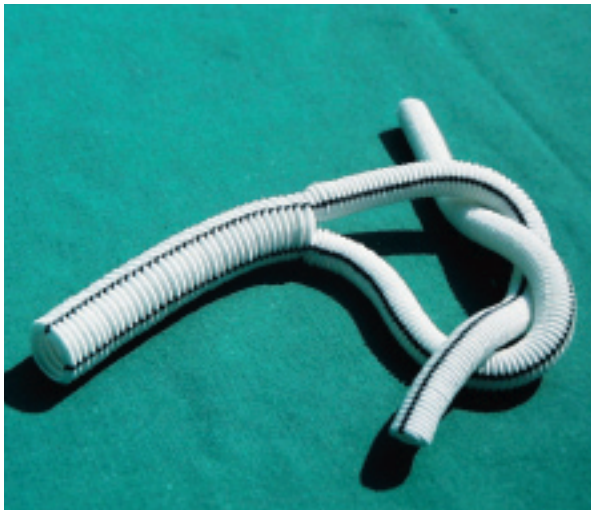
With the inevitable trend towards an aging society in European and most other industrialised countries health care and enhancement of quality of life for elderly and (chronically) ill people is becoming a more and more dominating societal priority. While medical capabilities are constantly improving, also the cost for medical treatments and health care in general is relentlessly growing, which puts *social care systems* Europe-wide under considerable strain.



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Innovative textile products can both add significantly to effectiveness of medical treatments as well as patient comfort during active medical care or recovery. At the same time, new medical textiles, while not being responsible for a large share of overall health care costs, may contribute to cost containment.
Such innovative products :

- Provide new treatment options (textile based implants instead of scarce donor organs; artificial tissues, joints and ligaments),
- Speed up recovery after medical treatment (innovative wound dressings; light, breathable orthoses/ protheses)
- Enhance quality of life of chronically ill people (functional clothing for people suffering from neurodermitis or psoriasis, anti-dust mite bedding for asthmatics etc.),
- Facilitate and secure the life of the elderly (adaptive compressing stockings, functional diapers, customised clothing for easy use and functionalities adapted to special needs)

2.3 Innovative mobility and energy solutions

The old tale of the flying carpet demonstrates that the idea of using textiles to (air-) transport humans or goods is not recent. Textile ropes and sails have been instrumental in powering ships since the early days of human civilisation and the birth of human aviation in the form of balloons, zeppelins and early airplane prototypes is equally textile-linked. Otto Lilienthal or the Wright Brothers would not have been able to achieve their feats without textile-covered aircraft wings.
The 21st century incarnations of mobility enabling textiles come in the form of:

- performance fibre-based textiles used in balloons, parachutes, sails, nets and ropes;
- aircraft wing and body structures or boat rumps made of fibre and textile-based composites;
- inflatable components of satellites or other spacecraft;
- flexible reservoirs, containers or bags used for transportation of gases, liquids and bulk goods by road, rail, water or air.

Major shifts from metal-based materials towards textiles and composites are underway or expected in the near future across all transportation system fields. They will exploit superior material characteristics such as better weight/performance ratios, durability, flexibility, bio-degradability as well as faster, cheaper or more versatile manufacturing and assembly options.

Lower weight vehicles and transport equipment like composite and textile based automobiles, airplanes and containers of inflatable spacecraft, will have a massive impact on energy consumption and the related environmental impact of transportation. New generation large-scale long-range sailing ships may have a similar effect on water-borne freight.

Also in the field of energy generation, transportation and storage, textiles find ever more innovative uses. These include:

- storage and piping systems for water, liquid fuels and gases made of textiles and fibre composites
- anchoring or flotation elements for off-shore platforms
- high-resistance aramide based rotor blades for gas and wind turbines
- flexible solar cells and inflatable solar panels.

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2.4 Efficient use of natural resources and protection of the environment

More efficient use of non-renewable resources and better use of renewables

Today global production of textiles and clothing uses approximately 40% of natural fibres (cotton, wool, linen, silk, flax, hemp etc.) and 60% of man-made fibres (polyester, polypropylene, polyamide, cellulosic fibres, acrylics etc.), with a general trend in favour of man-made fibres. On the basis of sustained demand from highly industrialised countries combined with strong growth in quickly developing economies especially in Asia, global fibre usage is expected to increase by 4-5% per annum in the next decade. Man-made fibres as a whole are expected to have a growth rate at the upper end of this range and natural fibres with rates at or below the lower end.

Natural fibres are clearly a renewable resource. However, their rapid growth as raw materials for increasing global fibre demand faces a number of significant constraints. Growing of cotton, the dominant natural fibre, is constrained by limited availability of suitable agricultural land having the required climatic conditions. All other natural fibres too face a variety of production and use related constraints which make a rapid expansion of their use in the textile industry over and beyond today's levels unlikely.
Today's man-made fibres on the other hand are predominantly made of non-renewable fossil fuel resources. While large-scale expansion of petro-chemistry based fibres is possible in principle, such manufacturing sites require massive investments. In addition, the enormous increase in world market prices for fossil fuels may act as a further deterrent to any above trend growth in this of fibre family.
An alternative route, which has been long practised in the field of cellulosic fibres, is the making of fibres out of various forms of plant biomass. Here advances in industrial biotechnology have opened new horizons, which led to the manufacture of some new fibre types e.g. those based on polylactic acid won from corn starch. The major limiting factors in this field are the long time frame and high development costs for such completely new fibre types.
The most promising innovation trends for a more efficient use of non-renewable resources and better use of renewables with a positive impact on European industry's competitiveness seem to be:

- The development of specialty fibres and fibre-variants, with efficient production systems and a build-up of knowledge about optimal onward processing in the textile industry.
- The improvement of processing and use characteristics of natural fibres which can be easily grown in European climatic conditions.
- Research into the production and processing of artificial fibres from renewable biomass.

Towards zero-impact on environment and human health in textile (clothing) production

Textile and clothing production processes may be broadly divided into mechanical and chemical processes. While mechanical processes require mainly electric energy as well as lubricants as major input resources, chemical processes, which are predominantly wet processes, often require in addition significant amounts of water and chemicals as well as heat.
While it is natural that every textile company should for economic reasons seek to reduce the amount of input resources to the bare minimum, it is an equally high priority to deal with undesirable processing output (textile waste, waste water, sludge & other chemical residues, dust, toxic gases, heat, noise etc.) in the most economic and fully regulation-compliant way.
Europe is leads the world in terms of legislation aiming at the protection of the environment, the promotion of resource efficiency and health and safety at the workplace. As a result, very strict and sometimes complex environment and safety regulations directly affect Europe's textile and clothing industry; often disproportionally in relation to their non-European competitors,

whose production processes are not subject to such strict regulation, but whose products still enter the European market. No one would envisage a lowering of Europe's environmental, health and safety standards, when general global trends move towards more sustainability in manufacturing albeit at very different speeds; the best course of action for Europe's textile and clothing producers would appear to be a pro-active combination of economy and ecology.

For example innovative processing concepts and production technology with greatly enhanced resource efficiency, combined with novel waste treatment, recycling or disposal concepts, can greatly boost European industry's competitiveness. As the globally rising component of raw material, energy and waste management becomes even greater as a proportion of total manufacturing. Similarly, flexible small-scale on-demand manufacturing units located close to the point of final use/consumption can render much of today's global transportation and its negative environmental impact obsolete.
Examples for sustainable textile processing concepts and related technologies include:

- Low water or water-free textile dyeing, printing and finishing techniques
- Integrated and intensified processes for fast multi-step treatments and maximum use of input resources
- Replacement of chemical processing by biotechnological processing through use of enzymes or other bio-organisms instead of chemicals
- Small-scale low-cost textile processing waste water treatment units
- Fault-free manufacturing systems for reduced production waste
- Direct 3D forming techniques for textile articles including clothing to reduce the cutting and joining steps as well as to reduce waste

2.5 Extending Europe's creative and innovative leadership

Global creative leadership based on Europe's cultural diversity - a sustainable competitive advantage

Textile and clothing product consumer unlike any other product derive their value from visual and haptic properties. They have direct appeal to the human senses. From an article of lingerie to a wall-to-wall carpet, these products are bought because of their aesthetics, their form, style, colour and design as well as their feel,

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touch and fit. Certainly they also possess functional properties in order to protect, insulate or absorb, and they should be durable, washable or cleanable. But such properties are usually not the decisive ones for the products value, and are rather taken for granted.
Aesthetic properties however are not objective and very rarely stable across time and space. They have to constantly change, be updated or reinvented. It is certainly no coincidence that this endless cycle of constantly changing aesthetic perceptions and expectations known as *fashion* is usually immediately associated with the world of textiles, and more particularly clothing.
Europe with its wealth and diversity of cultural heritage is the undisputed global powerhouse for fashion and design. While many lower skilled manual labour jobs have been lost in this industry in Europe and a proportion of manufacturing capacities have moved off-shore, economic value creation through design and product development has remained firmly in Europe and has seen considerable expansion employment in over time. This crucial European asset must be preserved and reinforced. While technological know how can be recorded, codified and transferred between people with a certain basic knowledge even across borders and cultures, creativity is a much more personal and cultural capacity which cannot be easily structured, codified and transferred; although its products are all too often illegally 'transmitted' in the form of copied designs, models and brands.

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A great part of creative innovation in textiles and clothing is *non-technological* in nature. It consists in new combinations of existing materials, designs, patterns, structures, colours etc. to derive a novel product. However, due to the absence of easily measurable success criteria for a new design prototype, compared to functional criteria for a technical product, fashion design can be as risky, time-consuming and costly as research or technological development.
Despite their creative or even artistic origins, fashion textiles must still be turned into manufactured products. This means that appropriate materials in the necessary quality and quantity have to be selected and sourced, manufacturability has to be ensured and manufacturing options have to be assessed, market size has to be estimated and market timing has to be defined. Finally overall costs have to be controlled in order to ensure a profitable product. For all these tasks many technological tools are used today and much more sophisticated methodologies and technologies, primarily based on the innovative use of Information and Communication Technologies (ICT), are expected in the future.

Relentless innovation through collaborative engineering and product development in clusters and networks

Industrial networks for specialised, high value added textile products are an emerging trend in response to the growing complexity of today's market requirements for product design and development. Members of such networks combine their complementary core competencies, including highly specialised knowledge about new materials and new processing procedures and technologies, the detailed requirements of niche markets, privileged access to specialised distribution channels or the end user in order to develop, produce and market sophisticated products.
The multi-stage value chain of the textile and clothing industry is dominated by SMEs which have been traditionally co-operated in communities and clusters for high performance. However in the past this was essentially in regional clusters and districts of close geographical and cultural proximity.
Today, the emergence of new types of fibres with new properties, of new processing technologies for new construction of yarns and fabrics and new textile surface modification techniques and also of new engineering possibilities for complex textile and multi-material products, opens opportunities to create new markets for textile consumer goods as well as textiles for industrial and technical uses. Innovation activities, which explore such promising new fields for Europe's textile and clothing industry, will typically cross other, non-textile sectors, or will target previously non-textile markets and will increasingly lead to the establishment of cross-sectoral and cross-border networks and clusters.
Such innovation-driven networks/clusters typically involve companies of all sizes, including pure R&D and engineering companies. They also have very close links to public research and education establishments and typically thrive in areas where diverse scientific (research and education) and industrial (engineering and manufacturing) capacities and qualified human resources co-exist, in geographic and cultural proximity to lead markets (pools of sophisticated end-consumers, key industrial customers), with infrastructure and a political and societal framework that are conducive to innovation. They are almost impossible to create artificially in the absence of such assets. Europe with its rich industrial tradition, its excellent research and education systems and its culture of flexibility and diversity is uniquely placed to enable the emergence of such innovation-driven networks/clusters.
Their functioning however requires dramatic conceptual and organisational changes as compared to more traditional production-driven vertical supply chain systems. These conceptual and organisational changes must be supported by innovative information and knowledge management tools, making use of advanced information and communication technologies (ICT). Such innovations will include:

- Holistic approaches and corresponding tools for cross-sectoral life cycle analysis and engineering,
- Inter-organizational knowledge management, in particular network knowledge modelling,
- Cross-sectoral supply net management (vertical and horizontal),
- Organisational and legal aspects of inter-operation in dynamic networks,

- Analysis and establishment of Virtual Clusters and Communities
- Integration of Management Systems and their extension to SME network management,
- Web-based knowledge retrieval and presentation of standards and of Best Available Technologies (BAT), and Best Environmental Treatment (BET),
- Knowledge "capturing" for organisational learning, knowledge transfer and communication,

Customisation & product-services

The vast majority of clothing and other textile-based goods are manufactured long before they are sold to the final consumer as product developers, manufacturers and retailers collectively seek to guesstimate demand in terms of material, colour, design, style, size etc. often many months in advance. The vagaries of this process, due to enormous product diversity, volatility of consumer preferences and very limited knowledge about actual demand, regularly lead to massive forecast errors resulting in destruction of economic value in the form either of unsold articles or missed potential sales due to unavailability of the right product at the right time at the right place. More and more complex and sophisticated forecasting, market segmentation or consumer feedback concepts and systems are now in use, none of which however manages to solve the underlying problem, which is the great distance in time and space between point of production and point of sale.
At the same time, virtually no advantage is being taken from the fact that every customer is different and that the uncompromisingly optimal satisfaction of personal preferences represents a high economic value and can translate into a corresponding gratification in the form of an attractive selling price of the product. Textile-based consumer goods and especially fashion clothing do not only serve functional purposes but often play a major role in personal identification and expression. They therefore represent ideal products for customisation and personalisation and offering them exactly according to a consumer's specifications adds significant value.

Recent advances in technologies for capturing, exploiting and managing personal product-relevant data and customised production including 3D body scanners and measurement software, information storage and data-mining solutions, made-to-measure CAD and CAM systems, single-ply cutters, Internet-based communication systems between manufacturers, retailers and end consumers, enable clothing manufacturers and retailers to develop successful mass-customisation operations comparable to examples in other sectors such as personal computers or automobiles.

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Experience from early adopters have shown that the concept can be successfully realised by manufacturers and retailers of different types and sizes. The advantages of made-to-order operations in the form of reduced stock cost and risk, no out-of-stock situations, smaller shop footprint, higher average selling prices and margins, increased customer satisfaction and loyalty, more customer feedback, absence of shop theft etc. can more than offset production cost disadvantages resulting from small-scale production and manufacture in a higher labour-cost EU country.

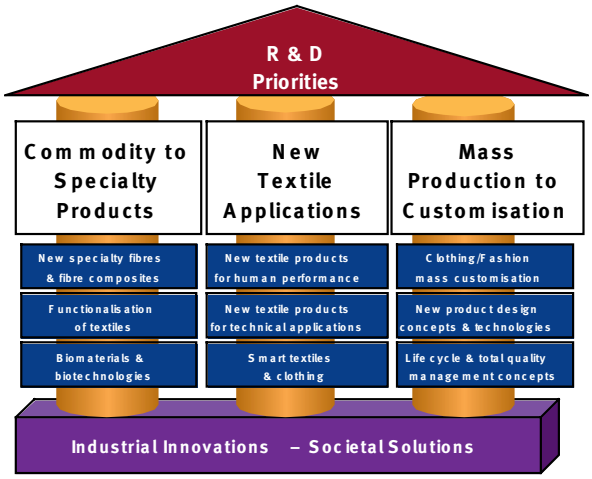
Customisation is one means of adding significant value to a well-designed and efficiently manufactured product. Another which is becoming increasingly widespread in the textile industry is the coupling of products with services. Such extended product-services attempt to maximise customer value derived from a product throughout its entire life cycle.
Most textile and clothing products are used for an extended period of time, on occasions serving several "generations" of users. During their period of use period textile products require regular care; usually in the form of cleaning (laundry or dry cleaning) sometimes followed by pressing, ironing or repair operations. A whole service industry takes care of these needs and also makes a business out of leasing or rental of textile products with particularly frequent or critical care requirements such as work or protective wear, hygiene, medical textiles or those for use in hotels.
With increased focus on cost and environmentally optimised product life cycles and quality and safety profiles of textiles, interesting innovation potential can be unlocked by improved cooperation between textile products and their uses and services.

3 Research Priorities

The innovation potential in and around this 'traditional' industrial sector of textiles and clothing is almost unlimited as demonstrated in the previous chapter. Many of the expected and even more so today's unforeseen textile innovations will help solve countless societal problems in the years to come. While a number of these innovations will stem from a creative use and combination of existing knowledge of materials, processes, technologies and methodologies, many others will only be possible if new knowledge is created through fundamental and applied research and development.

In order to identify priority areas for such necessary research and development work across the broad field of textile materials and processes, products and application areas as well as new business concepts and value chain and life cycle management, the following 9 Thematic Expert Groups have been created:

1. New speciality fibres and fibre-composites for innovative textile products
2. Functionalisation of textile materials and related processes
3. Bio-based materials, biotechnologies and environmentally friendly textile processing
4. New textile products for improved human performance
5. New textile products for innovative technical applications
6. Smart textiles and clothing
7. Mass customisation
8. New design and product development concepts and technologies
9. Integrated quality and life cycle management concepts



Over a period of 6 months more than 400 individual experts from industry and academia have developed and agreed on sets of research priorities for all 9 thematic areas, which are described in concise form in the following chapter. More detailed specific Strategic Research Agendas for all 9 areas are provided as an annexe to this document.

The 9 specific Strategic Research Agenda are however not be considered as unrelated stand-alone fields of research. On the contrary, implementation of the proposed research priorities will in most cases only lead to real innovations if topics from several areas are combined in joint projects and initiatives. They should be viewed as components or modules which can be combined in endless ways and whose combination and integration will be the basis for truly holistic research and innovation initiatives. This means projects which can combine innovative ideas of researchers with knowledge of suppliers about materials and technologies, know-how of producers about processing needs and options, input from customers on use requirements and scenarios.

3.1 New speciality fibres & fibre-composites for innovative textile products

Fibre innovation at the upstream end of the textile value adding chain is a powerful source of new products, processing options and application areas in many downstream user sectors. The man-made fibre industry deals with manufacturing, forming and modification of polymers into fibres and webs and their application in composite structures. Research and development in the fibre and fibre-composite field combines chemistry, physics and engineering (technology).

Strategic research should focus on new opportunities in manufacturing fibres and fibre composites for textiles in industrial, interior decoration and clothing applications by introducing entirely new or significantly enhanced material properties and by developing improved and new manufacturing processes.

Bulk fibres with new or significantly improved properties, novel fibres with tailored functionalities for special applications and new technological approaches for competitive new processes are expected as a result of collaborative research activities of the man-made fibre

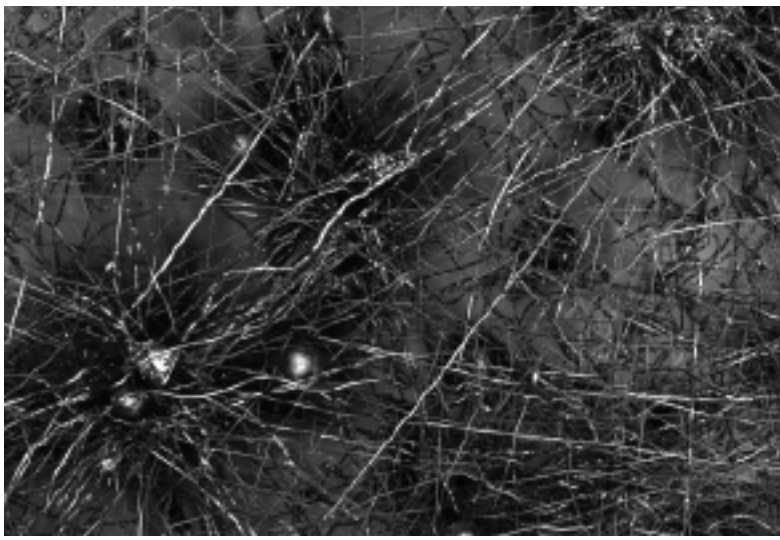
Areas	Polymer variations	Processing methods	Production parameters
Chemistry	Modification of (starting) materials or catalysts, chemicals reactions	(Temp.) surface modification, reactive extrusion	"Reactive" atmosphere quenching
Physics	Blending and mixing of polymers and (nano) additives	New solvents, E- spinning, surface coating	Structure property changes by orientation and crystallisation control
Technology	Activation of natural polymers	Multi-component (hollow fibre) spinning, fibrid- fibre-composite, retarded cooling	De-mixing of polymer systems by high / low shear

industry together with its downstream customers in the textile-clothing value chain.

The research priorities identified cover new fibres, new functionalities, new fibre composites and improved methods for the manufacture of fibres and composites as key and cross section products for the whole textile chain and for many other sectors of European industry. In detail they include:

- New fibres to create innovative products for human safety and protection;
- New fibres to enable the manufacture of innovative products with better health, wellbeing and comfort characteristics;
- Stronger, better and more efficiently manufactured composites;
- Improvement of sustainability of textile fibre and composite products and reduction of the environmental impact related to their production and use;
- Fibres as enabling materials for micro- and nanotechnology and related manufacturing
- Surface modification of fibres to enhance manufacture of textiles and composites
- Fibres for new textile products with enhanced care (cleaning, washing etc.) properties
- Fibres as medium for innovation delivery mechanisms (e.g. slow release of pharmaceuticals)
- Enhanced production methods for fibres, non-wovens and fibre-composites

Man-made fibres form the base of a multitude of products making our daily life more comfortable. Man-made fibres and textiles are key enabling materials for many other innovative growth sectors in Europe including the automotive industry, medical device makers, construction and mechanical engineering, aircraft and space industries. Textile innovations possess an enormous potential to contribute to the sustainability of our society.



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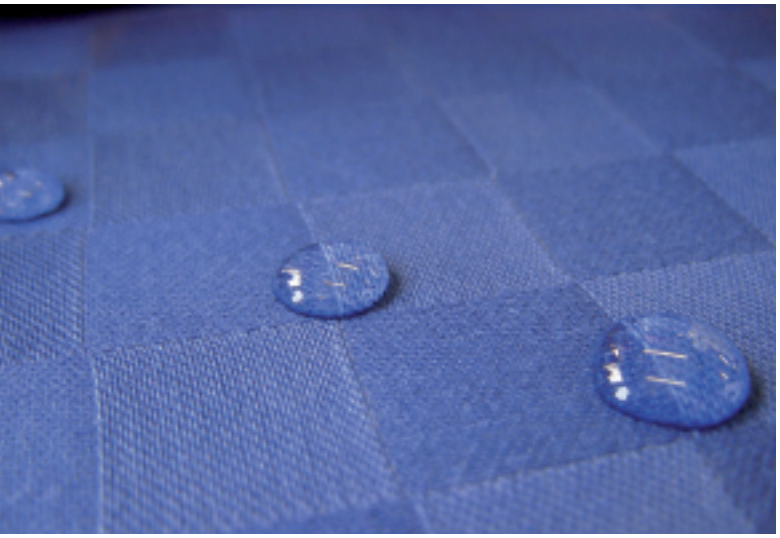
In particular, the markets for technical and functional textiles show high rate of innovation strong global growth and enormous product variety.

3.2 Functionalisation of textile materials & related processes

A broad field of highly relevant research and development covers the functionalisation of textile materials through the modification of surfaces of fibres, yarns, fabrics and other fibrous structures, or through the intelligent combination of materials (fibres, fabrics ...). It covers processing techniques (machines), chemicals and ICT for process control in existing (classical) wet finishing processes and related processes such as lamination and coating.



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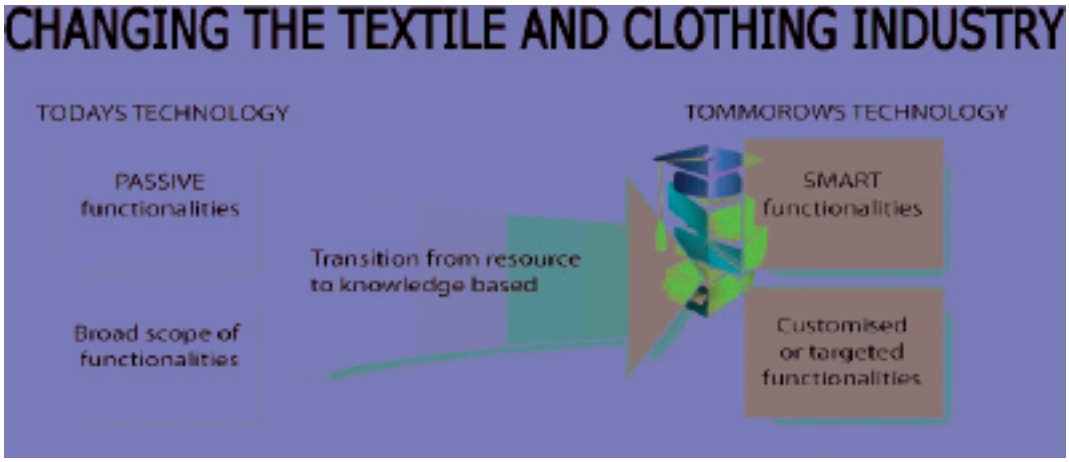
Functionalisation of textile materials is of major importance and an essential component in textile processing. In many cases it makes textile products suitable for use in entirely new application areas such as medical textiles, sports, protective clothing, automotive textiles, textiles for construction, industrial textiles. Functionalisation is also necessary for more conventional textile products like upholstery textiles and carpets (which today are still of major importance for Europe) and there is considerable spillover of achievements in high added value products towards more 'traditional' textiles.

The textile finishing industry comprises commission finishing or vertically integrated companies. This activity is of pivotal importance to the textile clothing supply chain and a loss of the European edge in this activity could put also other parts of textile industry in Europe into question.

Although it is recognised that **incremental research** addressing improvement of functional processes and properties is essential and very important for the success of the industry, the research priorities identified below are instrumental for strategies of more radical **industrial breakthrough** based on new functionalities and/or new processes. They correspond to a long-term vision for strategic research in the development of textile products with **targeted smart multi-functional** properties through the use of advanced technologies in efficient ways.

Identified research areas of high priority include:

- ***Increasing flexibility & efficiency in product development and materials by design:*** Productivity will no longer be the only answer to increasing global competition. Fast product development thereby bringing the customer into the product development stage, will be essential to compete successfully tomorrow.
- ***More for less: functionalities for high performance materials:*** The functional properties and the performance level of products require constant improvement to continue satisfying growing customer demands while at the same time avoiding cost increases.
- ***Green, greener, greenest:*** Processes used for the functionalisation of textile materials need to be increasingly environmentally friendly and the use of natural resources, energy, and chemicals need to be minimised.
- ***Performance tailored with the ability to change or adapt on demand***: Materials which are context aware and change their properties according to environmental conditions or impulses can bring many benefits for the user.
- ***New processes for functionalisation*** based on process intensification or plasma based processes which run faster and are more versatile, flexible and suited for small batches.



3.3 Bio-based materials, biotechnologies and environmentally friendly textile processing

Industrial or white biotechnology is seen as a major contributor of innovative products, not only in the chemical sector, but also in other 'downstream' sectors including the textile industry as identified also by the European Sustainable Chemistry Technology Platform.
The experts of the relevant working group of the Textile Technology Platform, identified three broad areas for future application of recent developments in biotechnology to the textile and clothing industry:

1. Bio-based materials

Bio-based materials has come a long way from their empirical beginnings when researchers took whatever material was available and attempted to use it in new ways and areas. Fossil resources - coal, oil and gas - are currently both the world's major sources of energy and the primary raw materials for chemicals manufacture. The alternative to conventional fossil feedstock is biomass: agricultural raw materials. They, contrary to oil, have become ever cheaper as farming yields have increased.
Biomass represents an alternative to conventional fossil and petrochemical feedstock. Better utilisation of natural raw materials would eliminate petrochemical feedstock shortages and increasingly expensive imports, making the European industrial sector more independent and self-sufficient.

Proposed research priorities in Bio-based materials application fields are:

- Production of new textile fibres based on fermentation and other bio-processes to more away from refined-oil based products ;
- Tailoring controlable biomedical properties of biomaterials by enzymatic chemical or physical structural modification;
- Smart surfaces and matrices to immobilise bioactive components;
- Biocomposite fibre reinforcements and bio-resins as fully biodegradable materials;
- Other bio-based materials with tailored properties intended for biomedical, textile and technical applications.

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2. Biotechnology

It is foreseen that industrial (white) biotechnology will provide the opportunity to replace harsh, less efficient chemical processes thanks to its increasing eco-efficiency. Namely, enzymatic biocatalysis will tend to gain a more relevant position in bioscouring, biopolishing, biosoaping, enzymatic stone-wash as well as in first synthetic (PET) fibre modifications. New natural fibre treatment processes based on biotechnology have recently been launched.

Proposed research priorities in the Biotechnology field are:

- Biopolymers and biomass as a new bass for textile surface modification and coating;
- Bio-based textile auxiliaries and relative applications in best available techniques (BAT) and emerging techniques to minimise environmental impact of textile processing;
- Enzymatic systems and grafting of enzymes (or proteins) on textiles surfaces
- Other bioprocesses (including biocatalysis) to improve technological applications of new fibre materials and sustainable processing for cleaner production principles.

3. Environmentally friendly processing

Research work in this field should target "Future" Best Available Techniques and eliminate, reduce and modify emissions from textile processes. Sustainability in production processes is today considered of the same importance as the need to increase quality and produc-

tivity. Besides, it is very often observed that technologies that contribute to emissions reduction can bring, with them, quality and productivity improvements as well as cost reductions.

Proposed research priorities in the environmentally friendly processing field are:

- Integration of process and on-line monitoring of technological and environmental parameters;
- Alternative processes and/or treatments targeting the reduction of water and energy of textile processing (eco-efficiency) and the reduction of impact on human health;
- Textile waste (used textiles) as source of biomass;
- Essential improvement of natural fibres and their production;

3.4 New textile products for improved human performance

New textile products for improved human performance are an important innovation area in the textile and clothing industry. The demands of end-users for functionalities of textiles and clothing are ever increasing. The performance properties like protection and healing functions have to be combined with lightweight, optimised heat and moisture management and comfort, as well as with durability in use and care and, at the end of the product life cycle, biodegradability or other favourable recycling or disposal options. Nowadays these properties cannot often be combined within one layer of fabric or one piece of clothing. However, developments in textile materials, and in combination with integrated electronic sensors and actuators will soon give rise to a whole new category of textiles and clothing. In the fierce international competition the textile and clothing industry is facing, a new generation of highly functionalised textiles and clothing will give the EU-textile and clothing industry a new competitive edge.

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The research priorities

The research priorities in this field derive from societal trends and needs combined with bottlenecks posed by the current state-of-the-art in material and process technology and application research. Five main societal trends were identified (the inclusive society, the health conscious and well being society, the active society, the safety and security society and the individual society) each posing specific demands on textiles and clothing in every day use. On the other hand major (technological) barriers exist which hinder the development of new functional textiles and clothing products for improved human performance.

Firstly, there is a strong need for simulation tools for interaction between the product and the user, the comfort properties (heat and moisture management as well as mechanical deformation in movement) and the functional properties in order to develop the most optimal functional textile products.
A second important research area is the development of active textiles and devices, which react autonomously or actively to the changing activities or conditions of the wearer in order to optimise comfort and safety at every moment.
A third important research line in this area is the development of functional (para-) medical textiles, which include targeted drug release systems, health monitoring systems, tissue scaffolds and intelligent textile implants.

Research projects in this field will need to combine advances in fibre research, textile surface functionalisation and the integration of electronic functions or components into textiles. Successful innovation will further be determined by product customisation options, cross-sectoral design and product development processes and sound concepts for management of quality, user friendliness, care, services and other product life cycle aspects.

3.5 New textile products for innovative technical applications

New textile products for technical applications comprise a diverse range of manufacturing activities tied to broad end-use markets. At this stage the industry manufactures products ranging from mundane, like wiping cloths to spectacular ones, such as nano particle filters, aerospace composites and architectural fabrics. The supply chain that connects fibre producers with end-use markets is a long and complex one. It embraces companies large and small from fibre producers through yarn and fabric manufacturers, finishers and coaters, converters, and manufacturers who incorporate technical textiles into their own products or use them as an essential part of their business operations. The common characteristic that unifies all technical textile applications, activities and companies is the use of fibres, often engineered in special fibre, yarn and fabric form in combination with polymer coating, to provide specific technical performance characteristics to meet the final customer as well as market requirements.

Technical textiles are going to stimulate the European engineering, transportation and construction industry. The production of textiles for technical applications in Western Europe is expected to grow by almost 15% between 2005 and 2010 (source David Rigby Associates). The reason for this comparatively rapid increase can be seen in the growing use of textiles for composite production in the fields of transport, building and construction as well as civil engineering (reinforced plastics, concrete or metal), and in the fact that traditional construction materials are replaced by textiles.

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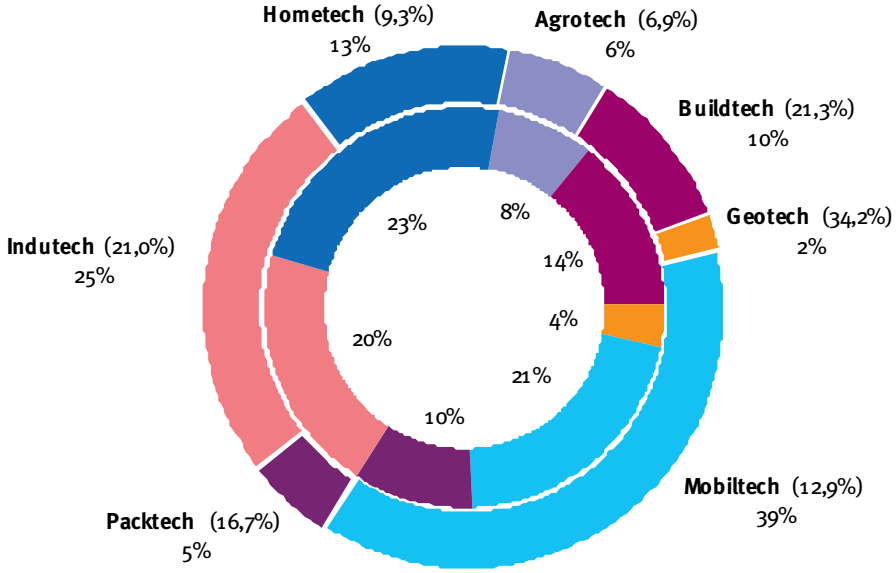
The main important research demand for all market fields are the opening of new application fields for technical textiles and the transfer of emerging and new technologies as well as prototype production into volume production. The main focus should be laid on product development based on combination of advancements in fibre and fibre-composite materials and textile formation and functionalisation technologies, for example improving the manageability and working properties of textiles for the component and composite production.
The figure below shows research priorities in the technical textiles field sorted by market and relevance, also bracketing the expected cumulative growth until 2010 of technical textiles in these markets.

Technical Textile Application Areas	Markets	Number of identified research priorities
Agrotech	agriculture, aquaculture, horticulture and forestry	14
Buildtech	building and construction	55
Geotech	geotextiles for landscaping, agriculture and civil engineering	20
Mobiltech	automobiles, shipping, railways and aerospace	60
Packtech	packaging	5
Indutech	filtration, conveying, cleaning and other industrial uses	24
Hometech	technical components of furniture, household textiles and floor-coverings	44



Comparison volumes/values of Western Europe consumption of technical textiles per market in 2005; in brackets the market segment growth rate until 2010

3.6 Smart textiles & clothing

Smart textile materials and clothing measure and react in a simple or advanced way. To this end they may have built in electronic related functionalities.

The area of Smart textiles and clothing has been identified as powerful source of potential innovation and growth for textile and clothing companies. These articles meet all criteria regarding innovation, economic and societal needs (multidisciplinary, high knowledge content, specialty products etc.) For some applications like wearable physiological monitoring systems and military applications, annual market growth rates of as high as 20% are forecast. Besides this a broad range of application areas for smart textiles are envisaged like sports and leisure, civil security and professional use, industrial textiles including filters, transportation, military, home, construction and geotextiles, agriculture, packaging, fashion, fun, entertainment and gaming, and "the wearable computer".

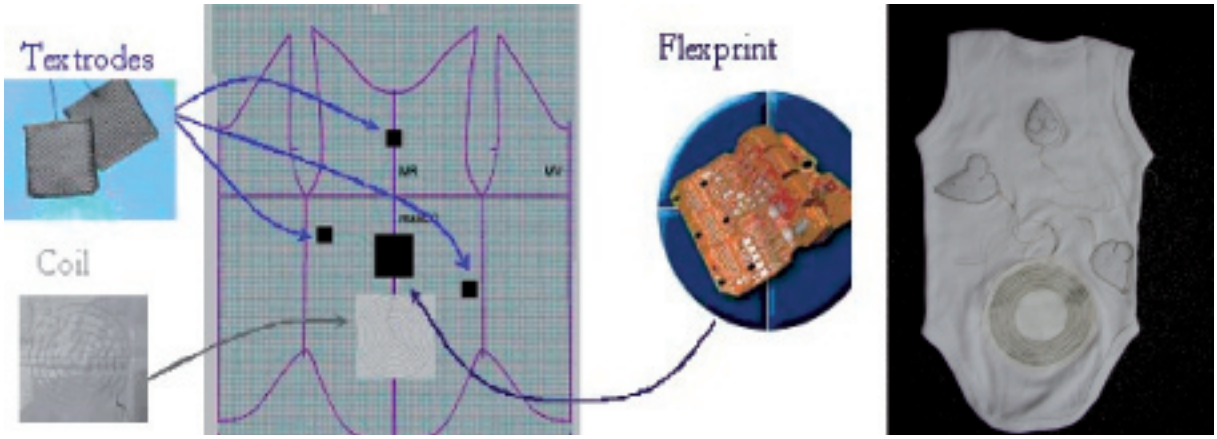
The successful development of smart textiles and clothing require high performance materials and systems. Textile sensors must be able to measure mechanical, physical, chemical, electrical and biological parameters of a human body and a person's environment (from the textile itself to the wider surrounding space).

Examples within industrial reach are temperature sensors, electrodes for cardiology monitoring, motion and respiration sensors. Long-term behaviour when used as textile material still is a key issue here. Biological, chemical and acoustic sensing still require more basic research.

Actuators give a response in terms of mechanical actions, release of chemicals, heat or cold, electrical pulses, light. The basic technologies for actively controlled release systems are largely known, but efforts are needed for design and implementation. Heating materials are available whereas cooling is definitely not. Muscle-like structures are expected to be very important but are also still far away. Electroluminescent fibres are an important element for the realisation of textile-based screens and displays.

As smart textiles and clothes use electrical signals, energy is required. Textile compatible energy storage systems like electrochemical batteries and supercapacitor materials as well as energy harvesting are critical. Flexible or fibre-based photovoltaic cells and piezo-electric materials are feasible ways to harvest some electrical energy, albeit in very small quantities to date.

New data processing algorithms are required to deal with the massive amounts of data delivered by permanent monitoring systems. Advanced data analysis and self learning capabilities are needed for full extraction of the information included in those data. Context awareness systems must be developed to support diagnosis. Self adapting dynamic control algorithms have to



Design and prototype of stand alone baby suit for wireless monitoring of heart signals developed by Ghent and Leuven Universities, Belgium

be developed for appropriate steering of the actuators. Electronic components must be developed with a high level of flexibility or even stretchability. They must be packaged in order to protect them from wear and washing.
As for communication, electroconductive materials still need to be improved as well as polymer optical fibres. Wireless textile communication systems are needed too. The materials performing these functions must be transformed into true textile structures or at least be fully compatible with them. Such integration also includes interconnections which have shown themselves to be a critical aspect of smart textiles. Efficient and reliable industrial manufacturing is a further key issue. The overall systems must keep their textile nature: comfortable to wear, easy to use, clean and maintain. Solutions that are available today generally do not fully meet these criteria.
Apart from technical needs, supporting actions are required. They include support to technology implementation, interdisciplinary knowledge and technology transfer, training and information management.

3.7 Mass customisation

The subject of Mass Customisation (MC) is of high importance for innovation in the textile-clothing-retail field. Mass customisation by definition focuses on the clothing industry without ignoring, that the clothing industry is a partner in the textile-clothing supply chain and has close relationships with the textile industry, the supply chain partners (including logistic services) and a very strong link to trade / retail and the end consumer. Therefore, innovations in the mass customisation field will result in new business concepts and technologies for the clothing and fashion field covering all partners in the supply chain.

To make mass customisation a success in the clothing and fashion supply chain, research priorities to remove the technological and organisational bottlenecks that restrain industrial innovation and adoption by the market of new business concepts, have to be tackled in a systematic manner.

The main research priorities for Mass Customisation in the **production technologies** field are **flexible, small-scale manufacturing systems and production technologies for direct 3D production**:

- The availability of flexible and small-scale manufacturing systems for the production of garments is the research topic with the highest economic relevance. The trend from mass production to single or small-scale production requires equipment of a type considered vital for future clothing production in Europe.
- Huge efforts are being made to develop the possibility to produce clothing directly in an 3D environment with 3D production equipment. These efforts suppose the availability of such production equipment in the near future and will help to retain European enterprises and jobs in garment making.

In the **Product development / innovation** field the main research priorities are the **use of virtualised textile material for simulation and the prediction of manufacturability**:

- A basis for the successful operation of advanced Mass Customisation systems is the availability and

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the use of virtualised textile materials for the simulation of the material and of garments. Some basic work has already been done but further work will be necessary and is genuinely required by industry.
- The availability of sound knowledge on manufacturability of textile materials would be a very helpful tool to ensure good quality and to avoid problems during production.

The main research topic in the **Production management** field is the **simulation, optimisation, flexibilisation, virtualisation of production processes (single processes, networked processes)**:
- The reorganisation of production processes has the highest economic relevance. The simulation, optimisation, flexibilisation and virtualisation of production processes may help the European clothing industry to produce in a more effective way and to maintain its leading role in production know-how. The reorganisation of complex supply chains and networks towards efficient mass customisation is a huge task and significant conceptual and technological advances are still required.

In the **Customer interaction / service** field the main research topic is **product-consumer interfaces (virtualisation)**:
- Innovation needs in this area have been identified across the entire process of interaction with the customer. They include the use of automatic body measurement technologies (scanners), a reliable and efficient use of the personal data obtained as far as an interactive co-design of garments involving provider and consumer, the realistic real-time simulation of the individual customer in the chosen (and created) garment; this in movement too is a huge challenge which still requires extensive research.

3.8 New design and product development concepts and technologies

Design and product development capacities are perhaps the number one competitive factor for an industry that operates in very fast-moving markets and that cannot rely on cheap labour, privileged access to raw materials or other tangible assets. It combines both creative and scientific-technical elements based on knowledge, skills and talent of people, but its success also heavily depends on the utilisation of concepts, methods and technologies necessary to turn ideas into industrially exploitable results. Design and product development are crucial capacities for companies dealing with all types of textile products and across all stages of the value chain (from fibres/yarns through to end products across all clothing, home and technical textile areas).

While the creativity and talent of people itself cannot be enhanced by research and development, concepts, methodologies and technologies for more productive and efficient design and product development processes can be greatly improved by the application from a wide range of scientific disciplines including mathematics, material and computer sciences, as well as social sciences and management research. According to industry experts, the following research topics should be tackled with high priority:
- Methods and tools for an effective analysis of requirements and functionalities of the new products in respect to societal and individual customer needs and use scenarios;
- Reduction of time and cost from product idea to market launch through better modelling, simulation and evaluation techniques for textiles in virtual reality;
- Concepts and tools for effective collaborative processes in distributed expert groups and networks including interoperability of systems and ways for effective communication of ideas;
- Collaboration methods and tools for cross-sectoral product development processes including interoperability with product development systems of other

sectors like automotive, medical or construction;
- Combination of aesthetical and functional/technical elements in one design and product development system;
- Decision-making tools to evaluate use of textile vs. non-textile materials.

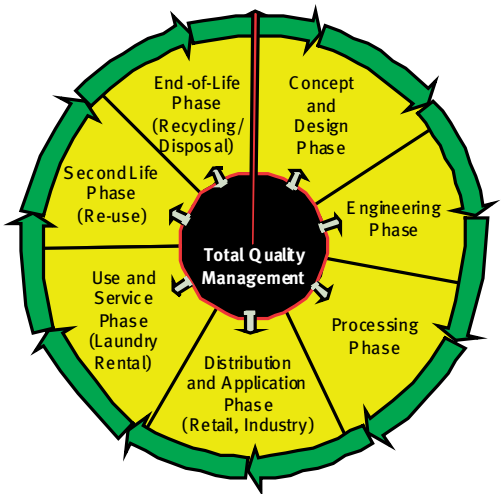
Design and product development give rise to new knowledge and related intellectual property. The wish to effectively use and re-use such knowledge with the simultaneous need to protect intellectual property rights (IPR) often leads to conflict and inefficiencies. Important advances are therefore expected from tools for marking, tracking, tracing of origin and ownership of virtual designs and prototypes and systems for efficient storage, search and re-use of existing knowledge, patterns, designs etc. across companies or company networks.

Apart from these more specific research and development priorities in the field of design and product development, the industry puts a high emphasis on more general activities to preserve, further extend and better use the existing vast textile and clothing design and engineering capacities across Europe. For this purpose it would be important to develop:
- Capacities for more efficient set-up of European networks of researchers/experts able to understand innovation and market dynamics in any textile-related field;
- More efficient information exchange between universities, industry and research centres;
- Concepts and tools for effective publicity campaigns supporting an innovative image of the European textile and clothing industry to draw more scientific and creative young talent to the sector.

3.9 Integrated Quality and Life Cycle Management

Novel products in the textile and clothing industries and textile services are increasingly complex requiring new functions and stricter quality and performance standards. In Europe, companies must implement quality management systems to improve both product quality and life cycle aspects. Highly innovative products include assurance of quality during the complete life cycle from design and development to production, distribution, use and maintenance through to recycling or disposal. New solutions for waste management and recycling of textile products are required.

Total Life Cycle of Textile Products



Furthermore, new and effective control mechanisms to assure quality along the whole textile chain have to be developed. That means that the fields of textile, textile services and clothing industries need to innovate their concepts, methods and technologies of Supply Chain Management and Integrated Quality Management.
20 key research topics for the 7 phases of the typical textile life cycle and 2 transversal topics across the value chain were identified by experts from industry and research centres across Europe.
For the *Conception and design phase* quantifying quality/sustainability parameters of raw materials, use/care aspects of end products and prediction/simulation of performance, comfort & compliance with standards, legislation are of importance.
The *Engineering phase* requires innovative tools for quality & environmental optimisation in production, distribution, application, use & service, recycling/disposal and prototyping based on use/service experience from existing products.
For the *Processing phase* traceability & a material/product specification record in the supply chain, quality management in flexible production networks, faults/defects management, self-optimisation of production systems, on-line quality and ecological parameter control were identified.
Product quality communication, i.e. standardised product records and data management, have to be improved in the *Distribution and application phase*.
The Use and service phase comprises methods/processes for maintenance & renewal of functionalities, sustainability optimisation in use/care, development of

targets for care & maintenance processes, new processes that meet such targets, instruction & training for correct use/care in a global context, analysis of use problems & returns, feedback systems to appropriate value chain stages, methods for responsibility assignment in failure scenarios, development of non-destructive quality test methods as well as modelling/simulation of ageing processes for different use/care scenarios.

The research in *Second life phase* and *End-of-Life phase* should be focussed on new processes for textile re-use and textile recycling. Knowledge management and information management systems are two priorities identified as transversal topics for the whole textile chain.

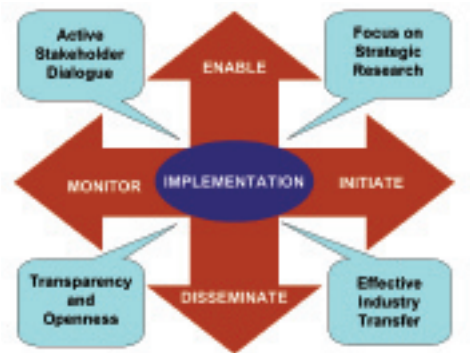
In summary, *Integrated Quality and Life Cycle Management* requires research and development efforts in investigations into the life cycle of novel products and technologies also considering new application areas of textiles (technical or medical textiles), models to predict life cycles of textile products as well as the quality of textile products, methods for modelling product and usage properties (non-technological innovations) and the development of targets for care & maintenance processes. In close relation to life cycle aspects, the requirements for *integrated quality management* (testing, certifying and monitoring textile products, production control, numerical simulation of production processes and properties of textiles, accredited testing methods for high performance textiles, non-destructive testing methods for textile products, monitoring methods for textile care and maintenance processes to ensure best quality of care and maintenance) and *Recycling/waste management* (recycling-friendly construction of textiles, integrated product policy, technological improvement of machinery and equipment for textile recycling, energy aspects, water re-use, saving of water, energy and chemicals as well as waste water treatment in textile service companies and waste prevention) have to be considered.

4 Implementation of the Strategic Research Agenda

4.1 Implementation Structures and Procedures

Implementation work of the SRA is expected to happen primarily through collaborative R&D projects co-funded by the 7th EC Framework Programme as well as EUREKA and various national or regional programmes and schemes. Fragmentation of resources and duplication of efforts should be overcome through coordination, combination and collaboration. For this purpose the development of ERA-Net projects will be encouraged and the set-up of Public-Private-Partnerships (PPP) will be fostered.
While some of the expected implementation projects can be of a larger size, long-term nature and involving many stakeholders, at this moment no permanent structures like Joint Technology Initiatives (JTI) are envisaged.

The main functions of the Technology Platform during the implementation phase will be *enabling*, *initiating*, *monitoring* and *disseminating*.
In its *enabling* role, the platform will work towards the best possible framework conditions and a maximum of opportunity for an effective and timely implementation of the Strategic Research Agenda. It will communicate research priorities to the appropriate research policy makers and programme managers and attempt to ensure a level playing field for research initiatives from the textiles and clothing sector. It will enhance awareness and knowledge about funding programmes among industry and research community and encourage active participation. It will create collaborative implementation structures characterised by openness and transparency, trust and clarity of rules and procedures as well as efficiency of resources deployed.
In well-justified cases, the Technology Platform will assume a more active *initiating* role. This may apply in situations when actions of a clearly strategic nature do not arise by themselves from usual stakeholder activity or when their necessary scale exceeds the capacities of a standard project consortium. This will also apply in cases where a substantial involvement of another Technology Platform or similar structure representing a different sector or research field would be required for the achievement of a strategic goal. The platform will also take the initiative should at later stages the creation of a Joint Technology Initiative or similar permanent structure with legal personality be considered.
From the beginning of the implementation phase, the Technology Platform will be closely *monitoring* implementation progress. It will at all times keep a complete overview of European programmes and funding opportunities available to implementation actions. It will also monitor the utilisation of available schemes by platform stakeholders in order to take corrective actions if opportunities remain unused or if existing schemes contain obstacles that restrict their use. The platform will keep track of progress of all projects and initiatives launched by stakeholders to assess advancement of implementation of the Strategic Research Agenda.
Finally the Technology Platform will play a crucial *disseminating* role. It will ensure that results of research and technological development work, with strict respect of IPR protection and confidentiality rules, are effectively brought to the knowledge of European industry in order to bring them more quickly into industrial application. For this purpose, in addition to its own annual public conference, the platform will build on partnerships with established conferences, networks and other forums on European, national and regional level. It will work particularly closely with similar existing or emerging structures like national technology platforms or research councils, regional innovation clusters and competitiveness poles.



The actual implementation work across the various thematic priority areas will be organised by Implementation Groups or Communities, which will be built on the existing Thematic Expert Groups created for the development of the Strategic Research Agenda. The Technology Platform's Governing Council will define the structure and rules of procedure and governance of these groups.

Also during the implementation phase the Governing Council will closely monitor and guide the overall progress of the platform. Under its leadership, the Strategic Research Agenda will undergo regular review and updating as initial R&D targets are reached, industry problems solved or new priorities arise. An updated Strategic Research Agenda will be published every 2 years.

4.2 Resources and time frames

Activities during the first 2 stages of the Technology Platform have been entirely financed by the platform stakeholders from industry and research. With an active involvement of close to 500 individual experts from research and industry across the 9 Thematic Expert Groups, the Horizontal Task Groups and the Governing Council, the organisation of more than 30 meetings and workshops and extensive desk work including the work of the Technology Platform secretariat a total of some € 2-3 million has been spent by completion of the Strategic Research Agenda.

Stakeholder investments will continue into the implementation phase as the Governing Council, Implementation and Horizontal Task Groups continue to meet and work together to propose and initiate appropriate R&D activities to progress in all priority areas identified in the Strategic Research Agenda and undertake regular reviews and updates of this document.

For the implementation of the present Strategic Research Agenda through collaborative projects on European level a total budget of at least € 1 billion is estimated for the first 3 years of implementation (2007-2009). Public funding will be matched by private funding according to EU state aid rules. The technology platform stakeholders will request that ample provisions be made in the 7th EC Framework Programme as well as EUREKA and various national or regional programmes and schemes for support of industrial R&D. In respect of the particular structure of this industry in which 96% of companies are SME's, specific funding opportunities targeting these companies (like CRAFT, Collective Research and SME-IP's under FP7 and similar project types in national and regional programmes) have to be made available in sufficient number.
In addition Technology Platform stakeholders will explore further R&D and innovation financing options like equity, loan and guarantee based schemes which so far are very little used for research, development and innovation projects in the textile and clothing industry.

In its 2008 Strategic Research Agenda update, the Technology Platform will assess if funding provisions from public and private sources have been adequate to achieve the strategic objectives as set out.

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4.3 Collaboration with other Technology Platforms and Research Fields

Innovation in the manufacturing of fibres, textiles and clothing has traditionally been enabled by scientific and technological advances in two research disciplines and related industries; chemistry and mechanical engineering. New chemical processing options and related polymers, reactive agents and other specialised chemicals are the key drivers for fibre innovation as well as for most new ways of bulk and surface modification of textiles including scouring, bleaching, (de)sizing, dyeing, printing, finishing, coating, lamination etc. New mechanical processing options and related machines, tools and control systems on the other hand are the number one enabler of innovation in the physical formation of yarns, fabrics and textile end products through spinning, weaving, knitting, braiding, tufting, embroidering, sewing and many other specialised processes. Most textile products receive their unique characteristics through a complex combination of chemical and

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physical processing in a long value chain of specialised production steps.

In recognition of these strong innovation links, the Textile Technology Platform and its working groups will seek active involvement of experts from the chemical and mechanical engineering sectors, which are organised respectively in the Sustainable Chemistry (SusChem) and the Manu*future* Technology Platforms. Dedicated cooperation agreements could help formalise research and innovation partnerships, and define objectives, working structures and procedures of such cooperations.

The textile industry, however, is not just at the receiving end of innovation. In the broad and growing field of technical textiles, textiles constitute materials or semi-finished products which can themselves enable countless innovations in application areas like transportation systems, construction, energy and environmental engineering, protective equipment and many other fields. Experts representing customer sectors for technical textiles will be invited to join relevant working groups of the Textile Technology Platform. Should broader strategic fields of common interest emerge, formalised cooperation agreements with the Construction, Road Transport or Aeronautics Technology Platforms can be envisaged.
In order to foster research cooperation in the field of environmentally friendly and resource-efficient processing, close collaboration will be sought with the Water Supply and Sanitation Technology Platform and the Industrial Biotechnology experts organised under the umbrella of the Sustainable Chemistry Technology Platform.

Cooperation with other Technology Platforms in general will be established with the purpose of exploitation of synergies and increased efficiency in the implementation of common research priorities. They should help reduce fragmentation and the duplication of efforts and lead to more effective deployment of resources.

5 Horizontal Issues

5.1 An innovation-friendly regulatory framework

Industrial innovation is entrepreneurial risk-taking. The risk is taken in expectation of a reward (profit) as compensation. The expected reward has to outweigh the risk in order for an innovation investment to be made. While public authorities cannot and should not remove risk from innovative economic activity, they can strive to make the reward scenario more attractive to the prospective innovator. The reward scenario improves when the time from investment to return shortens or when the total expected reward (total return minus total investment) increases.
Public authorities can do a number of things to shorten the time from innovation investment to return. Possible measures include:

- an easier access for innovative products to regulated markets including shortened regulatory approval processes,
- stimulating markets, and society as a whole, through incentives, to be more receptive to innovative products,
- an active role of public authorities as first buyers of innovative products through public procurement
- rapid, transparent and non-bureaucratic procedures for set-up of innovative spin-off or start-up companies

Even more can be done to increase the total potential reward from innovative economic activity. Measures in this field include

- an easier and more effective protection of intellectual property related to innovation and a better enforcement of IPR legislation to reduce illegal copying and counterfeiting,
- a reduction of total costs of bringing innovative products to the market by removal of excessive bureaucracy (e.g. unnecessary, repetitive or lengthy testing, application, registration and approval procedures),
- further opening of export markets for innovative European products

A textile and clothing Innovation Panel has been set-up in 2006 by the European Commission as part of the INNOVA initiative. In close collaboration with the European Technology Platform, this panel with make concrete recommendations for policy and regulatory initiatives to be taken in order to improve the innovation framework conditions for the textile and clothing industry in Europe.

Key Message:
Industrial innovation activity will automatically increase when framework conditions for innovation improve. Public authorities across Europe should actively work towards removing identified barriers and creating incentives.

5.2 An educational system to support industrial transformation

The extent to which the overall aims of the European Technology Platform can be met depends on the supply of well-qualified personnel to textile and clothing companies. The industries require technologically qualified graduates of high calibre, whose knowledge extends across disciplinary boundaries, and who are capable of developing new innovative products. The main challenge therefore is to ensure that an adequately educated human resource is available to the industry to facilitate the achievement of the overall aims of the Technology Platform. To this end, there needs to be constructive dialogue between each of the various working groups of the Platform, so that their educational requirements can be specified and coordinated actions taken to meet them. It is recognised also that human resource is required at other levels in addition to graduate and PhD. The industries also require highly competent staff at the technician level, and hence the provision of education at sub-degree level is also an important priority. Additionally, the provision of articulated education between sub-degree and degree levels needs to be harmonised to enable students to realise their full potential, regardless of the stage at which they enter the textile educational system, after leaving school.

It is recognised too that in addition to attracting new talent into the industry, it is equally important to value the human resource that is already employed and to provide the means by which it can be further educated in the emerging technologies, through Continuing Professional Development (life-long learning) activities. Thus attention needs to be given to the mode of course operation and the provision of short courses and seminars, for personnel at all levels, be they technicians, research graduates, managers or salespersons. The nature of the course materials will require to be focussed towards the needs of each category of employee. Catering for this requirement will require the development of flexible modes of course delivery

and the use of open/distance learning materials, web-based learning materials, summer schools, etc.

A key component of the require implementation of these objectives will be funding the initiatives. There exist various national and EU initiatives for educational development and it will be necessary to investigate the key schemes available to resource, amongst other objectives, the development of flexible learning materials. In order to attract graduates of high calibre into research in textiles and clothing, incentives such as scholarships will be required and consideration will need to be given as to how these can be resourced.

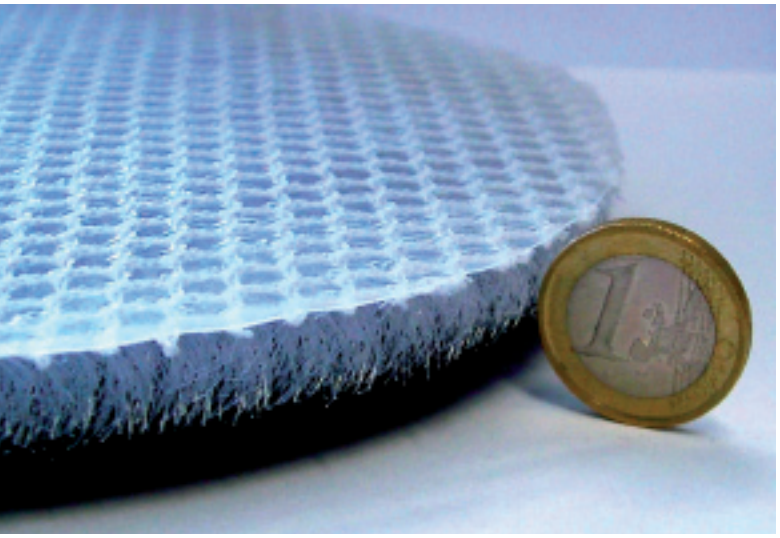
In the light of the above issues, and in order to realise the full potential of the innovation-driven industry transformation targeted by the Technology Platform, a Horizontal Task Group on Education is being created with the following strategic objectives:

- To establish educational programmes at undergraduate and postgraduate level that will produce graduates of high calibre, with knowledge and expertise relevant to the research and innovation needs of the textiles and clothing sector.
- To establish educational provision that enables graduates to research at various disciplinary interfaces, such as design/technology, materials/technology, design/management, etc
- To produce graduates for industry, research institutes and universities capable of carrying out high-quality research.
- To establish funding models to support:
- Undergraduate students
- Students following taught Masters' courses
- Students following research degrees
- To develop processes by which colleges and universities can establish coherent progressive educational provision that is pan-European.
- To develop a mechanism for meaningful interaction with the working groups of the Technology Platform in identifying educational needs and developing appropriate educational strategies.
- To encourage collaboration and facilitate staff exchanges between industry and education providers.
- To develop a programme of continuing professional development for industry personnel.
- To establish financial support for the development of flexible learning materials.
- To develop a strategy that gives the educational programmes and textile and clothing industries a vibrant and forward-looking image. Such a strategy will be an important element of the overall publicity strategy of the Technology Platform.

5.3 Financing textile innovation

An invention or creation only becomes an innovation when it actually satisfies a real demand in an economic transaction. Before such an economic transaction like the first sale of an innovative product or service on a market can take place an often complex and lengthy industrial innovation process has to be successfully completed. An innovation process always starts with an idea, but this initial idea then needs to be followed up through many innovation steps until a marketable innovative product is created.
The main innovation deficit of Europe's textile and clothing industry is not a lack of innovative ideas; it is a general lack of resources necessary to move quickly and effectively from idea to marketable product. The average EU textile/clothing company has an annual turnover of 1.2 million and employs 15 people. This implies that a majority of companies do not have the necessary technical, human, managerial and above all financial capacities to carry out research, development and *radical innovation* in an on-going and strategic manner. The more sporadic radical innovation processes at small and medium-sized companies are rather externally enforced (product innovation to meet changing requirements of a dominant customer or process innovation to cut costs in the face of competitive pressures) than internally controlled and strategically planned.

Nevertheless textile and clothing companies of all sizes do constantly invest in improvements of their production and business processes, in improved quality and increased variety of their products. In these *incremental innovation* processes a big part of a small company's staff from top management to the operators of production equipment is constantly involved and the company's own (financial) resources are invested - investments that often do not show up in research and innovation expenditure statistics.
However, whenever more radical innovations like the introduction of a new product line or novel processing technology are required, internal financial resources often need to be complemented by external funds, which are more and more difficult to obtain by European textile and clothing SME's. Tightening banking regulation (like Basel II), a traditional image of the sector which is regularly taken for a per se low creditworthiness, a virtually non-existing equity capital market for textile SME's in Europe and generally scarce or difficult to access public funding sources for textile innovation



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combine to make innovation financing a formidable challenge in the textile and clothing industry.
The main actions to be taken to improve access to finance for textile innovation include:

- a rigorous review of European state-aid regulation to make it more conducive to innovation in textiles and clothing, including the abolition of discrimination against non-technological innovation,
- a general re-orientation of public funds from unproductive transfer payments towards innovation-encouraging and economy-stimulation funding schemes,
- a simpler, faster, more reliable and transparent access to existing public funding schemes,
- a review and correction of financial market regulation which inhibits industrial innovation,
- a more intensive use of incentive schemes to stimulate and reward industrial risk-taking in the innovation field, including tax incentives for innovative companies,
- a general better support and guidance for companies, especially SME's, interested in the use of public funding and incentive schemes for innovation,

An extensive survey on the current situation of innovation financing in the European textile and clothing industry is currently carried out by the NetFinTex project, supported by the European Commission's INNOVA programme. On the basis of the survey's results, concrete policy recommendations for improvement of framework conditions for textile innovation financing will be made, guidance material for SME's will be developed and identified best practises will be disseminated across Europe. The NetFinTex advisory board composed of innovation financing experts will form the nucleus of a permanent Horizontal Task Group whose aim will be to work towards more comprehensive and accessible textile innovation financing schemes and structures in Europe.

Key Message:
The lack of financial resources is a major obstacle to more textile innovation. Access to innovation finance especially for smaller companies must be significantly improved.

5.4 Innovation and standards

Product, process and organisational innovation distinguish themselves from the existing state-of-the-art through superior performance, efficiency, safety etc. However in order to enable customers or users of such innovation to understand and value the actual improvements they have to be noticeable, quantifiable and comparable. In this process codified or indeed standardised parameters play a crucial role.
With the ever increasing importance of continuous innovation in products, processes or organisation and business models for the EU textile and clothing industry, codified knowledge, measurable qualities and standardised or generally accepted parameters play a greater role. Such standards or quasi standards in the textiles and clothing innovation field will mainly relate to the following areas:

- Fibre and textile material and surface properties,
- Processing technologies, including care and maintenance processes during the whole textile life/use cycle
- New application areas/uses of textiles,
- ICT for information and knowledge management in textile/clothing companies, supply chains and networks.

Due to the general complexity, diversity and volatility of its products and processes coupled with lengthy fragmented supply chains, the textile and clothing industry has comparatively limited experience in effectively dealing with standardisation in support of innovation.
The European Technology Platform through a dedicated Horizontal Task Group will tackle these shortcomings in order to improve the industry's capacities in this field.
The objectives of this group's work will include:

- an assessment of existing structures and competences dealing with standardisation in textiles and clothing in Europe,
- networking and better coordination of such struc-

tures and their reorientation towards standardisation in support of innovation,
- a survey to identify the industry's requirements in this field with particular focus on ease of access to information about existing standards and transparency of on-going standardisation initiatives,
- a review of best practises for innovation-supporting standardisation across different industries,
- the identification of areas in which increased standardisation efforts can have significant innovation impact,
- the provision and pooling of resources to support more innovation-driven standardisation activities in textiles and clothing, including the generation of support projects to tackle general problems identified by industry.

Key Message
Innovative textile products will come faster to market and will better face commoditisation if performance and quality standards exist and are enforced. The industry's ability to effectively drive standardisation work is too limited.

5.5 Managing Innovation

Advances in material, technology and management research fields, evolving societal needs as well as intensified global competition enable as well as necessitate a higher level and faster pace of innovation in the textiles and clothing industry.
The existence of innovation-friendly political, societal and economic framework conditions, the availability of adequate human and financial resources for innovation and effective normative procedures for innovative products, processes and services are all crucial elements to enable an industry to be more successful in the field of innovation.
However, the mere presence of these conditions will not by themselves make innovation happen. Innovation has to be actively pursued by companies and their managements through a strategic and effective combination of all these elements. They will only excel if company cultures, business models and strategies are geared towards innovation. Many European textile and clothing companies have recognised the importance of innovation, but often still fail in the implementation of *Innovation Management*. Important missing features include:
- the identification of innovation as a core element of company strategies and business models;
- effective strategies and measures for protection of intellectual property related to innovative products and processes;
- the implementation of collaborative innovation processes across supply chains and (cross-) sectoral networks;
- a constant screening for innovation input from scientific, technological and industrial sources;
- a strategic opening of new markets for their innovative products and product-services.

While the decisions to implement effective *Innovation Management* have to be made by individual companies and their managers, the Technology Platform can play an important supportive role in:
- the review of functioning innovation management concepts and systems in the textile and clothing industry;
- the study and benchmarking of other industries to discover the textile/clothing sector's weaknesses and identify transferable concepts and best practices for improvement;
- a wide dissemination of available methods and tools for innovation management in textiles and clothing;
- the provision of guidance and support for effective protection of innovation-related IPR;
- the identification of appropriate public support schemes and programmes and the initiation of relevant projects.

A Horizontal Task Group is being set-up by the Technology Platform to investigate innovation processes in the European textile and clothing industry in more detail and to initiate or execute concrete actions in support of more successful *Innovation Management* in the sector.

6 Conclusions

Research, development and innovation will play an increasingly important role in the competitiveness of the textile and clothing industry in Europe. More than 2.3 million jobs, over € 61 billion of European economic value added and € 42 billion of exports are directly linked to this industry - not counting further hundreds of thousand of jobs and billions of economic value creation in supplier, customer and related service industries. These figures alone demonstrate how important it is to ensure that this industry finds the best possible conditions for being innovative in Europe.
There are a number of clouds hanging over this industry today. But the sky will inevitably brighten if all stakeholders - industry itself, research and education establishments and public authorities - make an additional effort to put Europe's creativity and scientific excellence to work in this fascinating sector. All the necessary ingredients for future success exist in principle; an industrial structure and knowledge base of unparalleled breadth and depth, a growing global market for textile and clothing products made in Europe and an entrepreneurial spirit ready to turn creative ideas into successful innovative products. However due to a number of technological, economic and political reasons their full potential is not yet realised. Industry's innovation activities are still too sporadic, research and education efforts remain too fragmented and isolated, public and private financial resource allocation for textile innovation is inadequate, political framework conditions are incoherent and not sufficiently conducive to innovation, many global markets remain closed or difficult to access for innovative European textile products and the general image of the textile and clothing industry in Europe is far too negative.

The European Technology Platform in its first 18 month's existence has already given an enormous boost to textile innovation activity in Europe. The resolve by all stakeholders to make this joint undertaking a success has enabled the platform to move quickly and effectively through the first two stages of its development, (1) the gathering of a critical mass of stakeholders behind a common vision and (2) the collaborative development of a Strategic Research Agenda. In the coming months and years the success of the Technology Platform will be measured in tangible research and development results which will make a genuine contribution towards the innovation and competitiveness of Europe's textile and clothing industry.
If all private and public stakeholders continue to play a constructive and supportive role, the implementation of the present Strategic Research Agenda will unlock a technological and economical potential in this industry

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in Europe that will truly live up to the vision expressed in the title of this document - *The Future is Textiles*.

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