

Brussels, 23 June 2017

COST 037/17

DECISION

Subject: **Memorandum of Understanding for the implementation of the COST Action “Indoor living space improvement: Smart Habitat for the Elderly.” (SHELD-ON) CA16226**

The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action Indoor living space improvement: Smart Habitat for the Elderly, approved by the Committee of Senior Officials through written procedure on 23 June 2017.



MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA16226 INDOOR LIVING SPACE IMPROVEMENT: SMART HABITAT FOR THE ELDERLY. (SHELD-ON)

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);
- b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14);
- c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14);
- d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14).

The main aim and objective of the Action is to establish a multidisciplinary network to support the development of solutions that allow the elderly to live safely, comfortably, and healthily at home through integrating design, ICT, ergonomics and health knowledge into furniture and building design. 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 64 million in 2016.

The MoU will enter into force once at least five (5) 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.

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.

OVERVIEW

Summary

By 2050, the number of people in the EU aged 65 and above is expected to grow by 70% and the number of people aged over 80, by 170%, which will increase demand and costs for healthcare. Integrating ICT solutions into habitats, along with improved building design, will allow us to live at home and stay active and productive for longer despite cognitive or physical impediments.

Improving accessibility, functionality, and safety at home, at work and in society in general requires combining many disciplines together to develop solutions that integrate ICT, ergonomics, healthcare (psychological and physical), building and community design.

The furniture sector plays an incredibly important role. Not only is it a critical part of the European economy, it also can significantly improve the accessibility of the built environment for the elderly by integrating ICT solutions, ergonomic design, and taking into account the health needs of the elderly more completely.

The present COST action will be a science and technology network where relevant actors from academic, research and industry sectors will utilise networking tools and activities to address the ageing population challenges facing Europe, helping to reduce redundancy in RDI efforts, ensure solutions are developed with a broader set of expertise, and help refine the efforts of diverse group of researchers.

SHELD-ON aims to foster knowledge exchange and the development of a joint research agenda in terms of design and development of multifunctional indoor environments to meet the requirements of Europe’s ageing population while promoting healthy and safe ageing.

<p>Areas of Expertise Relevant for the Action</p> <ul style="list-style-type: none"> ● Electrical engineering, electronic engineering, Information engineering: Sensors and sensor systems ● Health Sciences: Health services, health care research ● Mechanical engineering: Product design, ergonomics, mechanical engineering aspects of man-machine interfaces 	<p>Keywords</p> <ul style="list-style-type: none"> ● Furniture ● Elderly ● ICT ● Habitat ● Healthcare
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Specific Objectives

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

Research Coordination

- RCO1: To define and provide all relevant inputs for the design and development of Smart Support Furniture and habitats from different disciplines: Health care, Psychology, Ergonomics, Construction, etc., and from the users: elderly, caregivers, etc.
- RCO2: To design and create innovative ICT solutions that will be integrated into Smart Support Furniture and habitat environments.
- RCO3: To design, develop and test smart support furniture and habitat environments according to user’s needs and further validated by these users (elderly and caretakers) for an active ageing.
- RCO4: To ensure dissemination, evaluation and exploitation of the Action’s results together with establishing a strong network with the relevant industrial stakeholders.

Capacity Building

- CBO1: To promote the participation and involvement of European researchers, engineers and scholars, regardless of their age and gender, in networking activities aiming to develop multifunctional furniture and living spaces for the elderly. To promote and highlight the presence of participants from less research-intensive countries.
- CBO2: To foster International cooperation between researchers from COST member countries, COST Near Neighbour Countries (NNC) and International Partner countries (IPC), bringing together different disciplines to enable breakthrough scientific developments in the field of Active Assisted Living.
- CBO3: To create knowledge alliances between research, user's groups and industry entities to increase the impact of research in the industrial sector and favour the exploitation of new products for making new spaces and environments for an active ageing a reality.
- CBO4: To introduce and familiarize students and young researchers with implementing AAL (Ambient Assisted Living) in the furniture at higher education and vocational levels.
- CBO5: To ensure the correct integration, dissemination and exploitation of all knowledge and results from SHELD-ON among the research groups of interest, industry sectors, and users.

1) S&T EXCELLENCE

A) CHALLENGE

I) DESCRIPTION OF THE CHALLENGE (MAIN AIM)

By 2050, the number of people in the EU aged 65 and above is expected to grow by 70% and the number of people aged over 80, by 170%¹, which will increase demand and costs for healthcare. Integrating ICT solutions into habitats, along with improved building design, will allow us to live at home longer, as most prefer, despite cognitive or physical impediments. These solutions will provide immediate benefits, and will reduce the healthcare and financial pressures related to the growing elderly population in most European countries. Improving accessibility, functionality, and safety in homes in a way that allows the elderly to stay in their homes longer requires combining many disciplines together to develop solutions that integrate ICT, ergonomics, healthcare (psychological and physical), building and community design. To create healthier and safer environments for the elderly and meet the coming demands related to our ageing population, scientists, practitioners and industry members from a design and architecture, manufacturing, ICT, healthcare, as well as material scientists and others that contribute to healthy environments must come together in an organized and open system to share ideas and improve each other's work.

Industrial sectors are already working to meet these challenges. In 2009 the AAL (Ambient Assisted Living) market, already a growing sector that is adding jobs, generated \$154.9 million and it will have generated in 2015 €525.56 million². The furniture sector plays an incredibly important role as well. Not only is it a critical part of the European economy, it also can significantly improve the accessibility of the built environment for the elderly by improving its product offering with integrated ICT solutions, ergonomic design, and taking into account the health and safety needs of the elderly more completely. The European furniture sector is a key driver of sustainable growth with a significant contribution to Europe's overall economic health, competitiveness, creativity, innovation, employment and exports. In 2012, more than 900.000 European workers were employed in approximately 126.000 firms, and the sector's production amounted to more than €84 billion (25% of world furniture production) with an added value of nearly €30 billion³. However, these production figures are 13% lower than in 2007, while the Asian market has increased its production by 230% during the same period⁴. To remain competitive in Europe and globally, the European furniture sector must strive towards targeted Research Development and Innovation (RDI) goals. ICT integration and personalized and targeted manufacturing (e.g., solutions for the elderly, bespoke solutions) to meet users' needs remain a crucial point. Developments in these areas present an excellent opportunity to create interdisciplinary solutions that meet user needs. Combining expert knowledge from ICT, ergonomics, healthcare, design, materials science, and other fields will provide the solutions for the Europe's ageing population and beyond.

II) RELEVANCE AND TIMELINESS

SHELD-ON (Smart Habitat for the ELDerly) addresses Article 25 of the EU Charter of Fundamental Rights, which recognises and respects the rights of the elderly to lead a life of dignity and independence and to participate in social and cultural life. The EU Employment Equality Directive (2000/78/EC)⁵, besides prohibiting age discrimination in employment and occupation, encourages reducing the impact of physical and cognitive barriers at the workplace for staying active and productive for longer.

The European Commission has identified active and healthy ageing as a major societal challenge common to all European countries, and an area that presents considerable potential for Europe to lead the world in providing innovative responses to this challenge.

The relevance and timeliness of this proposal is can clearly be seen in the European Innovation Partnership on Active and Healthy ageing. This Action will provide the necessary critical mass of Europe-wide knowledge needed to achieve the future developments required to more fully support Europe ageing population. The networking, multi-disciplinary collaboration, exchange of knowledge, and scientific excellence, as well as the expertise of industrial members, will address societal, scientific and economic issues through open access dissemination and promotion that will:

Create an innovative, encouraging and engaging environment that will result new concepts and products for ageing well at home, in the community, and at work, thus increasing quality of life, autonomy, participation in social life, skills and employability of older adults.

Share knowledge among different disciplines that may not otherwise engage to promote future collaborations addressing indoor living space improvement.

Boost the transformation of the furniture and habitat sectors to competitive innovation- and knowledge-based industries that provide improved solutions for the elderly with the support of relevant sectors such as the healthcare and ICT.

Overcoming coming the challenges SHELD-ON addresses will support the recovery and enhance the sustainability of the economic sectors involved. All networking tools and activities in this initiative will facilitate progress and enable this novel and emerging subject to truly develop and achieve maximum effectiveness.

B) SPECIFIC OBJECTIVES

The main aim of SHELD-ON is to establish a multidisciplinary network to support the development of research and solutions that allow the elderly to live safely, comfortably, and healthily at home later in life. These solutions will be created by integrating design, ICT, ergonomics and health knowledge into furniture and building design. This includes encouraging active lifestyles by incorporating kinesiological solutions into furniture; making housing more accessible by adjusting building designs, interior furniture, and household items to provide benefits for users and occupants; adding ICT elements to all of these to simplify living, monitor health, provide feedback to occupants, simplify communication, and much more.

I) RESEARCH COORDINATION OBJECTIVES

The present COST Action will be a science and technology network where relevant actors from the academic, research and industry sectors will utilise networking tools and activities to address the ageing population challenges facing Europe. Bringing together a core group of scientists, practitioners, industry members and users representatives in this Action will help to reduce redundancy in RDI efforts, ensure solutions are developed with a broader set of expertise, and help refine the research efforts of diverse groups of researchers. To bring the

coordinated activities of the core group of researchers, the following Research Coordination Objectives (RCO) will be achieved:

- **RCO1:** To define and provide all relevant inputs for the design and development of Smart Support Furniture and habitats from different disciplines: Health care, Psychology, Ergonomics, Construction, etc., and from the users: elderly, caregivers, etc.
- **RCO2:** To design and create innovative ICT solutions that will be integrated into Smart Support Furniture and habitat environments.
- **RCO3:** To design, develop and test smart support furniture and habitat environments according to user's needs and further validated by these users (elderly and caretakers) for an active ageing.
- **RCO4:** To ensure dissemination, evaluation and exploitation of the Action's results together with establishing a strong network with the relevant industrial stakeholders.

II) CAPACITY-BUILDING OBJECTIVES

This COST Action aims to foster knowledge exchange and the development of a joint research agenda in terms of design and development of multifunctional indoor environments to meet the requirements Europe's ageing population while promoting healthy, sustainable, and safe living. To this end, the following Capacity-Building Objectives (CBO) are defined:

- **CBO1:** To promote the participation and involvement of European researchers, engineers and scholars, regardless of their age and gender, in networking activities aiming to develop multifunctional furniture and living spaces for the elderly. To promote and highlight the presence of participants from less research-intensive countries.
- **CBO2:** To foster International cooperation between researchers from COST member countries, COST Near Neighbour Countries (NNC) and International Partner countries (IPC), bringing together different disciplines to enable breakthrough scientific developments in the field of Active Assisted Living.
- **CBO3:** To create knowledge alliances between research, user's groups and industry entities to increase the impact of research in the industrial sector and favour the exploitation of new products for making new spaces and environments for an active ageing a reality.
- **CBO4:** To introduce and familiarize students and young researchers with implementing AAL in the furniture at higher education and vocational levels.
- **CBO5:** To ensure the correct integration, dissemination and exploitation of all knowledge and results from SHELD-ON among the research groups of interest, industry sectors, and users. The Action will target the most traditional industries such as the furniture and habitat as well as emerging ones, such as ICT and eHealth. Other stakeholders include interested organisations, actors, paying special attention to elderly and caretakers representatives, and agencies at the regional, national and international level. The Action will raise awareness at the EU level and beyond related to the results obtained in these from the cooperative and supportive work it fosters.

C) PROGRESS BEYOND THE STATE-OF-THE-ART AND INNOVATION POTENTIAL

I) DESCRIPTION OF THE STATE-OF-THE-ART

Home automation, along with telecare and telehealth services are considered part of the niche that comprises the Ambient Assisted Living market. Within this concept, smart and multifunctional furniture plays an important role to manage the promotion of health and well-being, the prevention and management of non-communicable diseases, physical and mental fragility and other impairments and serves to reduce the impact of physical and cognitive barriers that impair one's ability to remain active and productive in the workplace for longer.

Furniture and Habitat related industries, are continuously designing and developing multifunctional solutions for ageing well at home, in the community and at work, thus increasing the quality of life, autonomy, participation in social life, skills and employability of older adults. From simple mechanisms integrated into sofas and chairs that help users sit down and up⁶, to the most complex components, such as mattresses and sitting furniture pieces containing presence sensors⁷ or carpets/flooring able to detect falls⁸.

Most of the solutions already in the market are oriented for geriatrics and nursing homes to work as a non-intrusive monitoring system able to trigger an alarm when out-of-routine situations occur. Due to the complexity and costs of the vast majority of these systems, they are not feasible to be installed at private homes.

Some other initiatives have addressed the seamless integration of health monitoring into furniture, such as the VitalMob (meaning vital furniture) Project⁹, which investigated the viability of non-contact sensors for heart monitoring.

Studies carried out by the European Furniture Industry¹⁰ show that furniture producers find several problems at the design and development of furniture production, such as lack of skills and knowledge in electronics and domotics (i.e.: familiarity with the electrical legislation and CE marking requirements), integration of AAL in furniture and limitations associated with ageing from a psychological perspective. As part of its main objectives, **SHELD-ON will gather the necessary knowledge from all required disciplines** and will create inputs that can be easily understood and directly used by furniture designers. These inputs will empower **designers and will make their work much more efficient manner**, since it currently requires the collaboration among people of very different backgrounds and industries.

For the case of the workplace, some solutions and concepts¹¹ are already available on the market that may help workers stay active and productive. However, the number of solutions is very limited and few of them can be used to reduce the impact of physical and cognitive barriers of the elderly.

As a matter of fact, the AAL Programme in call 6 (2013)¹² was titled “ICT-based solutions for supporting occupation in life of older adults”. Most of the approved projects aim at developing passive ICT platforms for older worker to simplify the transmission of their knowledge to younger generations of co-workers, or to find new occupations as either work or volunteering. These initiatives do not really contribute to improving the work in a daily basis. Actually, only four projects are focusing on developing “active and intelligent” systems that help the older worker to work more efficiently and healthy. These systems monitor older workers through sensors, analyse their behaviour/context and suggests proper actions accordingly. These projects are STAY ACTIVE, Fit4Work, Active@Work and healthy@work, which all rely on mobile and/or wearable sensors in order to either detect fatigue/stress or prevent it through recommendations. COST will certainly contribute to the development and improvement of similar systems, which are the most useful for old workers to stay active, productive and healthy, but with the extra value of exploiting the non-intrusive nature of furniture for monitoring, instead the permanent use of wearable devices.

Other European-level initiatives supported by different programmes have been already established tackling the design and development of smart and multifunctional furniture for ageing-well. VETAAL and Mind the GAP have been identified as the most relevant in this topic. The VETAAL project¹³ brings together actors from the furniture sector, Vocational Education and Training (VET) providers, policy makers and health care experts to address the challenges of the vocational skill mismatch that the new demand of an AAL-integrated Habitat has produced. Mind the Gap¹⁴ is a European Strategic Cluster Partnership where even clusters along the value chain develop best practice examples for collaboration to provide intelligent solutions to support health and wellbeing for the elderly with focus on different disciplines,

furniture and Habitat among them. The activities they develop are market analysis, knowledge transfer projects and the development of new product solutions.

Both initiatives are oriented towards improving the furniture sectors offerings of solutions for ageing well by creating training curricula and fostering collaboration among industry partners. However, they aim to improve the training offer and evaluate market studies and analyse this market niche. **This COST Action will address research and scientific knowledge sharing among researchers and experts from different disciplines and nationalities to enable breakthrough scientific developments leading to new concepts and products, enabling EU citizens to lead healthy, active and independent lives while ageing.**

Regarding COST, several funded Actions have been identified addressing active ageing issues^{15,16,17}. The present COST Action will be complementary to these initiatives.

II) PROGRESS BEYOND THE STATE-OF-THE-ART

Demographic change has promoted the design and development of many products for ageing well at home, in the community, and at work, thus increasing the quality of life, autonomy, participation in social life, skills and employability of older adults. Significant progress for the elderly will stem from concepts and products providing services per their specific needs. Most solutions already on the market are considered as a complete object, typically based on isolated wearable and mobile sensors that do not interact with other products or services. On the other hand, **SHELD-ON will contribute to the development of novel products** that exploit the advantages of being **seamlessly integrated** into both homes and work, and that collaborate within **complete habitat systems** for **efficiently addressing all user's needs**. To achieve this goal, SHELD-ON will promote new approaches and developments in the ICT field for smart furniture and habitats by identifying and spreading the most suitable technologies available to:

- reduce the impact of physical and cognitive barriers,
- stay active and productive for longer,
- ensure active involvement in the community/society and guarantee access to services, and
- manage the promotion of health and well-being, including the prevention and management of non-communicable diseases and the management of physical and mental fragility and other impairments

Clearly, furniture and habitat designers are lacking the overall knowledge necessary to create these new products and systems, which fortunately this COST Action will bring to them. In order to achieve this, SHELD-ON will provide valuable insight on the actual activities of users and how to integrate these solutions into their lives simply. It will define their expectations and needs clearly, which will greatly help to identify design and performance issues at the earliest stage of design projects. It should be noted that the identification of psychological and physical needs of users at the design and validation phases plays an important role for developing sustainable solutions.

SHELD-ON will focus on progressing beyond the state of the art through the **development of a collaborative work methodology** among all disciplines required to achieve a significant forward move in the design and development of smart furniture and habitat-related products and services.

III) INNOVATION IN TACKLING THE CHALLENGE

The major innovation of the proposed COST Action lies in the creation of an initiative involving leading scientists from different fields together with industry partners to work on a common Technology Roadmap for research, design and development of smart furniture and habitats for a healthy and active ageing. Further innovative aspects are:

- The European scope including Inclusiveness Target Countries.
- The Interdisciplinary approach.
- The strong cooperation among academic and research entities and industry partners

D) ADDED VALUE OF NETWORKING

I) IN RELATION TO THE CHALLENGE

Research into solutions to improve elderly welfare and the products and services necessary to achieve produce them must place more emphasis on the needs of the users. Each discipline participating must engage with each other and with users to create relevant, applicable, and useable solutions (linked with objective RCO1). Traditionally, individual experts and research groups work separately and often on a project basis. This COST Action is a unique opportunity to bridge various disciplines (e.g., entrepreneurs, designers, ergonomists, ICT researchers, psychologists and healthcare specialists) and research topics to develop of breakthrough concepts and solutions for ageing well at home, in the community and at work (linked with objectives RCO2 and RCO3).

A holistic assessment of the current situation in Europe related to safe and healthy ageing does not yet exist. This is largely due to the fact that availability and access to data in different countries depends, on language skills, informal local knowledge, traditions, and connections to local stakeholders. Furthermore, the fact that the furniture and habitat industry in Europe is comprised of mostly small enterprises has left information on the topic fragmented or unknown. Having a network of experts from many countries and institutions improves information sharing and data acquisition in terms of quantity and quality as well as generates synergies among results obtained by initiatives at regional and national level (linked with objective CBO2).

Networking will yield the aims and objectives of this Action by: *Making* connections, facilitating collaboration and building enduring, mutually beneficial relationships between individuals, institutions and companies from different disciplines; *Creating* transnational, innovative interdisciplinary excellence to enhance the research and innovation performance of the sector; *Facilitating* collaboration between industry, SMEs, stakeholder associations, research organizations, leading-edge scientists from the wider range of disciplines and other relevant fields who will bring their broad expertise to this Action and enable the aims and objectives of this Action; *Scientific excellence* supporting interdisciplinary research and development underlying new innovative solutions and concepts for ageing well at home; *Training and development* for professionals as well as under- and post-graduate students in COST countries, COST Inclusiveness countries and COST Near Neighbouring countries (linked to objectives RCO4, CBO1 and CBO5).

SHELD-ON's activities will be enabled through Working Group meetings, International conferences, Short-Term Scientific Missions, Interaction with and visits to innovative companies, Training Schools for Early Career Investigators, International seminars, and Workshops.

II) IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

There is a very broad and rich body of knowledge and experience among participants of the proposed Action in several international programs (FP7, H2020, COST, Lifelong Learning, Erasmus+, etc.) and networks (European Strategic Cluster Partnerships, International Platforms, European Innovation Partnerships, etc.). This COST Action will enable synergies between research activities in on-going projects throughout Europe. Additionally, SHELD-ON will enable development of future joint projects among participants in this Action. The collaboration, exchange of knowledge, and practical experiences of industrial members will lead to scientific excellence in fundamental and applied research and consequently in

competitive projects that will contribute to the EU2020 Strategy. It will do so by strongly focusing proactive measures to tackle the future challenges posed by an ageing population and by prioritizing initiatives that will contribute to building a healthy and active population for the future. SHELD-ON will also find synergies among existing European initiatives, such as ongoing projects or collectives including those from the European Innovation Partnership on active and healthy ageing and even previous and future COST Actions focused on scientific and technical research in healthy and active ageing. Activities of the Network will also promote changes in the current regulations and standards for the geriatric furniture^{18,19,20}, providing suggesting not only from furniture manufacturers, but also from ICT experts and especially from the elderly and caretakers. The Action will also work closely with pan-European organizations to ensure maximum impact and complementarity.

2) IMPACT

A) EXPECTED IMPACT

I) SHORT-TERM AND LONG-TERM SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS

1.1.1. Short-term and long-term scientific, technological, and/or socioeconomic impacts

Table 1 shows the Short and Long-term impacts of the SHELD-ON Action at scientific, technological and socioeconomic levels:

	Short Term (4 Years)	Long Term (Beyond 4 years)
Scientific	<ul style="list-style-type: none"> -International availability of data, results and knowledge from regional and national research. -Relationship-building among researchers and industry from COST countries, COST Inclusiveness countries and COST Near Neighbouring countries, leading to a positive transformation of the involved sectors (furniture, ICT, etc.). -Novel techniques on how to automatically understand sensor data as meaningful user behaviour (i.e. context) and how this knowledge can be translated into useful actions. 	<ul style="list-style-type: none"> -Impact on the future development of involved sectors due to strong emphasis on Early Stage Researcher involvement and gender balance. -The networking and collaboration will result in new international and interdisciplinary project proposals. -Fuller and wider access to scientific publications and data provided by SHELD-ON will help to: <i>build on previous research results</i> (improved quality of results); <i>foster collaboration and avoid duplication of effort</i> (greater efficiency);
Technological	<ul style="list-style-type: none"> -New technologies and new approaches for those already existing for concepts and solutions for ageing well at home, in the community and at work. -Definition of accurate specifications for new technologies due to interdisciplinary cooperation. 	<ul style="list-style-type: none"> -Standardisation of Smart Furniture production, certification schemes. -Fuller and wider access to scientific publications and data provided by this Action will help to offer small and medium-sized enterprises (SMEs) access to the latest technology developments.

-Definition of the basis of new industrial value chains.

-Better provisions of product innovation from the furniture sector corresponding to the user's demand, jobs and income by increasing the competitiveness and innovativeness of the sectors involved in this new industrial value chain.

-Increase the efficiency of public funding by ensuring fewer redundant R&D projects.

-Foster the participation of Small and traditional industries in research and technological initiatives and the knowledge share among industry and scientific partners, increasing their innovation capacity and international networking and cooperation.

-Identification of the physical and psychological needs of the elderly for ageing well at home, in the community and at work.

-Knowledge improvement within furniture manufacturing industry in assistive technologies and their applications, with the potential creation of new products with new functionalities.

Contribution to the Europe 2020 strategy for a smart, sustainable and inclusive economy by fostering emerging sectors such as ICT and traditional sectors such as the furniture and related, representing both 3.2% of total employment in EU, and

-reducing people in or at risk of social exclusion

-Fuller and wider access to scientific publications and data provided by SHELD-ON will help to *accelerate innovation* (faster to market = faster growth); *involve citizens and society* (improved transparency of the scientific process) and enhance industries economic performance and improve their capacity to compete through knowledge.

Table 1: Short-term and long-term scientific, technological and socioeconomic impacts of the Action.

B) MEASURES TO MAXIMISE IMPACT

1) PLAN FOR INVOLVING THE MOST RELEVANT STAKEHOLDERS

This Action will involve as many relevant stakeholders as possible and these falls into two general groups (that often overlap, by design):

- **Active contributors:** Researchers in academic institutions and industry from COST countries, COST Inclusiveness countries and COST Near Neighbour Countries that participate in the Action.
- **Beneficiaries:** Practitioners, industry members (micro companies, SMEs, large companies, business associations) and the general public (especially the elderly and their caregivers), education institutions, scientists and industry members working in the field; professional organizations, ministries, policy makers and other government organizations, academics, public institutions, and communities.

More specifically, these stakeholders are:

- **The scientific community:** Action members, their colleagues, and networks. Networks from other COST Actions, research and education institutes, centres of excellence in the field.
- **Practitioners:** workers in health, medical and psychological fields, kinesiologists, ergonomists, caregivers to the elderly, and the relevant professional associations.
- **Industry:** Furniture producers, ICT professionals, electronics manufacturers, architects, designers, construction firms and their relevant professional associations.
- **Policy makers:** European, national, and regional policy makers involved in health, sustainability, social wellbeing, etc.
- **General public:** Members of the general public who are affected by the increased ageing population, the elderly, their families, friends, and any other interested parties.

- **International Organisations and Technology platforms** for widening the dissemination of the Action, such as the Forest-Based Platform²¹, through Innovawood²², integrating the furniture industry and which have already confirmed their support. During the development of the Action, some other Technology Platform will be addressed and asked for support, such as EPoSS²³, representing the ICT sector.

The Action will encourage industry members and practitioners to implement the findings of the Action in their businesses, while promoting awareness among potential users (the elderly and their relatives and caretakers) and their involvement along with the rest of the participants. Furthermore, feedback loops will be created and integrated into the process of developing solutions for the elderly. Engagement between potential users, industry members and practitioners will ensure user concerns and ideas are part of the design process. Members of the Action will also benefit from a feedback loop between themselves and the general public, so their research can focus on solutions users need, and they will gain feedback from industry members to ensure their research paths lead to implementable solutions.

Engagement will occur at workshops, over social media, and through personal contact between Action members and Stakeholders. The dissemination plan details use different activities to reach the appropriate stakeholders and gauge success of the outreach activities.

II) DISSEMINATION AND/OR EXPLOITATION PLAN

The Action's Dissemination Plan is intended to engage and bring the results to as many relevant stakeholders as possible including researchers, policy makers, practitioners, industry members, and the general public. Not only will the dissemination plan share information with these stakeholders, it will also address the involvement of participant, in particular elderly and their relatives and caretakers and will also attempt to promote cohesiveness and integration in discourse together through social media, workshops, and other useful tools determined by the Management Committee.

The Action's dissemination activities will be implemented by Working Group 5 (WG5, see section 3.1.1), but in many cases, will require input from the Management Committee (see section 3.2).

The main channels for dissemination will include personal outreach by Action members, social media use (especially: LinkedIn, Facebook and Twitter), traditional media (newspaper articles, professional journals, fliers, etc.), scientific journal articles based on research conducted by Action members and supported by the Action (e.g., STSM results), presentations at other conferences, and other channels deemed appropriate by the Management Committee, and WG5.

Outreach and dissemination targets have been set and are indicated in Table 2. All Action members will be encouraged to participate in dissemination activities, particularly social media activities. At conferences, on STSMs, at workshops and training schools participants will be asked to take photos, share them on their social media using appropriate "hashtags" for the event. Event organisers will also participate in this way, sharing their work and the work of participants. All Action members will be encouraged to notify the Action leadership with news of publications, dissemination activities, and other relevant information so it can be shared and amplified to further the impact of the Action activities and promote greater participation. Other channels, goal modifications, and activities may be added if approved by the Management Committee.

Activity	Sub activity	Indicator	Target Quantity
Social media	Facebook	Likes/Members	500
	Twitter	Followers/Retweets/ Favourites	300
	LinkedIn	Group Members	300
	Social media marketing campaigns	Number of the campaigns	4

Organized events	International conferences	Quantity and attendance	4 (70 attendees each)
	Training schools	Quantity and attendance	3 (20 attendees each)
	Workshops	Attendance	4 (15 attendees each)
Websites	Project site	Monthly visitors	100
		Monthly visitors increase	5% over previous month
Leaflets/Posters	For promotion at events	Quantity	3 posters; 3 leaflets
Newsletters	For promotion among academia and industry.	Quantity	5
Action reports	Yearly report		4
	Yearly evaluation	Quantity	4
	Final report		1
Articles/Papers	Book of abstracts		4
	Academic-peer reviewed journal articles	Quantity	20
	Newsprint, online journals		20
	Professional magazines		20
	Conference proceedings		20

Table 2: Dissemination channels, indicators, and targets.

In addition to these planned activities and outputs, the Management Committee may suggest and approve other activities or opportunities that arise. The changing landscape on the internet may also require adjusting the plan to include other services (for example, sharing data using a service like figshare²⁴.) Once identified, these opportunities will be discussed and put to a vote by the Management Committee. WG5 will then be responsible for their implementation.

C) POTENTIAL FOR INNOVATION VERSUS RISK LEVEL

I) POTENTIAL FOR SCIENTIFIC, TECHNOLOGICAL AND/OR SOCIOECONOMIC INNOVATION BREAKTHROUGHS

Innovation activities tend to be geographically concentrated in areas where knowledge has been transferred among different industrial, educational and training sectors, and is heavily influenced by regional culture. Scientific and technological innovation breakthroughs are rarely achieved in isolation, as competences and experiences are spread across different entities from academic institutions and industry and geographical borders. The international approach and the interdisciplinarity of this Action will boost both scientific and technological innovation breakthroughs in the participating countries that are and will be involved and in the fields that this Action addresses.

The major innovation lies in involving leading scientists from different fields along with industry partners to work on a common Technology Roadmap for research, design and development of smart furniture and habitats for a healthy and active ageing. Partners of this COST Action will perform analysis of current furniture, habitat and ICT solutions for the elderly and will deliver recommendation for future standards for assessing smart support furniture and habitat products for the elderly and labelling. This will support future developments for integrating expertise from seemingly divergent fields into these sectors.

Strong cooperation with industrial and policy partners, as well as the main challenge that SHELD-ON addresses, its relevance and timeliness (see sections 1.1.1 and 1.1.2) give this proposal a strong potential for significant socioeconomic innovation and breakthroughs.

3) IMPLEMENTATION

A) DESCRIPTION OF THE WORK PLAN

I) DESCRIPTION OF WORKING GROUPS

The proposed Action contains five Working Groups:



Image 1: SHELD-ON Pert Chart (3.1.3)

Each partner involved in this initiative will participate in the activities related to at least one Working Group from WG1, WG2 and/or WG3 according to their background, expertise and interests. Participants in each Working Group involving entities with different expertise, forming multidisciplinary groups of experts. These Working Groups are designed to remove the traditional barriers to integrated and systemic solutions addressed by this Action that target the industry as a whole. Obtained outputs from these WGs will feed WG4, a transdisciplinary Working Group leading to new concepts for ageing well.

WG5 will build up a knowledge base and will coordinate the dissemination and exploitation activities of this COST Action. WG5 operates in conjunction with the entire COST Action from the beginning until the end.

All Working Groups will run during the four years of this COST Action. Results needed for WG4 will be prepared by WG1, WG2, and WG3 and delivered at the end of the first year. During years 2nd, 3rd and 4th, WG1, WG2 and WG3 will continue their activities updating the state of the art and making progress beyond the networking. During the 1st year, participants in WG4 will build the inputs and information needed from WGs 1, 2 and 3.

WG1: Furniture and Habitat industry	
Associated Objectives (*)	RCO3, CBO2, CBO3.
Tasks	- Assess state of the art for disciplinary understanding, identification of advances in smart furniture and habitat, products, industries, success stories, etc. (Q1-Q4).
Activities	-2 WG1 Meetings at Q2 and Q4. -WG1 Research on the state of the art -Scientific conference at Q5
Deliverables	-WG1 Report on the state of the art Q5 (**). -Minutes of the WG meetings. -Report on the scientific conference for WG1, WG2 and WG3.
WG2: ICT developments	
Associated Objectives (*)	RCO2, CBO1, CBO2, CBO3.
Tasks	- Assess state of the art for disciplinary understanding, identification of advances in ICT developments with potential applications in the active and healthy ageing (Q1-Q4).
Activities	-2 WG2 Meetings at Q2 and Q4. -WG2 Research on the state of the art. -Scientific conference at Q5
Deliverables	-WG2 Report on the state of the art Q5 (**).

	<ul style="list-style-type: none"> -Minutes of the WG meetings. -Report on the scientific conference for WG1, WG2 and WG3.
WG3: Healthcare	
Associated Objectives (*) RCO1, CBO1, CBO2, CBO3.	
Tasks	- Assess state of the art for disciplinary understanding, identification of the elderly needs at physical and psychological level (Q1-Q4).
Activities	<ul style="list-style-type: none"> -2 WG3 Meetings at Q2 and Q4. -WG3 Research on the state of the art. -Scientific conference at Q5
Deliverables	<ul style="list-style-type: none"> -WG3 Report on the state of the art Q5 (**). -Minutes of the WG3 meetings. -Report on the scientific conference for WG1, WG2 and WG3.
WG4: Solutions for ageing well at home in the community and at work.	
Associated Objectives (*) RCO3, CBO1, CBO2, CBO3, CBO4.	
Tasks	<ul style="list-style-type: none"> -Interdisciplinary scientific, technological and socioeconomic exchange and analysis of the state of the art of the different areas. -Update and develop training content on implementing AAL solutions in the furniture sector. -Support the development of new concepts and solutions for ageing well at home, in the community and at work through network building, enhanced communication, and alignment of research work at institutions across Europe and beyond.
Activities	<ul style="list-style-type: none"> -4 WG4 meetings at Q5, Q9, Q13 and Q16 -3 training schools at Q8, Q13 and Q16. -Short-Term Scientific Missions, the number of STSM expected are 10, 15 and 20 during 2nd, 3rd and 4th year respectively. -Final Scientific Conference. "Pathways to Integrating AAL Innovations in the furniture Industry", presented by academics and industry members.
Deliverables	<ul style="list-style-type: none"> -Minutes of the WG4 meetings. -Reports on the training schools. -Reports on the STSMs. -Report on the scientific conference for WG4. -Training content available on the website. -White paper on policy implications.
WG5: Management, dissemination and exploitation	
Associated Objectives (*) RCO4, CBO5.	
Tasks	<ul style="list-style-type: none"> -Management, coordination and organisation of the Action (see section 3.2). -Coordination and support of all dissemination activities of the COST Action. -Identification of relevant stakeholders and potential participant to join the COST Action. -Identification of events, and specialized media for promoting the knowledge acquired. -Community management: Presence at social networks to increase social awareness. -Lobbying: Reaching policy makers, and EU and national program operators.
Activities	<ul style="list-style-type: none"> -First MC meeting and Kick off Meeting establishing coordination at Q1. -Yearly MC meetings at Q5, Q9 and Q13. -Set up and perform maintenance of a web platform for exchange and communication of WG results, website release at Q1. -Definition and update of a dissemination plan for managing dissemination and involve users. -Periodical Newsletters. -Scientific and non-scientific publications. -Organise STSMs, conferences, training schools, workshops, etc.

- Sustainability plan (identification of suitable programmes for funding activities coming from this Action).
- Scientific Reporting.
- Action monitoring and final assessment

Deliverables	<ul style="list-style-type: none"> -Minutes of the MC meeting. -Web platform -Dissemination plan -Newsletters every year and at the end of the Action. -SCI Articles/papers as a result of the networking -Conference contributions. -Progress reports
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(*) See sections 1.2.1, 1.2.2.

(**) These reports may be publications (book chapters, journal pubs, special issues, etc.)

MILESTONES		Date	Related WGs
MS1	Inputs for WG4	Q5	WG1, WG2, WG3
MS2	Results of the WG4	Q13	WG4
MS3	Book including the upgrade of data from WG4	Q16	WG4

Table 3: SHELD-ON Milestones.

II) GANTT DIAGRAM

	1st year				2nd year				3rd year				4th year			
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
WG1 Meetings																
WG1 Research on the SoA																
WG2 Meetings																
WG2 Research on the SoA																
WG3 Meetings																
WG3 Research on the SoA																
Scientific Conference on WGs 1, 2 and 3																
WG4 Meetings																
Training Schools																
Short Term Scientific Missions																
Final Scientific Conference																
MC Meetingg																
Dissemination																
Action Monitoring																

III) PERT CHART (OPTIONAL) (See image 1 at section 3.A.I)

IV) RISK AND CONTINGENCY PLANS

With respect to the Work Plan, Table 5 defines for each WG the main risk and provides an appropriate mitigation and contingency plan.

WG	Risk	Description	Mitigation Plan	Contingency plan
WG1 WG2 WG3	Medium	The overview provided in the WGs doesn't reflect the technical advances at European level as well as the social needs from the users: elderly, caregivers, etc.	Involve a high representation of EU countries, especially ITCs. Multidisciplinarity, involving EU platforms such as Innovawood paying special attention to entities of and for the elderly during the first stages (i.e. AGE Europe Platform).	After preparing WGs 1, 2, and 3 final reports in Q5, these will continue active updating state of the art and made progress beyond do the networking and acting in case any aspect research must be reinforced.
WG4	Low	Traditional standards for product validation will be replaced by new ones, what provokes resistance by different stakeholders.	Creating an open dialogue with key stakeholders on the added value of introducing new standards	Develop a comparison of current and new standards for material testing by key experts in the WG.

WG4	Medium	Low acceptance of the Users (elderly, caregivers, etc.), stakeholders from furniture.	Mitigation: have users and industry representatives in the action.	Focus on feasibility of WG4
WG4	High	Reserved perception of industry might exist against new collaboration with research entities and implementation of the results.	Involvement of industry representatives at national and EU level (Innovawood) for boosting the implementation of these practises. Identification of new industry members and stakeholders.	Reinforcing dissemination at industry level. Contact with EU representatives from the furniture and habitat sector (i.e.: UEA ²⁶ , EFIC ²⁷).
WG4	High	Technical challenges for ITC developments like transmission through obstacles and signal interference from other electronic household appliances delay the development process.	Involvement of research and industry entities with experience in this field, using results from WG1 and WG2 as basis.	Refine description of challenges and possibilities to overcome them. Redefine objectives and further work on these topics.
WG4	High	General challenges like environment heterogeneity, user diversity, subsystem heterogeneity, rapid developments in users' needs and user acceptance delay the development process ²⁸ .	Awareness of these challenges during the whole process. Involvement of research and industry entities experienced in this field, using results from WGs1, 2 and 3 (user acceptance) as basis.	Refine description of challenges and possibilities to overcome them. Redefine objectives to preparation of further work on these topics.
WG5	Medium	Challenges due to scarce knowledge of English language at smaller companies.	Members of this COST Action will communicate with many nations in mother tongue.	Involvement of native speakers in communication process.
WG5	Medium	Low acceptance of the older generation (users and producers) to social media.	Open discussion with important knowledge bearers.	Increase distribution by printed media.
WG5	Medium	Any conflict arising among partners/ No proper dissemination of STSM results	Every STSM, the core group will request a short paper for professional journal, scientific congress, industrial event, etc.	Management of the conflict through the Management Committee and all partners to find a consensual solution looking for the Action's sake.
WG5	Medium	WG leaders are not able to lead the WGs for the 4 years		Vice leader with take over the leadership, while additional person will be appointed as vice leader.
WG5	Medium	No proper dissemination of STSM results	Every STSM, the core group will request a short paper for professional journal, scientific congress, industrial event, etc.	

B) MANAGEMENT STRUCTURES AND PROCEDURES

The management structure and the management activities respect COST Policies. The structure covers a Management Committee (MC), a Core group (CG), and 5 Working Groups (WGs) described in section 3.1.1:

- The MC will elect the Action Chair (AC) and a Vice-Chair (VC), who will lead the MC. The MC is responsible for the coordination, implementation and management of the Action activities and for supervising the appropriate allocation and use of the grant with a view to achieving the Action's objectives. The MC will install (1) a Board, which is responsible for the integration of new Action Participants (especially from Inclusiveness Target Countries, Near Neighbour Countries and International Partner Countries & International Organisations), relationship and interaction with other research frameworks, (2) a STSM-Coordinator, who will promote and coordinate STMS activities and who will be part of the

Board, and (3) an appointee for inclusiveness, who will develop a strategy and will monitor the implementation for fulfilling the inclusiveness criteria according to COST Policy.

- A Core Group (CG) within the MC will be installed consisting of the AC and VC and the WG Leaders and Vice-Leaders and the STSM-Coordinator. The CG will support the AC in carrying out duties and exchanges information about the activities in individual WGs.
- Each WG will be coordinated by a WG Leader and a Vice-Leader (VL). The WGs responsible for developing the scientific activities in line with the Action strategy (defined by the MC) to achieve the Action's objectives. Each WG Leader and VL will be approved by the MC and will report to the MC. Inclusiveness criteria will play an important role in allocating tasks and work. The WGs will engage in mutual exchange, especially WG4 with WG1, WG2 and WG3, and WG5 with the remaining WGs. Each WG will implement and contribute to the networking tools.
- To manage various phases of the COST Action, a web-platform will be created and used in conjunction with the e-COST system. The web platform will be used for scheduling, communication and dissemination. e-COST will be used for Action management, voting, reporting, STSM management and other aspects. Modern communication tools (e.g. video conferences) will be used to increase communication beyond the meetings, when possible. This COST Action expects ethical behaviour and fairness from all participants. The MC will encourage participants to report delinquencies of any kind (e.g., in gender issues) to the appointee for inclusiveness, who guarantees confidence in managing the case.

C) NETWORK AS A WHOLE

To achieve the Action's objectives, the Network of Proposers comprises an interdisciplinary and intersectoral pool of experts who (a) have been personally invited to join the network, (b) declared a strong interest in the topic, (c) contributed to the Technical Annex, and (d) guarantee an optimal starting position for implementing the COST Action (e.g. critical mass, expertise and geographical distribution). The Network of Proposers has the following features:

- **Critical mass**, achieved for the Network because it covers Proposers (1) across all relevant disciplines including users representatives, (2) with active involvement in both national and international research initiatives/implementation strategies, and (3) who are well connected with relevant stakeholders at national and international level (i.e., National technology platforms and International, such as Innovawood). This guarantees an excellent starting position and the involvement of relevant stakeholders beyond this Network ensuring an optimal dissemination.
- **Expertise**: Proposers are well-known and recognised experts from basic and applied research institutions/groups and representatives of the industry sector (SMEs, Technical Research Centres, especially representatives from the furniture and habitat sector and healthcare solutions). All the Proposers are active on different institutional levels, but all of them deal with the Action subject matter: Solutions for ageing well at home, in the community and at work.
- **Geographical distribution**: The Network of Proposers has 25 experts (17 of them, early career investigators) representing 22 entities from 17 different countries, 16 are COST Countries of which 7 are COST Inclusiveness Target Countries (ITCs). The COST Action will include additional ITCs and NNGs to create the following mutual benefits: first, to gain more information about the state of the art on the different disciplines that SHELD-ON covers on a national or plant level; second, to consider more stakeholders for dissemination and exploitation; third, for knowledge and technology transfer between countries with large differences in economic power.

REFERENCES

- ¹ ec.europa.eu/health-eu/my_health/elderly/index_en.htm
- ² Assisted living in Europe technology and market trends 2010, <http://www.slideshare.net/FrostandSullivan/assisted-living-in-europe-technology-andmarket-trends-2010?qid=000ca65d-bf63-4d33-9486->
- ³ Eurostat SBS Eurostat, (sbs_na_ind_r2).
- ⁴ CSIL processing data from official sources: Eurostat, UN, National Statistical Offices, National Furniture manufacturers associations.
- ⁵ <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32000L0078&qid=1398413786803>
- ⁶ Donald L. Bottemiller, Arthur A. Apissomian, US 5286046A, Geriatric chair.
- ⁷ <http://reco-raco.thomasnet.com/category/bed-chair-occupancy-sensors>
- ⁸ <http://www.manchester.ac.uk/discover/news/article/?id=8648>
- ⁹ <http://proyectovitalmob.blogspot.com/es/>
- ¹⁰ VETAAL project: Analysis of the questionnaires to determine the skills, knowledge and competence needs of the furniture production for the elderly and disabled people.
- ¹¹ <http://darma.co/>
- ¹² <http://www.aal-europe.eu/our-projects/call-6/>
- ¹³ Lifelong Learning Programme, www.vetaal.eu.
- ¹⁴ www.clustercollaboration.eu/mind-the-gap
- ¹⁵ COST Action 219 bis, Access for elderly and disabled people to the information society (1997-2001).
- ¹⁶ COST Action 334, Accessibility of heavy rail systems to elderly and disabled people (1995-1999).
- ¹⁷ COST Action A5, Ageing and technology (1990-1994).
- ¹⁸ Council Directive 93/42/EEC of 14 June 1993 concerning medical devices.
- ¹⁹ EN 60601-2-52:2010 Medical electrical equipment -- Part 2-52: Particular requirements for basic safety and essential performance of medical beds (Endorsed by AENOR in April of 2011.)
- ²⁰ EN 12182:2012 Assistive products for persons with disability - General requirements and test methods
- ²¹ www.forestplatform.org
- ²² www.innovawood.com
- ²³ The European Technology Platform on Smart Systems Integration, <http://www.smart-systems-integration.org/>
- ²⁴ <http://www.figshare.com>
- ²⁶ The European Furniture Manufacturers, www.ueanet.com/
- ²⁷ European Furniture Industries Confederation, www.efic.eu
- ²⁸ Labonnote, N.; Høyland, K., Smart home technologies that support independent living: challenges and opportunities for the building industry – a systematic mapping study, Intelligent Buildings International, 2015.