Brussels, 13 April 2018

COST 018/18

DECISION

Subject: **Memorandum of Understanding for the implementation of the COST Action "European Network to connect research and innovation efforts on advanced Smart Textiles" (CONTEXT) CA17107**

The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action European Network to connect research and innovation efforts on advanced Smart Textiles approved by the Committee of Senior Officials through written procedure on 13 April 2018.

MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA17107
EUROPEAN NETWORK TO CONNECT RESEARCH AND INNOVATION EFFORTS ON ADVANCED SMART TEXTILES (CONTEXT)

The COST Member Countries and/or the COST Cooperating State, accepting the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action (the Action), referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any new document amending or replacing them:

a. "Rules for Participation in and Implementation of COST Activities" (COST 132/14 REV2);
b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14 REV);
c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14 REV2);
d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14 REV).

The main aim and objective of the Action is to to create a network of relevant stakeholders to address the key challenges around smart textiles:
- Miniaturization of electronic materials
- High production costs
- Incompatibility of manufacturing practices
- Lack of competences for the assembly
- Ensuring consistent power supply
- Rising demand from transportation sector
- Growing demand from sports sector. This will be achieved through the specific objectives detailed in the Technical Annex.

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 40 million in 2017.

The MoU will enter into force once at least seven (7) COST Member Countries and/or COST Cooperating State have accepted it, and the corresponding Management Committee Members have been appointed, as described in the CSO Decision COST 134/14 REV2.

The COST Action will start from the date of the first Management Committee meeting and shall be implemented for a period of four (4) years, unless an extension is approved by the CSO following the procedure described in the CSO Decision COST 134/14 REV2.

OVERVIEW

Summary

CONTEXT COST Action objective is to create a network of European researchers and main relevant stakeholders in order to develop joint ideas and initiatives which can be turned into advanced smart textile products.

A smart textile material is a “functional textile material, which interacts actively with its environment, i.e. it responds or adapts to changes in the environment”. They find applications in all sectors and especially in health and medical; automotive and aeronautic; personal protective equipment; sports and wearables and buildings and interior design.

Although several R&D projects have been carried out during last years in that field, most of the prototypes obtained haven’t reached the market due to many reasons such as: product reliability, production economies, missing a demonstrated use case and/or value proposition.

In that sense, what CONTEXT aims is to ignite research and innovation projects (with high TRLs output expected) by joining under the same network and through Working Groups, people with the right competencies and experiences from the academic and research fields, the industrial sector and from clusters.

CONTEXT will promote the development of a joint research roadmap for smart textiles, will foster the transfer of knowledge among different actors in order to find suitable applications in various multidisciplinary fields, will act as stakeholder platform to identify needs and requirements from different points of view in a bottom-up approach and will promote networking activities in order to attract talent, build more and better research projects with more consciousness on the objectives of creating exploitable results.

Areas of Expertise Relevant for the Action	Keywords
● Materials engineering: Biomaterials, metals, ceramics, polymers, composites ● Electrical engineering, electronic engineering, Information engineering: Sensors and sensor systems ● Nano-technology: Nano-materials and nano-structures	● "smart textile" ● "technical textile" ● "innovative textile" ● "advanced textile" ● "functional textile"

Specific Objectives

To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination

● Providing a hub to combine existing knowledge and to identify common issues and problems in order to develop new smart textile materials, production technologies, services and business models.
● Promoting the development of a joint research roadmap in accordance with the Strategic Innovation and Research Agenda for the European Textile and Clothing Industry and other related ETPs in order to increase the efficiency and efficacy of the innovation process
● To coordinate, compare and bring together results of research related to integration of ICT and IoT communication systems on textiles with the aim of defining optimized solutions and potential applications.
● To coordinate the development of new and improved surface functionalities in order to maximize the performance of the textile products.
● Introducing and promoting the sustainability concept in the research and development of new textile advanced products in order to adapt the sector to the new competitive and environmental rules.
● To obtain an updated state-of-the-art on the functionalization of textile materials to face societal

challenges, such as ageing of population, security and protection or access to leisure.
● Implement a Dissemination Plan including the organization of Thematic Workshops and participation in at least two International Conferences, Scientific Publications, Electronic Newsletters, Action Webpage and News and articles in media.
● Foster the transfer of knowledge among different actors in order to find suitable applications in various multidisciplinary fields e.g. mobility, health, medical, sports or building.

Capacity Building
● Development of a common strategy at European level for the development of Smart Textile research lines, in order to build strong European research activities (at lowest TRL) and develop the basis with the aim of being included as a priority in EC Policy programs.
● Accelerate knowledge transfer from fundamental research to the industrial application by identifying suitable industrial applications and addressing Smart Textile key market barriers.
● Create a virtual collaboration-open space that fosters team work and real-time communications so that new relevant partners can be incorporated into the CONTEXT COST Action.
● Act as stakeholder platform to identify needs and requirements from different points of view in a bottom-up approach (from society, through industry, businesses, clusters, researchers and academia to policy makers).
● Promote the development of networking activities in order to attract talent and build more and better research projects with more consciousness on the objectives of creating exploitable results, under the scope of H2020 (Horizon 2020) or other funding schemes.

TECHNICAL ANNEX

1. S&T EXCELLENCE

1.1. CHALLENGE

1.1.1. DESCRIPTION OF THE CHALLENGE (MAIN AIM)

The main objective is to create a network of European researchers and main relevant stakeholders (CONTEXT) in order to develop joint ideas and initiatives which can be turned into advanced smart textile products.

The definition of smart (or intelligent) textile material is a “functional textile material, which interacts actively with its environment, i.e. it responds or adapts to changes in the environment”, according to the technical workgroup CEN/TC 248 Textiles and textile products, WG 31 Smart Textiles on standardisation of smart textiles.

Smart textiles are able to react to external stimuli (light, temperature, humidity, pressure, etc.). They might be active and connected (integrating sensor and actuators) or passive (e.g. Ultraviolet- colour changing materials). These textiles have numerous potential applications, such as the ability to communicate with other devices, conduct energy, transform into other materials and protect the wearer from environmental hazards. Connected textiles are included in the big area of connected devices (Internet of things, IoT). They might be wearables (e.g. clothes) or not (e.g. seats for automotive).

The textile industry is experiencing a growing demand for high-tech materials driven largely by both technical textiles and the increasing integration of smart textiles to create wearable devices based on sensors. Unlike today’s ‘wearables, tomorrow’s devices will be fully integrated into the garment through e.g. the use of conductive fibres, multilayer 2D or 3D printed structures and two dimensional materials such as graphene. Smart textiles must be considered as functional systems (built from traditional processes, smart materials and electronic functions) that will bring functionalities to end-products. These smart textile functional systems will find applications in numerous sectors such as in health & medical; automotive & aeronautics; personal protective equipment; sports, buildings and interior design. Applications do not include only enhanced functionality but also the possibility of collecting and extracting data that can set grounds for new services and business models in the era of the Internet of Things and Industry 4.0.

The worldwide market for smart textiles (including fabrics and interactive textiles) will expand at an exponential 14.0% CAGR (Compound Annual Growth Rate) between 2014 and 2020. If the projections hold up, the market will rise from a valuation of US$1.5 billion in 2013 to US$3.8 billion by 2020, according to a report from Transparency Market Research. Largely driven by the use of nanotechnologies, this sector has the potential to be one of the largest end users of nano and two dimensional materials such as graphene, with wearable devices accounting for over half of the demand by 2022.

The key challenges that are hampering market growth in the global smart textiles market are:

- Miniaturization of electronic materials: Integration of electronics into the core yarn of textiles will increase the feasibility of, for example, wearable systems but there is still much research and development to be done.

- High production costs: Accessibility to smart textiles is still to be mainstreamed, for many vendors these products are too expensive mainly because the benefit-use case is still considered a high-end option in many application areas.
- Incompatibility of manufacturing practices: Integration of textile and electronic production lines is not simple, there are quite a few incompatibilities and there is a need to increase the understanding of requirements to fully close the gap in this field.
- Lack of competences for the assembly/connection: Specialization in electronics and in textiles exist but not in the assembly of both, as it is not part of the core business in textiles nor electronic industries.
- Ensuring consistent power supply: One of the biggest challenges is that the current power supply technologies are not providing the desired technical performance and are also not well perceived by users. Research efforts are driven by organic electronics based circuits.
- Rising demand from transportation sector: The integration of advanced functionalities in automotive and aeronautic applications provides added value to this sector but it needs to be compatible with mass-scale production and comply with several safety standards and materials recyclability.
- Growing demand from sports sector: The analysis of athletes' performance at professional level is a key task in order to identify improvement points. The use of sensors and the collection of data in light weighted equipment made of smart textiles is an enabler for this kind of task.

1.1.2. RELEVANCE AND TIMELINESS

Although several Research and Development projects have been carried out during last years in that field, most of the prototypes obtained haven't reached the market due to many reasons such as: product reliability, production economies, missing a demonstrated use case and/or value proposition. In that sense, what CONTEXT aims is to help reaching the goals missed in the past and to ignite more ambitious projects (with expected higher Technology Readiness Levels, TRLs, output) by joining under the same network and through Working Groups, people with the right competences (different knowledge backgrounds) and experiences from the academic and research fields, the industrial sector and from clusters. The network also includes Early- career investigators, who have the potential, creativity and talent to lead future developments and who are often unaware of previous research efforts.

Finally, the Action's work will be the development of a roadmap for the advanced textile industry with the aim of being included as a priority in EC Policy programs.

According to information from the European Commission DG GROW, the textile and clothing sector plays a crucial role in the economy and social well-being of many regions in Europe. Companies in the sector are mainly SMEs (Small and Medium Enterprises), having 90% of them less than 50 employees. Europe gathers more than 160.000 textile companies. It also states that cooperation at local, district and even regional level has proven inadequate to ensure that the chain of production remains at close proximity to the European market, as many companies subcontract or relocate production to countries with lower labour costs. In this sense, the CONTEXT Action will foster activities on a wider-geographical area and the improvement of knowledge in materials, production processes and applications with the objective of increasing competitiveness of companies and researchers with a global projection.

COST Scheme offers by far the most appropriate framework for this Action, as it aims to bring together the existing expertise from different national initiatives in the larger EU-region to study the potential for new advanced smart textile materials. The timing to create this network is essential as there are different European policies and strategies that are going to be implemented or drafted in the next four years that will have a direct impact on the textile industry such as the Smart Specialization Strategy (S3) with focus on Industrial Modernization where the textile sector is already one of the first sectors to propose an initiative (Regiotex) or the next European Commission Framework Programme for Research and Innovation.

Furthermore, the European Technology Platform (ETP) for the Future of Textiles and Clothing published on October 2016 a roadmap detailing the key Innovation Themes and Research Priorities of the European textile and clothing industry for the next 10 years (Smart, high-performance materials; Advanced digitised manufacturing, value chains and business models; Circular economy and resource efficiency; High-value added solutions for attractive growth markets). Other technology platforms such as the ETP on Smart Systems Integration, ENIAC Joint Undertaking (nanoelectronics), NetWorld2020

(ETP for communications networks and services), EuMat (ETP for advanced engineering materials and technologies) have also developed roadmaps on their fields with which CONTEXT will also be aligned due to the interdisciplinary of smart textiles.

CONTEXT will provide a hub to combine existing knowledge and to identify common issues and problems in order to develop new smart textile materials, production technologies, services and business models. The Action will foster future collaborations to prepare joint research projects under the scope of H2020 (Horizon 2020) or other funding schemes.

1.2. OBJECTIVES

1.2.1. RESEARCH COORDINATION OBJECTIVES

CONTEXT network is formed by a group of more than 60 experts in the smart textiles field. The cooperation within this network will allow coordinating research efforts and to specifically achieve the following Research Coordination Objectives (RCO):

- RCO1: Providing a hub to combine existing knowledge and to identify common issues and problems in order to develop new smart textile materials, production technologies, services and business models.
- RCO2: Promoting the development of a joint research roadmap in accordance with the Strategic Innovation and Research Agenda for the European Textile and Clothing Industry and other related ETPs in order to increase the efficiency and efficacy of the innovation process and, therefore, having a direct impact on the development and implementation of new technologies, processes, methodologies and products.
- RCO3: To coordinate, compare and bring together results of research related to integration of ICT and IoT communication systems on textiles with the aim of defining optimized solutions and potential applications.
- RCO4: To coordinate the development of new and improved surface functionalities in order to maximize the performance of the textile products.
- RCO5: Introducing and promoting the sustainability concept in the research and development of new textile advanced products in order to adapt the sector to the new competitive and environmental rules.
- RCO6: To obtain an updated state-of-the-art on the functionalization of textile materials to face societal challenges, such as ageing of population, security and protection or access to leisure.
- RCO7: Implement a Dissemination Plan including the organization of Thematic Workshops and participation in at least two International Conferences, Scientific Publications, Electronic Newsletters, Action Webpage and News and articles in media.
- RCO8: Foster the transfer of knowledge among different actors in order to find suitable applications in various multidisciplinary fields e.g. mobility, health, medical, sports or building.

1.2.2. CAPACITY-BUILDING OBJECTIVES

The Action Challenge requires joining knowledge from several fields, thus it encourages the building of interdisciplinary teams. In that sense, CONTEXT Action will build and coordinate efforts to address the Challenge by the following Capacity-Building Objectives (CBOs):

- CBO1: Development of a common strategy at European level for the development of Smart Textile research lines, in order to build strong European research activities (at lowest TRL) and develop the basis of processes and technologies in the smart textiles area and with the aim of being included as a priority in EC Policy programs.

- CBO2: Accelerate knowledge transfer from fundamental research to the industrial application by identifying suitable industrial applications and addressing Smart Textile key market barriers. Establishing the bases to transfer knowledge from technology development to pilot/prototype development (through H2020 Innovation Actions) and pilot/prototype development to market scale deployment levels ((through H2020, FTI (Fast Track to Innovation Pilot) or SME instrument)).

- CBO3: Create a virtual collaboration-open space that fosters team work and real-time communications so that new relevant partners can be incorporated into the CONTEXT COST Action.

- CBO4: Act as stakeholder platform to identify needs and requirements from different points of view in a bottom-up approach (from society, through industry, businesses, clusters, researchers and academia to policy makers).

- CBO5: Promote the development of networking activities in order to attract talent and build more and better research projects with more consciousness on the objectives of creating exploitable results, under the scope of H2020 (Horizon 2020) or other funding schemes.

1.3. PROGRESS BEYOND THE STATE-OF-THE-ART AND INNOVATION POTENTIAL

1.3.1. DESCRIPTION OF THE STATE-OF-THE-ART

Textile materials are multi-materials (fibres or filaments making yarns, making woven, nonwoven, knitted, braided materials, making complexes, making products), with one intrinsic very specific property especially useful for all the application sectors: conformability. This property means comfort for the sport & fashion sector, ability to reach 3D shapes with good mechanical properties for the composites industry (automotive), ability to fit to the human body for the healthcare & medical sectors, creation of complex shapes for architectural applications and develop new high performance composite structures for automotive and aeronautic applications, high thermal performance and an ability to adapt to external conditions with an outstanding and inclusive design for building & architecture sector.

One significant part of work during the next years will be in materials science to optimize existing materials or develop new approaches for highly stretchable and comfortable but reliable functional and sustainable textiles. Many R&D projects have focused on the integration of smart systems into textiles and, while the functionalities have been demonstrated, work still has to be done in order to improve parameters such as wearability, comfort and durability (under users' conditions (washing, sweating, etc..)) of the textiles with integrated smart devices. This topic will also strongly benefit of developments within the electronics sector (more flexible and stretchable), bringing these two worlds closer together taking advantage of for instance connectors, that can be adapted to textile applications solving some of the interconnection issues.

In addition to the development of materials and components, structures and functionalities, the focus has to be set on the testing of these textiles in order to gain all the knowledge indispensable for industrialisation and commercialization. A first approach will be using standardised tests from textile and electronics and adapting them to e-textiles (electronic textiles), but new testing methods, especially for simulations of use, will be required. The availability of suitable test methods will also enable faster progress in development of the necessary standards and certifications.

The industrialisation of textile electronics and smart wearables in Europe needs to be sped up to match the developments of new ideas and demands in the marketplace. The main cause of delayed industrialization is the gap between the development phase and the actual production for the market. Companies have to be supported in investing in additional prototyping and pilot production equipment to overcome the current lack of small to medium scale industrial production of e-textiles.

Huge challenges are to be faced in the future: water, energy, environment, industry of the future, etc. Smart textiles may help to find solutions for several societal challenges: ageing of population, security and protection, access to leisure. The main offer of the textile industry for that is: the textile material and

the intrinsic properties of conformability. The success will come mainly from the match between electronics & smart materials and the textile properties.

The main driver for sports textile market is the relation between several variables: cost of the product, added functionality (with the integration of sensing and always connected embedded and wearable systems), performance and comfort (thermal and mechanical performance for high- performance garments is particularly relevant) and design concepts.

For the medical and healthcare sector the main driver for innovation remains the added value in terms of better functionality and performance, but also total cost, compared to established approaches, the continuous integration of new technologies in the development of new products while adapting to new challenges placed by the ageing society ((for integrated ICT (Information and Communications Technologies) tools that enable remote monitoring of patients)), the enhancement of barrier and comfort properties for professional medical garments and the success of textile fabrics/structures to be used in human tissue and organs repair.

For the automotive and aeronautics sectors the main challenges focus on the integration of new fibre and yarn functionalities incorporating new ones such as the integration of natural based fibres and textiles and structures into and onto structural composite components, with emphasis on the integration of ICT and ubiquitous sensing and actuation functionalities to develop new interactive surfaces and new self-lighting surfaces textile structures. Additional challenges will focus on the optimization of comfort via the integration of new textile fibres and structures with enhanced thermal performance, breathability and enhanced surface technologies using sustainable processes for self-cleaning, UV (Ultraviolet) and IR (Infrared) reflection properties. Further challenges will focus on the development of new 3D textiles for reinforcement structures for composite components and parts.

Regarding the PPE (Personal Protective Equipment) sector, comfort optimisation and weight reduction while maintaining or even improving protective function remains the main driver, with more emphasis being currently placed on design and new methods of integration of ICT wearable/e-textile solutions that allow the construction of comfortable and user-friendly wearable ICT systems. The main goal of these wearable ICT systems is bio-monitoring the user, assessing the integrity of the PPE and also monitoring hazardous conditions in which the PPE is used.

Concerning the building & living sector, one of the main concepts that is being explored is the zero-energy building, based in the improvement of materials used, construction methods and architectural design. In this scope the use of textile based materials, such as composite structures, that can contribute to both the reduction of the amount of raw materials that is used and the energy consumption reduction can be seen as a determinant factor in order to achieve this goal.

1.3.2. PROGRESS BEYOND THE STATE-OF-THE-ART

With ongoing collaboration between textile industry, materials science, electronics, medical technology etc., and end users of smart textiles in other sectors, the integration possibilities of electronics in textile applications are constantly widening. Whilst first applications were limited to electronic modules connected to a textile substrate, important progress came with conductive textiles and yarns. These new materials allowed the true integration of electronics into textiles and even the building of electronic functionalities with textile processes. Thus, the textile itself took a functional role in the landscape of innovation. Furthermore, conductive inks and coatings enabled the application of new functionalities at the end of manufacturing processes. The latest textile trend is to take not only supporting functionalities, like power supply, but to constitute the electronic component/functionality itself. These latest developments open up new product ranges and possibilities as well as new challenges in market and design.

With the different stages of textile integration, it becomes possible to tackle all the different stages of textile manufacturing processes to ensure the e-textiles' functionalities. They provide the base for innovations in a wide range of industries such as automotive, food, chemicals, electronics, energy, pharmacy, medical and care, construction, and telecommunication. Moreover, they can be used in emerging sectors as well as in traditional sectors such as the fashion, sports and outdoor industry.

Textile technology innovation is an enabling technology for numerous fields and can make important contributions to new solutions for effective and affordable health care, highly functional sportswear and

goods and smart personal protection. All these are rapidly growing markets and targeted by the European societal challenges of active ageing and safety and security.

For the healthcare and medical textile sector key technological challenges are: (1) development of controlled drug release fibre and textile structures for therapeutics of different skin conditions; (2) development of garments and home textile products with fully integrated bio- monitoring, active systems to improve life quality and ICT systems enabling remote monitoring of patients and assisted living services for “better ageing concepts”; (3) development of fibre and textile structures with enhanced thermal/breathability electro-active properties with integration of new surface functionalities for improving barrier (antiviral and antibacterial) properties.

For the automotive and aeronautics sector key technological challenges are: (1) integration of fully integrated and printed electro active and interactive sensors and actuators that enable the development of ubiquitous sensing and interactive surfaces, while also integrating fully embedded (or printed and/or fibre and yarn integrated) haptic feedback systems via both lighting integration and mechanical stimuli responses; (2) integration of fully customizable self- lighting materials based on active fibres and yarns, and integration or programmable textile matrixes for interactive sensing.

For the sports textile sector key technological challenges are: (1) development of light weight performance garments having new textile surface coatings enhancing thermal management (insulation), controlled drug release for muscle care, and also proving optimized comfort, low pill, low shrink and fast drying; (2) integration of low power/autonomous bio-monitoring and/or integrated ICT and IoT communication systems for training monitoring and performance assistance and integration concepts of training analytics, always connected and data sharing for garment/textile structures “peripherals”.

For the personal protective textiles sector key technological challenges are: (1) the integration of geo tracking and personal GPS systems (Global Positioning Systems), physiological and biometric monitoring, embedded and integrated communications and energy harvesting, with all data monitoring systems sharing data in real-time; (2) integration of cooling/heating systems into garments.

For the building & living sector the challenges are (1) development of new functional textile materials using nano- materials and industrial waste, eco-friendly technologies (like ultrasonic deposition, bi/tri-component fibres, UV curing coatings), considering multilayer approaches; (2) focus on high thermal performance (applying eco-efficient heating and cooling systems, together with low thermal conductivity and diffusivity coatings and additives, infrared reflective and phase change materials), in order to achieve Net Zero Energy Buildings (NZEB); (3) textile functionalization with smart and efficient systems like sensorization, communication systems and actuators, considering printing electronics approaches, in order to maximize comfort, well-being; (4) develop interoperability between connected devices.

1.3.3. INNOVATION IN TACKLING THE CHALLENGE

As already commented before, the assessment from EC DG GROW shows that disperse collaboration has proven inadequate to tackle competitiveness challenges in the textile and clothing sector; for this reason, the CONTEXT Action proposes a EU level coordination of efforts. The CONTEXT network is already willing to collaborate, cooperate and share their knowledge and experience with the objective of making a clear step forward in TRLs of smart textile technologies.

Another difference from previous efforts is that this Action includes cluster organizations, which are already used to coordinate activities from industry, research and public bodies in their own regions. Through their participation, all the members of the clusters are being represented and can be potential new participants if they are willing to be active in the network activities.

A third point of innovation is the willingness of integrating the industry as main actor in each of the Working Groups and therefore driving innovation from the demand side instead of looking for new applications for a recently developed technology. Furthermore, involvement of end-users in the different fields, such as: hospitals, sportsmen, architects, etc. is considered as essential to achieve the COST Action objectives.

An added value of this COST Action is that it is a multi-disciplinary partnership and the Action structure is not separated by knowledge areas but is driven by market applications working its way through the complete innovation cycle, ignited by a market need. It will first study ideas from a business perspective

and then dig into the technical feasibility and development needs and will complete the cycle checking for standardization and qualification needs so that the entry into the market is easier. This multidisciplinary network facilitates the whole process from the idea to the final marketable product validated by the final users. A network of smart textile experts should give the opportunity to experts from complementary sectors (electronic, battery, printed electronics, etc.) to interact with an established platform in order to develop R&D ideas and projects for the smart textiles sector.

Finally, CONTEXT, unlike other initiatives, such as Technology Platforms or cluster activities, will be an open and free access platform in which involved experts will directly participate in the generated projects, the industry and end-users will be a key actor within the network and several related disciplines, such as advanced manufacturing, IoT, etc., will be integrated to align the COST Action with the main challenges of these fields.

1.4. ADDED VALUE OF NETWORKING

1.4.1. IN RELATION TO THE CHALLENGE

Many R&D projects fall in one of the two “valleys of death” (inefficient of knowledge transfer from basic research to prototyping and from pilot to commercialization) due to the fact that the outputs are not market driven and although there is public expenditure on early stage research there has not been sufficient attention paid to investment decisions at later stages of the innovation process. In this sense, the CONTEXT Action brings industry players to participate directly or indirectly in the decision making process where basic and middle research objectives are set.

The Action Challenge will combine efforts made by different stakeholders (participating directly or not) as the objectives are beyond the possible reach of a single group. The Challenge is far too big to be handled by individual research groups via inter and national projects. Coordinated efforts will help to avoid work being duplicated and to establish and develop the research lines according to the market needs.

The Community will grow into a huge collaborative effort by combining knowledge from different knowledge areas, and thereby considerably increasing the chances of tackling the Action Challenge with success.

The Challenge is complex and multidisciplinary in essence, and the networking of the involved international experts from clusters, academia and R+D+i centres, including researchers from different disciplines and experts from the private industry, is essential to properly address the Challenge and also to enhance the potential impact. Proper design, materials, production processes and applications need the cooperation of textile, electronic, mechanical and material engineers, chemists and designers. In fact, this challenge, spans over different science and technology domains and requires a wide range of expertise and industry insights, which is more likely to be available across different countries.

The networking activities will help increase collaboration, spread knowledge, promote productive collaboration among stakeholders, stimulate communications that will contribute to identify technical and market barriers and will bring, as a consequence, new and innovative ideas from fundamental research directly to market applications, and to raise the TRL of several technologies.

The dynamic and flexible characteristics of the COST Action network will contribute to optimize the outcomes and results by identifying and incorporating new relevant partners who will contribute to a better achievement of the goals.

1.4.2. IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

The Action includes clusters and integrates organizations who are taking part in European and international level efforts. In this sense it will serve to create a big picture of these disperse efforts and encourage cooperation in order to develop projects of more impact and which can be taken by industries and exploited.

Several R&D projects concerning smart textiles have been executed with EU funding by different organizations and industries. Some examples are listed below:

- BETITEX - Development of sustainable textiles against bugs,
- CLEVERTEX - Development of a strategic Master Plan for the transformation of the traditional textile and clothing into a knowledge driven industrial sector by 2015,
- DEPHOTEX - Research and development of flexible photovoltaic textiles based on novel fibres,
- MICROFLEX - Development of flexible materials in the form of high added value smart fabrics/textiles which are able to sense stimuli and react or adapt to them in a predetermined way,
- PASTA - Integrating Platform for Advanced Smart Textile Applications,
- PLACE-it - Development of a technology platform for lightweight, thin and conformable opto-electronic systems interconnect technology,
- PROCOTEX - Promoting smart textile research and collaboration,
- POLYTECT - Smart textile materials for infrastructure reinforcing and monitoring,
- PROSPIE - Protective Responsive Outer Shell for People in Industrial Environments,
- SAFE @ SEA - Advanced personal protective clothing,
- SMARTPRO- Development of lightweight and flexible protective clothing, incorporating smart functionalities and designated for law enforcement authorities,
- SUSTA-SMART - Supporting Standardisation for Smart Textiles,
- SYNTEX - Successful investigation of the smart textiles landscape: markets, projects, vision and roadmap,
- WearIT@Work - aimed to prove the applicability of computer systems integrated to clothes, creating wearable interfaces for various industrial environments.

In the framework of Horizon2020 there are also some on-going projects mainly under the topic Nanotech, Material and Processes (NMP) and some developments also under the Societal Challenges topics. CONTEXT will identify H2020 topics within the new Work Programme 2018-2020 as potential opportunities for projects related to the Action with the commitment to lead future project submissions.

CONTEXT represents an added value with respect to other similar approaches. It will focus exclusively on smart textiles by joining efforts from different existing initiatives both in the textile and smart textiles' related sectors to align and exploit research; innovation and knowledge with a market pull orientation (Figure 1).

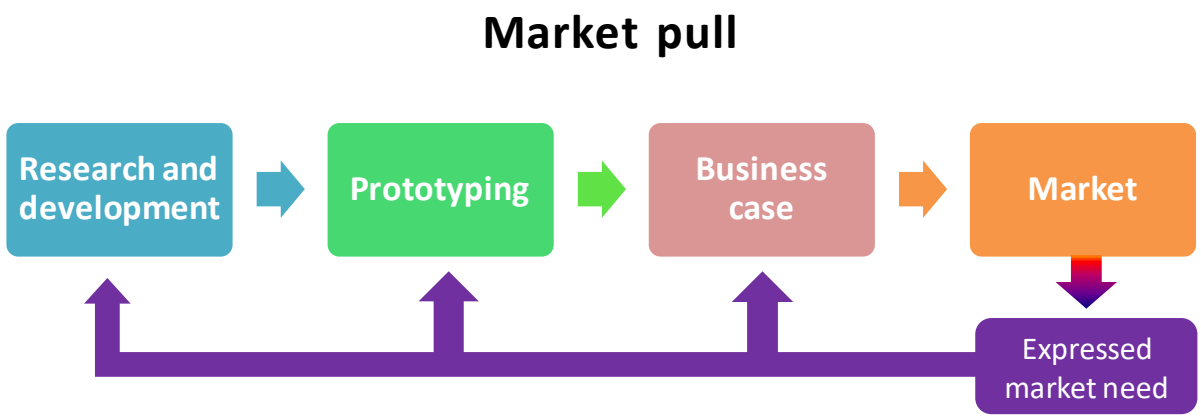

Figure 1 - Market driving the innovation cycle

It aims to avoid repetitive research work and directly act in the lack of capital, human or knowledge resources, especially with the participation of Early Career Investigators.

2. IMPACT

2.1. EXPECTED IMPACT

2.1.1. SHORT-TERM AND LONG-TERM SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS

CONTEXT Action will boost research activity in Europe through the cooperation and coordination of existing efforts. European research should focus on markets with high potential growth and address market needs instead of developing technologies and then finding an application. CONTEXT will have a major impact on the research agenda by including industry players from supply and demand side in the Working Groups and surrounding them with experts from multi-disciplinary backgrounds to propose projects that will result in a real advance of scientific knowledge and technological solutions for real problems.

Mobility (through Training Schools and Short-Term Scientific Missions) within the network will provide the partners, especially Early-Career Investigators (ECIs), access to hands-on Training Schools in avant-garde institutions from EU countries and international partners. Emphasis is made on enhancing their leadership skills. This will result in larger numbers of early-career researchers from different knowledge fields (textile, mechanical, electronic, chemical, ICT, design, etc.) who are highly trained to work on smart textile solutions.

In addition, the Action will establish a communication cycle between academia, research centres and companies, in which companies will communicate their needs and expectations and will be recipients of technology transfer fit to their application requirements. This cycle will create new opportunities for participants to the network, find partners and bid for research funds in forthcoming years. Experienced researchers will have the opportunity to mentor ECIs in the process of building Research and Innovation projects resulting in the increased visibility and integration of ECIs in European Framework Program project proposals.

The Action will contribute to meet the European Council ambitious economic and employment objectives for 2020 as it will provide new air to a traditional industrial sector: to have an employment level of 75% of people aged 20–64; to have a 3% of the EU's GDP invested in R&D.

The goal of the collaborations within CONTEXT will help deal with important scientific, technological, industrial and societal challenges that Europe is facing today.

2.2. MEASURES TO MAXIMISE IMPACT

2.2.1. PLAN FOR INVOLVING THE MOST RELEVANT STAKEHOLDERS

In the CONTEXT COST Action, five types of partners will actively participate:

- Clusters (network, business, creativity): Cluster organizations are the natural link between industry, science and public authorities. Clusters represent many SMEs, public bodies, research and academia institutions. Cluster representatives will channel the inputs and interests of their members who are one of the main stakeholders in this value chain.

- R+D+i centres (technology transfer): they are partners who are actively doing research in the field up to date. Their research is focused between TRLs 3 and 6.

- Academia (research): These partners usually do basic research much of which usually stays in the first valley of death for a long time because of the complexity of up scaling or implementing their results.

- Industry (manufacturing, business): This includes companies whose activities substantially depend on continuous product innovation. CONTEXT does not only focus on textile manufacturers but also on companies who do electronics and ICT research.

- End-users (products validation): End-users in the different application fields: healthcare centres, security corps, etc. The best way to get innovation to the market is by having users pulling research results. End-users will be invited to take part in CONTEXT activities to provide their inputs.

In addition, European organizations which are stakeholders of the sector such as EURATEX (European Apparel and Textile Confederation) and the Textile ETP; Commission Directorates-General (DGs) such as DG CONNECT and DG GROW plus international organisations from Japan, Korea and other International Partner Countries (IPC) will be invited to join and participate in the Action.

As described in Section 3.1, the Action is composed of six Working Groups (WGs), five of which are related with industrial applications of Smart Textiles, and the last one covering Dissemination and Communication.

Fifty partners have actively participated in preparing the proposal, mainly from clusters, academia and research institutions. However, more efforts in the industrial sector are needed in order to involve more industrial partners both from the supply and demand side. A plan to involve more industrial partners will be devised during the first quarter of the Action and implemented along its span.

The following dissemination activities will act at the same time as tools to involve more stakeholders:

- Communication tools: Website, stakeholder registration form, partner expression of interest form, Electronic Newsletters about the Action advances made every six months, social media channels and participation in most representative professional groups.
- The events planned during the Action (such as Training Schools and Conferences) will be open to all stakeholders and, therefore, will be an opportunity to identify potential members or simply stakeholders that want to be informed, end-users will be invited and encouraged to attend. The collaboration results obtained during the Action, presented within the frame of these events, will be used as a presentation card to contact and incorporate new members into the Action with hard proof of the Action impact and interest to the stakeholders' community.
- The Publications (Conference Proceedings, Short-Term Scientific Missions' (STSM) Reports, Electronic Newsletters and Roadmap) obtained through the collaboration and coordinated efforts of the Action will also attract the interest of new interested partners, and will help advertise and increase the number of members.

2.2.2. DISSEMINATION AND/OR EXPLOITATION PLAN

The collection and dissemination of the Action outcomes will be one of the most important tasks undertaken by the Dissemination & Communication Working Group, which will be set up to achieve maximum impact for the Action work.

An outbound dissemination strategy will be adopted to reach a wider European and International audience by presenting results and promoting partner collaboration in publications and conferences. The public website will provide information on the research needs and the sought application cases and will present information on the advances of the Action, Training Schools, Reports, and Electronic Newsletters and will contain a contact form to request further information. Industry and end-users will be invited to provide both inputs and feedback which will be used to support dissemination.

The following tools will be used to disseminate the Action's results (ordered from wider/general audience to more concentrated/specialised groups):

- Action website.
- Articles and news in the media
- International Conference on Smart Textiles
- Electronic Newsletters
- Publications
- Strategic Workshops
- Training Schools

Some of the smart textiles developed through collaborative projects resulting from the Action are expected to be susceptible to intellectual/industrial property protection. During the first six months of activities of the Action, the MC will approve the internal procedures for Intellectual Property Rights protection and confidentiality issues.

2.3. POTENTIAL FOR INNOVATION VERSUS RISK LEVEL

2.3.1. POTENTIAL FOR SCIENTIFIC, TECHNOLOGICAL AND/OR SOCIOECONOMIC INNOVATION BREAKTHROUGHS

Main innovation breakthroughs to be achieved by CONTEXT are:

- Generate new business model ideas in the innovation process (low TRL) in order to better fit technological developments to the future needs.
- Identify, gather and create synergies between European specificities in textiles and electronics. Structure the smart textile industry and bring to it an efficient pool of experts.
- Initiate new research opportunities to be explored in the field of smart textiles for several applications.
- Offer unprecedented opportunities for tackling societal challenges by providing solutions in the areas of healthy ageing, patient monitoring, emergency management, safety at work, amongst others.
- Reduction of the “valley of death” by moving closer research lines to main problems and priorities of the textile companies. Promote moving from a technology-push to a market-pull approach. Promote the information flow regarding market challenges and needs of technological transformation to research centres.
- Contribute to meet the goals defined by the textile Strategic Innovation and Research Agenda and to the application of Key Enabling Technologies at a traditional manufacturing industry.
- Consolidate and link specialization hubs in EU regions: local or regional innovation communities specialized in specific areas of the textile industry and related-smart textiles’ industries.
- Increase the competitiveness of the EU textile industry by generating new business opportunities.

Main risks detected are, from one side, the involvement of the industry (due to design, production, etc. difficulties) and, from the other, the factors that inhibit to uptake smart textiles (lack of awareness, price, etc.). These major risks will be tackled by working closely and involving both the industry and end users in the core activities of CONTEXT.

3. IMPLEMENTATION

3.1. DESCRIPTION OF THE WORK PLAN

3.1.1. DESCRIPTION OF WORKING GROUPS

The CONTEXT Action activities will be developed through six WGs (Working Groups). Each of the WGs will be in charge of developing and promoting research actions that will lead to the increase of the TRL of smart textiles for the following applications (1) Health and Medical, (2) Automotive and Aeronautics, (3) Personal protection, (4) Building and living and (5) Sports and wearables. A sixth WG will be responsible for maximising the outreach of the Action.

Each WG will have a triple helix approach, integrating academia, research and industry working under the coordination of cluster organizations. The description of some examples of technology usecases are listed below for each WG:

WG1: Smart textiles for health and medical applications, such as bio-monitoring of cardiovascular, neural, muscle and respiratory activity or thermoregulation, from one side and bandages and wound care during surgery, uniforms for medical personal, or drug-release systems such as bandages or plasters, from the other side.

WG2: Smart textiles for automotive and aeronautic applications, such as structural applications, light weight components, tailored reinforcement structures, heated seats, and passenger sensoring systems working on the integration of novel eco sustainable materials and integration of ubiquitous computing sensing-actuation onto materials structures.

WG3: Smart textiles for personal protection applications, for example monitoring the safety of workers during work and exercises (e.g. fireman, mineworkers, …).

WG4: Smart textiles for building and living applications, including textile reinforced concrete, geo-textiles, colour changing materials (wallpapers), smart lighting, etc.

WG5: Smart textiles for sports and wearables' applications like connected skies, tennis racquets, ski clothes with embedded sensors, GPS, airbags for skiers, etc.

Figure 2 shows the general structure of the Action and how the WGs will work transversally in some research lines although looking for specific results in the area of application.

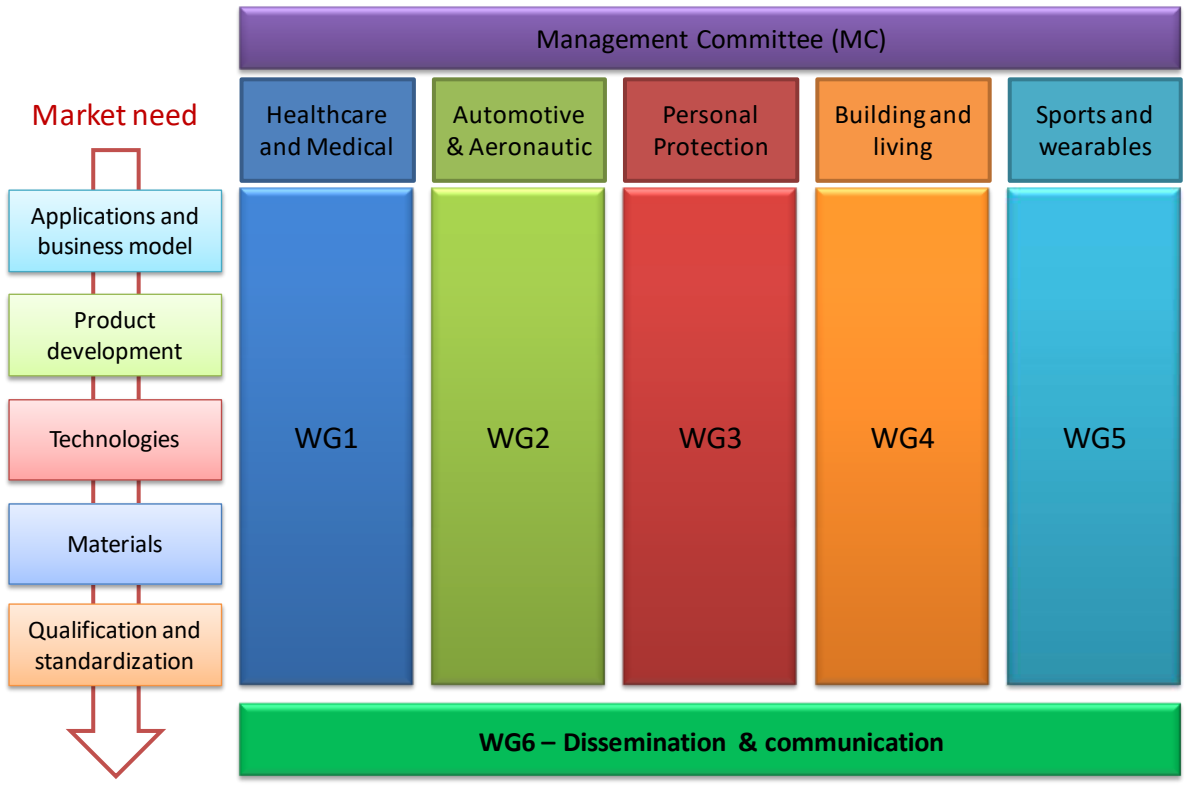

Figure 2 - CONTEXT Action WGs structure

3.1.2. GANTT DIAGRAM

The objective of the COST Action is to set the roadmap in order to coordinate efforts in one direction and to produce collaborative results in a faster way than the usual. For this reason, the Action will adopt the Agile project methodology, which is used in many sectors to manage complex projects with minimum risk by delivering by separate working parts instead of as big final development without intermediate deliverables/revisions (Figure 3).

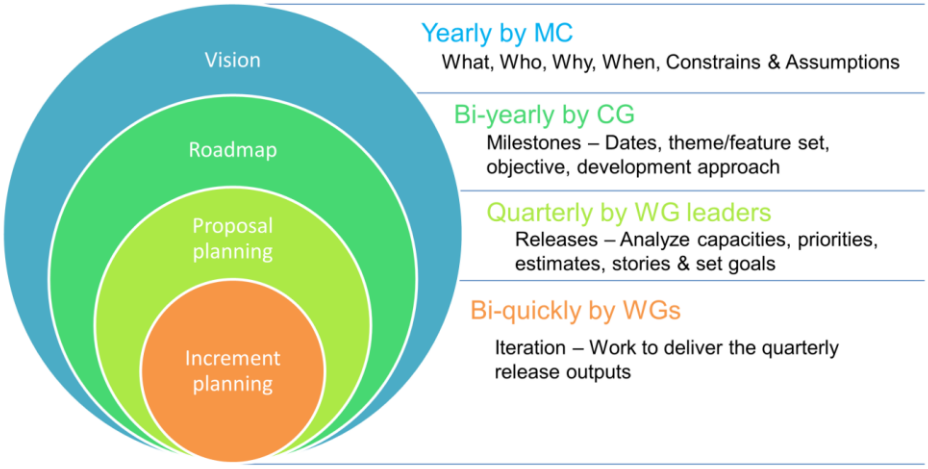

Figure 3 - Agile methodology applied to CONTEXT COST Action

Inside this methodology, different networking activities have been scheduled with the objective of creating a semi-continuous feedback loop. The following activities are planned (milestones are summarized in Table 2):

- A1. Management Committee (MC) and Core Group (CG) meetings will be held every twelve months, preferably organised by different partners. These meetings have the objective of setting the vision for the next period. Deliverable: Annual Vision reports.

- A2. Working Groups (WG) meetings will be held every six months, preferably organised by different partners. These meetings have the objective of working on the detailed roadmap and objectives that drive the WGs actions. Deliverable: Biannual roadmap updates.

  For costs optimization, the MC, CG and WGs meetings will be held in the same location and preferably on the same day. In addition, Thematic Workshops will be set coinciding with WGs meetings.

- A3. Thematic workshops: The idea of thematic workshops is that WG participants (at least 10 attendees) join to discuss how to achieve the milestones set in the roadmap, analyse possible project calls, build consortiums and together with industry (suppliers and end-users) analyse the viability of the project, which will be the developments, desired outcomes, and next steps if these are achieved. Deliverables: Workshop reports (attendance list, photos, minutes, needs of the sector, ideas of R&D projects or ideas of new activities).

- A4. Training Schools (TS): Their objective is to share knowledge among members. Training Schools will be organized during spring/summer and they will be open to interested public (fostering new members). Experts in the field will be invited as speakers to facilitate access to latest developments. COST Inclusiveness Target Countries (ITC) and Early Career Investigators (ECIs) will be prioritised to hold and attend Training Schools, respectively. Deliverable: TS report.

- A5. Short-Term Scientific Missions (STSM): The objective of the STSMs is to strengthen the networking among the researchers of the different groups participating in the Action Network to improve their knowledge and/or gaining access to specific instruments and/or methods that are not available in their own institution. A call for STSMs will be launched twice a year, in May and November. STSM applications will be assessed within 1 month; the assessment based on excellence and impact by prioritising applications from ESRs and countries that have less capacity in the field of the Action. Deliverable: STSM report.

- A6. International Conferences: The participation at two International Conferences, in which the results and next steps of the Action will be presented, is planned for Year 2 and Year 4 of the Action. All the participating experts, the COST-organisation and the national committees will be informed in due time to ensure a good attendance rate and publicity. Deliverable: Biennial participation report.

- A7. Dissemination: The dissemination activity will run along the whole Action. This activity includes also the attendance to Dissemination events by members of the MC, the production of dissemination materials, the creation and update of the website and the celebration of a Final International Conference, scheduled at the end of the Action, in order to disseminate the achievements made during the Action. Deliverable: Biannual dissemination report.

CONTEXT Action is planned to last four years, beginning in 2018 Q4 and finishing in 2022 Q3. Table 1 presents the Gantt Diagram of the Action, including the planning of the Activities among the four years of duration:

Activity	2018	2019				2020				2021				2022		
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
A1. MC and CG Meetings	X				X				X				X			
A2. WG Meetings	X		X		X		X		X		X		X		X	
A3. Thematic Workshops			X				X				X				X	
A4. Training Schools		X			X					X			x			
A5. STSMs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A6. Int. Conferences							X								X	
A7. Dissemination	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 1 - CONTEXT Action Gantt Diagram

In Table 2, a list of Milestones, the Action Research Coordination Objectives and Capacity-Building Objectives and activity they are connected with and the deadline foreseen are presented:

Objective	Activity	Milestone	Deadline
RCO1, CBO1	A1	MC/CG/WGs Kick-off Meeting	Year 1/Q4
RCO1, CBO1	A1	Definition of the work plan	Year 1/Q4
CBO3, RCO7	A7	Launch of the website	Year 1/Q4
RCO2, RCO5, RCO6, CBO4	A2	Definition and updating a roadmap	Every year in Q2
RCO5, RCO6, RCO7, RCO8, CBO2, CBO5	A3	Organization of Thematic Workshops	Every year in Q2
RCO3-4, RCO8, CBO5	A4	Calls for Training Schools	Year 2/Q1, Year 2/Q4, Year 4/Q1, Year 4/Q4
RCO3-4, RCO8, CBO2, CBO5	A5	Calls for STMSs	Every year May and November
RCO7, CBO5	A7	Call for the Final International conference	Year 5/Q2
CBO4, RCO8	A3	Identification of possible new applications of smart materials considering industry and end-users inputs	Year 2 to 4 at Q4
CBO1,2,5, RCO1	A2	Definition of proposals for new R&D projects	Year 2 to 4 at Q4

Table 2 - CONTEXT Milestones

3.1.4. RISK AND CONTINGENCY PLANS

The main risks of CONTEXT are: 1) Not having an active community: an online platform to encourage active participation will be set, plus there will be activity in social networks. Furthermore, MC members will contact country participants that are too passive in order to explain the benefits of the network and

how easy it is to participate; 2) Low participation in dissemination channels: as there is already a large network from inception, if the Action lacks visibility, the more active members will be asked to reach out to event organizers, media, etc. to increase awareness and propose solutions. 3) Lack of engagement of industry/end-users: This target group is reluctant to join networks, although some people from industry have participated from the inception stage. Some members of cluster organizations have already expressed their interest in joining the Cost Action when it is established. In that sense, the clusters (which count together with more than 500 associated companies) will be responsible of encouraging industry/end-users within their network to join the Action or participate at specific activities/events. Furthermore, clusters have an extended cross-sectoral network of end-users' clusters which directly approaches them to the final users.

3.2. MANAGEMENT STRUCTURES AND PROCEDURES

The Action will be supervised and coordinated by a Management Committee (MC), chaired by a Chair and a Vice-Chair, according to COST "Rules and procedures for implementing COST Actions". All research activities of the Action members' will be carried out and funded by internal resources of the participating groups, with COST supporting only the coordination, networking, and dissemination activities. To achieve the Action objectives effectively, coordination will involve:

- Action management: The MC will set up the network, discuss the achievements and the problems encountered, and plan future activities. It will report to the COST Association on a regular basis. The MC will appoint a Core Group (CG) to assure rapid, efficient and flexible coordination of the Action. The CG will consist of the MC Chair and Vice-Chair, the WG Leaders, the STSM Coordinator, the Science Communication Manager and the Training Schools Coordinator. The CG will prepare all relevant documents for the MC meetings.

The following roles within the action are foreseen to support the achievement of the COST objectives. These roles will be appointed by the MC after a selection process where candidates will voluntarily present their candidacy.

- WG leaders: responsible for coordinating the COST Action activities undertaken in each WG; Interconnecting the WGs participants with MC.

- Science Communication Manager: the MC will appoint a Coordinator whose mission is to create maximum impact of all networking actions through the proposed dissemination tools. The dissemination coordinator will be as well leader of WG6.

- Gender Equality/ Early Career Investigators (ECIs) supervisor: the MC will appoint an Action Participant to steer and promote gender equality and ECIs active participation.

- Event Coordinator: the MC will appoint a Coordinator who will be responsible for planning the meetings and workshop liaising with the Local organizer and providing all the knowledge and support needed to have a successful event.

- Training School/STSM Coordinator: the TS/STSM Coordinator will be responsible of overseeing the coordination and implementation plan, prepare the selection and review process of the TSs and STSMs. Operative decisions on the TS and STSM will be taken by the CG and reported to the MC.

3.3. NETWORK AS A WHOLE

The proposers of the Action consist of 5 clusters/associations, 12 universities, 10 technological centres and 11 industries from 10 European countries, currently with representatives from 7/10 major countries in the textile and clothing sector, representing the necessary expertise in the fields of material engineering, electronics, chemistry, mechanics, design and business. Furthermore, collaboration with International Partners is of mutual benefit as it can bring together expertise fields that are spread worldwide. For this reason, CONTEXT already includes one IPC.