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Integrating Cooperative Design and Innovative Technology to Create Assistive Products for Older Adults

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With a focus on increasing quality of life and independence for older adults, the MATUROLIFE project aims to utilise smart textiles in the development of desirable assistive products (specifically footwear, clothing and furniture). The project integrates designers, with researchers and technologists from a range of disciplines in a multidisciplinary team to facilitate design-driven innovation. This paper will outline the approach taken to building empathy and understanding with the wants, needs and requirements of the older adult population in Europe and thus bring a human-centric focus to the MATUROLIFE project. Collaboration with end-users and stakeholders as well as between partners during the co-creation process is central to the ongoing research and development approach.

Keywords: assistive technology; smart textiles; co-design; co-creation; independence; multidisciplinary design

1 Introduction

The '**M**et**a**llisation of **T**extiles to make **Ur**ban living for **Ol**der people more **I**ndependent and **F**ashionable' (MATUROLIFE) project is a unique multidisciplinary project funded by the European Commission involving 20 partners from 9 countries. It integrates material science together with creative and artistic design to produce innovative products that aim to revolutionise assistive technology (AT) for older adults.

Urban areas are seeing an increasing population of older adults and existing approaches to care for them are becoming unsustainable, creating a European-wide societal challenge (Wait & Harding, 2006). As a result, there is an increasing need for products that assist people in maintaining their health, well-being and independence. The World Health Organization (WHO) highlights assistive technology as an umbrella term covering the products, systems and services that maintain or improve an individual's functioning and independence, thereby promoting their health and well-being (WHO, 2018). However, such technologies are developed without in-depth consideration of the design, and can be unsightly and stigmatise the user (Yusif, Soar, & Hafeez-Baig, 2016). Typically, the user is not part of the end-to-end design process, and as a result, the outcome does not provide a meaningful, valuable service, thus resulting in high abandonment rates. In contrast,

MATUROLIFE was initiated to provide an opportunity to increase quality of life through assistive products that are enhanced with smart technology and appeal to the end-user – thus bringing scientific innovation together with design (Moody, York, Ozkan, & Cobley, 2019).

2 Design Approach and Development Process

The MATUROLIFE project has involved three approaches to embed the needs of older adults in the innovation process. A qualitative research strategy utilising interviews was first adopted to gather participants convergent and divergent views, interests and propositions (Ritchie, Lewis, Nicholls, & Ormston, 2014). A co-design approach has then been employed to ensure the AT solutions are not only designed for older adults, but also most importantly with them. Ongoing development from concepts through to functioning prototypes has then been achieved through a multidisciplinary approach. This has guided the integration process as we bring together the creative design work with technical development activities, as well as the utilisation of innovative metalized textiles. A design management approach has been adopted to address the resulting complexity and facilitate collaboration between different partners, countries and disciplines through development process.

2.1 Design research

The early design research explored the health and independence needs of European older adults. A literature and product review were used to narrow the project focus and gain an understanding of existing knowledge in relation to the needs, wants and preferences and factors affecting independence. Semi-structured interviews were then undertaken with 37 older adults from France, Italy, Poland, Spain, Turkey, and United Kingdom. The questions explored real life experiences and views, building insights into attitudes, behaviours and preferences. The interviews explored what participants felt most threatened their independence, where they most needed support, as well as their current use of products and technology (Callari, Moody, Magee, & Yang, 2019). The findings led to the generation of tools for use by the design team including personas, a list of requirements, experience highlights and some guiding design principles for the project.

2.2 Co-design

As an exploratory process of “joint inquiry and imagination” where “problem and solution co-evolve” (Steen, 2013), co-design allows a design team to combine knowledge and insights from end users and professionals (Trischler, Pervan, Kelly, & Scott, 2018). The approach involves designers and people not trained in design work working together in the design and development process (E. B.-N. Sanders & Stappers, 2008; Venkat & Ozcan, 2018). Here co-design was used to bring together and integrate views and ideas from participants and project partners with varying expertise through a series of workshops (an exemplar workshop is shown in Figure 1).

Figure 1. Co-creation workshop

Ten co-creation workshops were conducted in nine countries (Spain, Italy, Belgium, UK, France, Slovenia, Poland, Turkey and Germany) as illustrated in Figure 2. In total, 94 older adults were involved. During the workshops, the participants worked alongside designers, manufacturers and researchers from the project consortium to create new ideas responding to the insights and functional requirements from the design. The process enabled the development of design concepts to address their needs and prioirties and fit with their life experience.

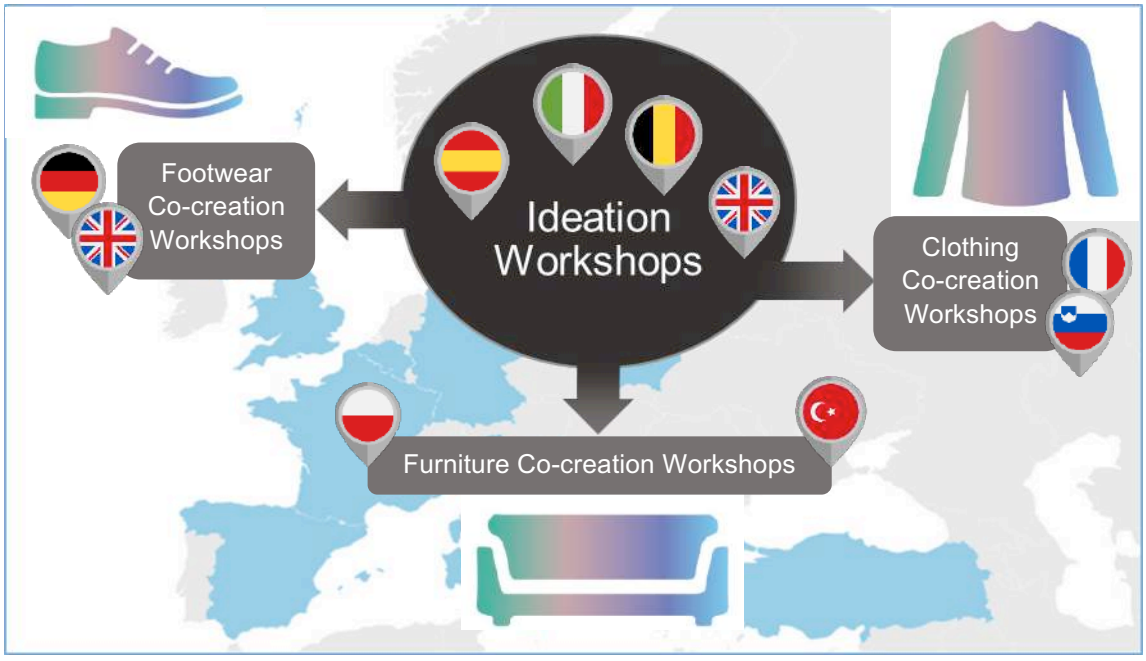

Figure 2. 10 Co-Creation Workshops in 9 Countries

In designing the co-creation workshops it was understood that people contribute at different levels depending on their level of expertise, creativity and also based on their character (Venkat & Ozcan, 2018). In order to make it easier for participants to contribute and express themselves, various design tools and conversation canvasses were created to provide a framework for participant creativity and encourage collaborative exploration and dialogue (B. E. Sanders, Brandt, & Binder, 2010). With workshops taking place in nine countries in nine different languages, these tools were also valuable in ensuring ease and consistency in the

facilitation of the workshops, as well as in capturing the workshop content and translation and analysis of the workshop outputs. A number of tools were utilized including product idea canvases, journey mapping, concept critiques and prioritisation activities (Blomkvist & Segelstro¨m, 2015).

As shown in Figure 2, the first phase of ideation workshops in four countries (Spain, Italy, Belgium and UK) were facilitated to scope initial requirements and develop a design brief. The design team then translated the design brief into a series of early product concepts. These were focused on product areas that embedded selectively metallised textiles in their design to allow utilisation of the emerging smart textiles. Assistive footwear, clothing and furniture concepts were considered. These were then further developed and iterated during the following six focused workshops, with the aim then being to prioritise the functionalities and styles that users wanted to see incorporated into the final products. Examples of the output generated in the workshops are shown below - footwear design in Figure 3a and 3b, clothing design in Figure 4a and 4b, and furniture design in Figure 5a and 5b. Concepts were presented in 'sketch' form to communicate work in progress and encourage comment and intervention from participants (Raijmakers, Thompson, & Garde-Perik, 2012).

Figure 3a. Participants critique and evaluation of the smart footwear concepts generated by designers

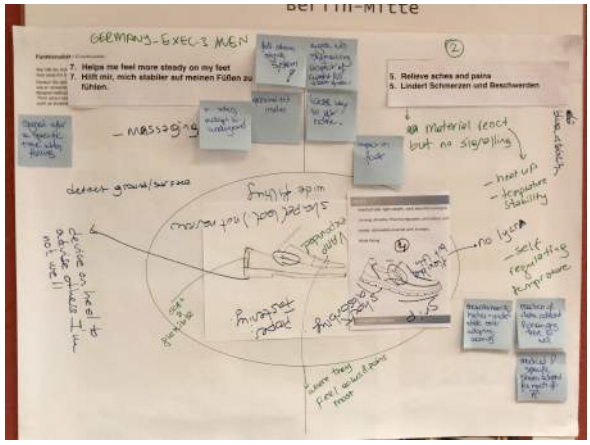

Figure 3b. Group modifications in Germany in collaboration with the designer

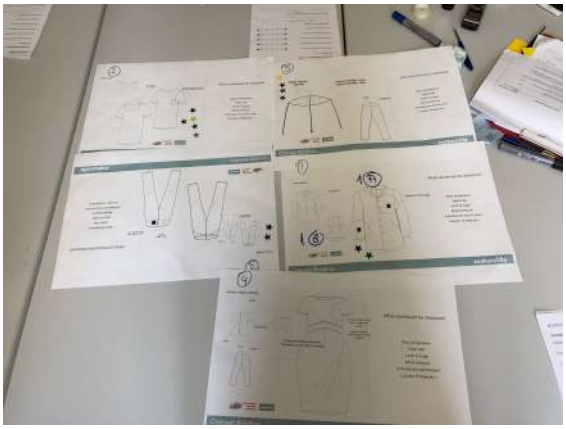

Figure 4a. Clothing design development of Men's T-shirts, trousers and long jacket in France

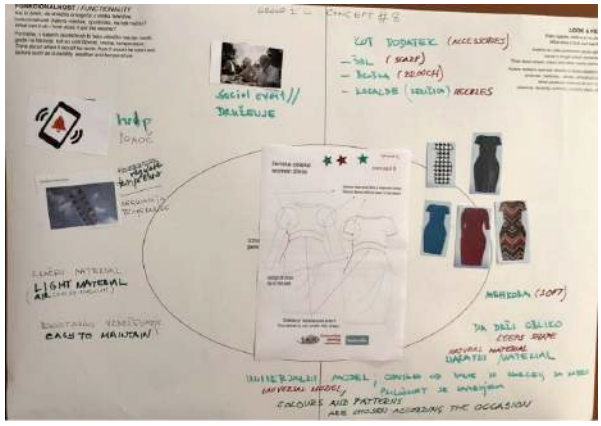

Figure 4b. Design development of a smart dress concept in Slovenian workshop

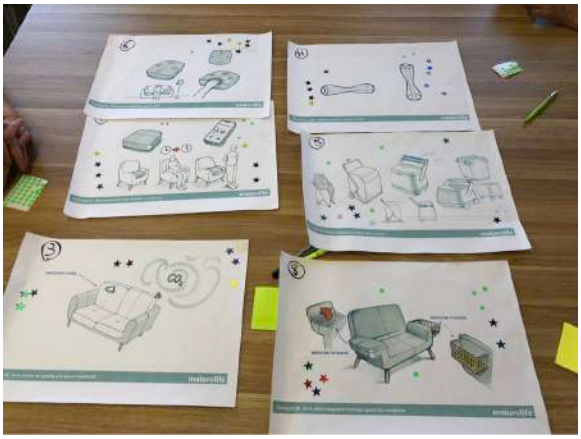

Figure 5a. Participants voted on their preferred six concepts using stars

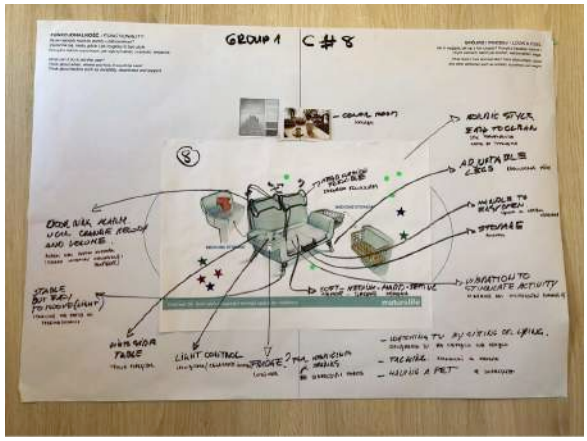

Figure 5b. Design development of a smart sofa concept at the co-creation workshop in Poland

2.3 Multidisciplinary design approach

Following the co-creation workshops, the design partners who had taken part further developed the generated ideas for footwear, clothing and furniture. They refined the designs embedding the style preferences discussed and exploring further the technology that might be embedded to enable the proposed assistive functions. The design and development activities for each of the three prototypes was then facilitated and reviewed through a series of meetings and workshops. These workshops enabled an in-depth focus on the products and creation of a working culture and language around the product narrative.

During the multidisciplinary team workshops three sub-teams were formed to support the ongoing development activity and enable the production of functional prototypes. These were focused on the design of footwear, clothing and furniture, and included expertise from across the consortium representing design, materials, manufacturing, electronics, data and connectivity. The interaction between the teams and the interrelation of activities are illustrated in Figure 6. The teams were led at this stage by partners representing a specific area of design expertise i.e. footwear manufacturers, clothing designers, and furniture design.

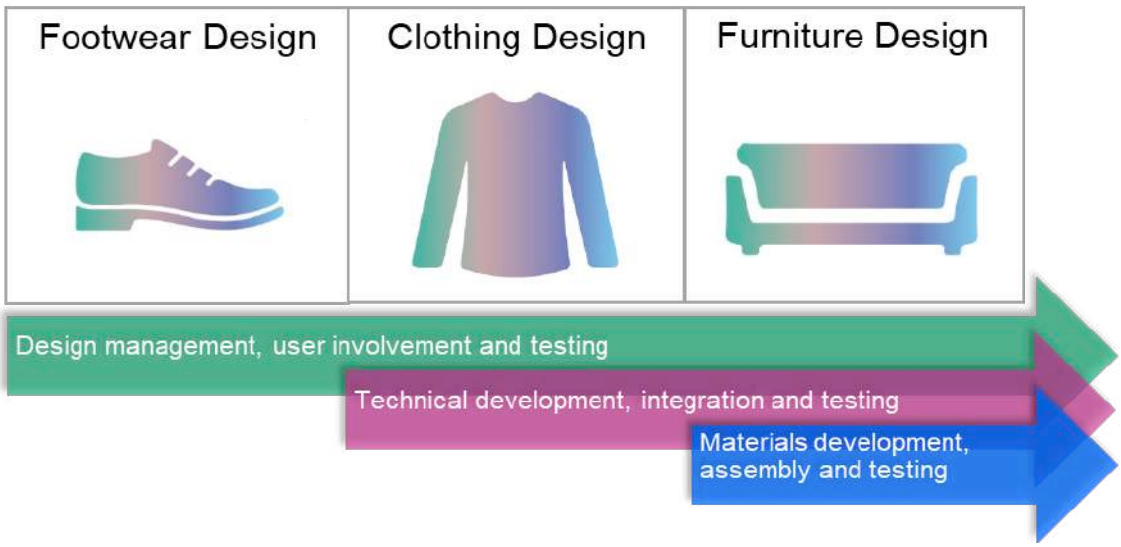

Figure 6. Multidisciplinary Teams with Concept Development Activities

During the session, the developing designs were reviewed against a set of criteria including the extent to which the concepts incorporated a metallised textile, mapped to identify user needs, technical feasibility, manufacturing difficulty and commercial viability. Iterative development by the teams occurred between each workshop. A significant element of the process was collaborative development of service design maps and detailed user journeys to map interactions with the proposed products. This was an important activity to align partners and develop a shared understanding of the project scope and directions.

2.4 MATUROLIFE Concept Prototypes

Ongoing development of the prototypes continues through multidisciplinary team working. The emerging prototypes address the following needs:

1. Assistive footwear to improve balance and reduce falls
2. Assistive clothing to help regulate temperature and encourage hydration
3. Assistive furniture to support safety at home and enable improved sleep and mobility

From traditional data collection to creative co-creation, low resolution and workshop-based concepts are being developed alongside use of 2D-illustration, 3D modelling and rapid-prototyping to help participants' ideas come to life with initial functionality and aesthetics, interaction design and control systems.

The electronic design and sensing technology, including the development and integration of big data platform will be further developed in the functional prototypes, whilst the overall aesthetics will continue to be developed through iterative design and testing activities. Local user groups have been established to ensure user feedback is embedded throughout the development phase to maximise user acceptance and usability.

3 Conclusion

This paper has outlined the focus and development approach employed in the MATUROLIFE project. Our focus is on assistive technology and smart materials, and how these can be harnessed for a better quality of life and independence for older adults. The concepts that emerged through the co-creation activity demonstrated a desire for attractive products discretely embedding assistive functionality and vital signs monitoring for a sense of safety, security and independence in older age.

A multidisciplinary design approach is crucial to successfully integrate the elements of the emerging prototypes and to fully utilise the skills and methodology from a wide range of disciplinary experts. The approach is bringing together electronics, sensors, informatics, material science and care into a collaborative effort with artistic designers to produce smart and assistive footwear, clothing and furniture.

How we deliver the envisaged assistive products to meet user expectations without compromise of design aesthetics or technological ability is a key challenge. Sustained multidisciplinary work and iterative user involvement, as well as partner collaboration is key to achieving optimal solutions.

The project is now 18 months into the 3-year timeframe. The remaining months will involve prototype production, integration of smart textiles and a thorough testing and validation schedule. Continuing the user-focused development approach, iterative testing will ensure the involvement of older adults with the aim of producing assistive technology that is

functional, meets the needs and requirements of the end user whilst being aesthetically pleasing, desirable and fashionable.

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with a focus on innovative and enabling technologies to add functionality and value to materials.

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