

# Improving the experience and mobility of the Elderly at the Beach from a Product Design approach

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**Abstract.** The beach is a popular place for the elderly to relax, socialise and engage. Nevertheless, there are physical and social barriers that jeopardise access and mobility. Most existing solutions are unsuitable for elderly users. From an inclusive design perspective, the condition of reduced mobility and disability is common to other users. However, few studies analyse how the elderly relate to beaches and how design may improve active ageing in beaches. This study aims to explore the experience of the elderly user in the beach environment and create solutions to improve the user-environment-product relationship. Inclusive design made it possible to enhance the mobility and experience of the elderly at the beach by designing a solution centred on their real needs and expectations, while at the same time adapting to the beach landscape and other users. An innovative product that differs from existing responses was achieved.

**Keywords:** Product design, Inclusive design, Ageing, Beach accessibility, Mobility aids

## 1 Introduction

Portugal is a country with a wide coastline and is known for its 440 beaches with a blue flag [1], 37% of which are covered by mobility aid services for people with disabilities [2], which is considered a good example internationally [3], but insufficient to promote the use of beaches by elderly users with more severe limitations. Portugal is also, in Europe, the country with the second highest percentage of elderly people [4], which poses challenges regarding beach accessibility and the experience of the elderly at the beach from an active ageing perspective.

The concept of accessibility aims to create conditions so that everyone, regardless of their abilities, can participate fully in society and enjoy all services. This means that public and leisure spaces, such as beaches, must not only fulfil minimum requirements but must also be redeveloped with long-term, durable solutions [5]. However, studies carried out with beach users are infrequent [3, 6].

There is a 6.1 per cent prevalence of mobility disability in Portugal, especially among older people [7]. This is a temporary or permanent condition that also affects individuals in other age groups to a greater or lesser degree. On the other hand, limitations in mobility make it more difficult for older people to interact with beaches, not only because they require more complex motor skills [8], but also because of external obstacles and the circumstances of the beach space and surrounding areas [6].

Although mobility on beaches can be improved by using external aids that enhance the experience and eliminate social exclusion [5], the design process approach for people with mobility disabilities, has been limited to wheelchair users, resulting in solutions that are far from being adapted to the real needs and habits of the various older users.

Thus, designing for older people from an active ageing perspective aims to reverse this logic and optimise opportunities for health, safety and active participation in social, economic, cultural, spiritual and civic dimensions [6, 9]. Older people are increasingly required to participate more actively in society in current times [10] and the benefits and contributions of social and recreational activities on personal well-being, sense of worth and identity are evident in older ages [11].

In the context of ageing societies, design can be an instrument for 'eliminating barriers and compensating for loss of capacity' [9], namely through products capable of assisting, improving, enabling or restoring functional capacities of people with disabilities, or reducing the consequences of disability in the ageing process [12].

Design solutions inherently carry ideas of inclusion or exclusion, potentially affecting individuals or specific social groups. As a result, we can refer to certain artefacts as 'inclusive' or 'exclusive.' Universal or inclusive design seeks to reduce exclusion by ensuring that products and environments are usable by as many people as possible, and as often as possible [13].

From this perspective, the design process must encompass the needs of all individuals and must be aware of individual differences so that it can determine who the design project can and cannot accommodate [14-15]. To get to know the elderly user, it is necessary to understand their complexity and their multiplicity of needs, to explore their experience of the environment of the public beach space [6], and their relationship with the products that might improve it. To this end, Benktzon's model [16] identifies a hierarchy of user disability levels, from the most common users with the greatest capacity, to the lowest number of those with severe disabilities. This model helps designers to define appropriate solutions between each extreme group, without harming the average users, and balancing aspects of the project for each of the groups [17].

According to the principles of inclusive design, Czaja et al. [15] state that ‘good design for the elderly will be good design for everyone’ and, in this sense, responding to the problems of the elderly is to address issues of the rest of the population. What becomes easier for elderly in complex motor ability situations will inevitably become more comfortable for those who don't directly need it, but who end up benefiting from the solution [5]. In this perspective, “understanding how people relate to the landscape based on environmental perception and site histories” [18] is an insightful way of enriching the knowledge towards equity in the use of beaches.

It should also be noted that product-user relationships are valued for the emotion and experience provided [19]. Understanding the object, the relationship between parts, the materials and the way it is used and perceived through behaviours, sensations and emotions, defines the symbolic value and connotations attributed to it, the learnability and ease of use [20-21].

For the elderly, the use of aids may be the only external indicator of a disability. Not accepting the condition or not wanting to raise prejudice and stereotypes, by revealing a condition of disability, can lead to the refusal to use these products [17]. The appropriation by the user, the cultural context, the appearance of the product and the way it is marketed, all have an impact on how a product is received. To avoid and circumvent stigma, some authors propose making the aid products something common and conventional, to become socially accepted. Moreover, it is the designer's role to make products not only useful, but to foster user confidence and to promote health and well-being at all levels [17, 20], and to promote an understanding of the relationships with the landscape in a holistic perspective [18].

So, this paper explores the research question: How can Product and Service Design contribute to improving the elderly user's experience at the beach? It is based on a design research project developed in 2024 with the goal to improve the mobility and experience of the elderly at the beach, by designing a solution centred on the users' comprehensive needs.

## 2 Methodology

The design research project was divided into three phases: exploratory, generative and evaluative.

To understand the elderly and their user experience at the beach, the exploratory phase began with ethnographic observations at beaches, followed by the application of the card sorting method and questionnaires to caregivers. The aim was to establish proximity with users, understanding personal lifestyles, mobility and beach experiences, and gain a global perspective of the beach environment. This stage resulted in a user journey of the elderly on the beach establishing the foundations for the development of the project.

The ethnographic observation was carried out at Conceição beach in Cascais, in an exploratory way, using written descriptions and small sketches. The observation took place when several elderly people were on the beach on different

days and at different times, lasting 1 to 3 hours, for two weeks. Data was gathered on the habits in terms of what the elderly did, how and where, and what kind of aid equipment they used at the beach.

To better understand the journey of the elderly going to the beach and their preference for existing products, Card Sorting interviews were conducted with 25 elderly users from 3 institutions on the Cascais coastline (day centres and senior spaces) that encourage active ageing activities among their users. This sample included elderly people who frequent the beach and elderly people who don't, with different levels of motor ability. The 25 participants ranged in age from 60 to 90, (median of 80 years old) with the majority (36%) in the 80 to 84 age group.

The Card Sorting had three stages. The first focussed on understanding the individual experience by showing a map with questions relating to each stage of going and staying at the beach i.e. motivation, travelling, access, staying and going to the sea, and all the activities during the stay at the beach; and a set of cards with options, with which the elderly user was able to create their own user journey, identifying difficulties, needs, fears, desires and feelings during the experience of going to and staying at the beach.

In the second stage, participants were asked to organise different attributes (comfort, safety, ease of use, and intention of use) related to function, appearance, the relationship with the user of aid products in general, by order of preference and value. The products were chosen to reflect users' experiences of accessing the beach and performing activities in the sand and sea. Wheelchairs, walking aids and scooters were selected to evaluate the experience of accessing the beach and walking on the sand. Floats, buoys and amphibious chairs were selected to evaluate the experience of being in the sea.

Finally, they were asked to associate specific products, currently in use by beach concessionaires, with the same categories, while commenting and evaluating each product in relation to personal needs, expectations and experience at the beach.

The online questionnaire was administered to caregivers to understand their perspectives on the autonomy of the elderly, focused on the beach environment. The questionnaire aimed to compare the caregivers' perceptions of older adults' needs and expectations with those previously identified by older participants through the card-sorting exercise. It included questions addressing perceived interest (e.g., "Based on your experience with elderly people, what percentage would like to go to the beach?") and perceived barriers (e.g., "What are the most common obstacles for an elderly person going to the beach?"). Additionally, the questionnaire explored the relationship between caregivers and the elderly in terms of mobility support in the beach (e.g., "Which products would you choose to assist an elderly person at the beach?") using the same set of products presented during the card-sorting activity with the elderly.

The generative phase began with a competitive analysis in which products and services were analysed to assess strengths, weaknesses and technological aspects of adapting to the beach environment and innovative solutions for the elderly.

Then, product-service concepts were generated for the product to be developed, based on the findings of the user research into the user, the functions

required, needs and aspects understood to be crucial. The hypotheses were then refined and from this, scale models and digital simulations of the solutions were developed. In the process of developing the product, it was necessary to use ergonomic analyses to ensure correct sizing from an interaction perspective.

Finally, the evaluation phase aimed to validate and evaluate the concept through a panel of experts. Thus, new attributes were discussed and introduced in the development and evaluation of the product as well as in its possible implementation.

The sessions were divided into three stages: presentation of the project and its development; qualitative evaluation of certain dimensions of the product, using the Portuguese version of the System Usability Scale (SUS) [22]; free discussion to comment on the project.

The panel of experts integrated professionals from various fields and was divided into two separate sessions. The first session aimed to understand the relationship between the product and the different users at all stages of use, assessing anthropometric and formal suitability and correspondence to the needs and problems investigated. Experts in rehabilitation, ageing and ergonomics were included in this session: two ergonomists, one from Lisbon City Council in the Pedestrian Accessibility Plan division, and two architects from the National Institute for Rehabilitation. The results of this session were based on expert perceptions regarding the implementation of solutions in public beach spaces in Portugal. The second session involved two product design experts who assessed the development of the design project, both in its creative formulation, the materialisation of the product and its engagement with the beach landscape.

All stages of the project respected the ethical principles and all methods involving the participation of people were preceded by an informed consent form, signed by the participants. Everyone took part on a voluntary basis. All the results presented were grouped or blind ensuring the anonymity of participants.

### **3. Design project and research findings**

In this chapter, the design project is presented as well as the research results, according to the three phases of the study.

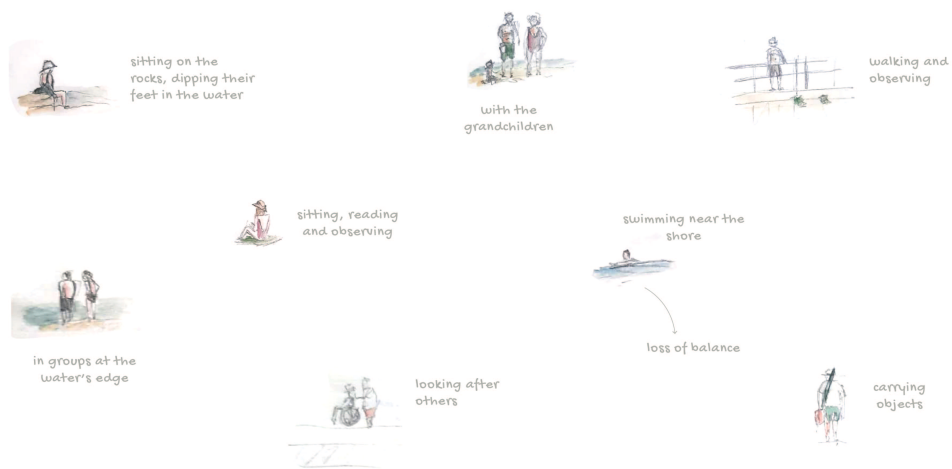
#### **3.1 Exploratory Phase**

Ethnographic observation on the beaches revealed an aspect that proved to be central and unblocking in the development of the project, namely the realisation of a common habit among elderly: when there is a huge area of rocks on the beach, this is an area preferentially chosen and used by the elderly to sit, lean and linger.

In the observation made and confirmed by other images taken of other beaches, groups of elderly people stay near and, on the rocks, using them to put their belongings and towels. Because it's higher up, they use the rocks as a seat, since it's more difficult at this age to lower oneself to sit on the ground. The elderly

organise themselves in groups or on their own, taking advantage of the proximity to the sea and the weaker waves to put their legs in the water, either sitting or standing with support, or just sunbathing (Fig. 1.).

Some of the aspects found during the observation were confirmed by the card sorting participants, particularly in relation to the use of the amphibious chair, such as the reluctance or difficulty of using this product, the difficulty and fear of walking on the sand without falling and the fear of being in the sea without being carried away by the tide.



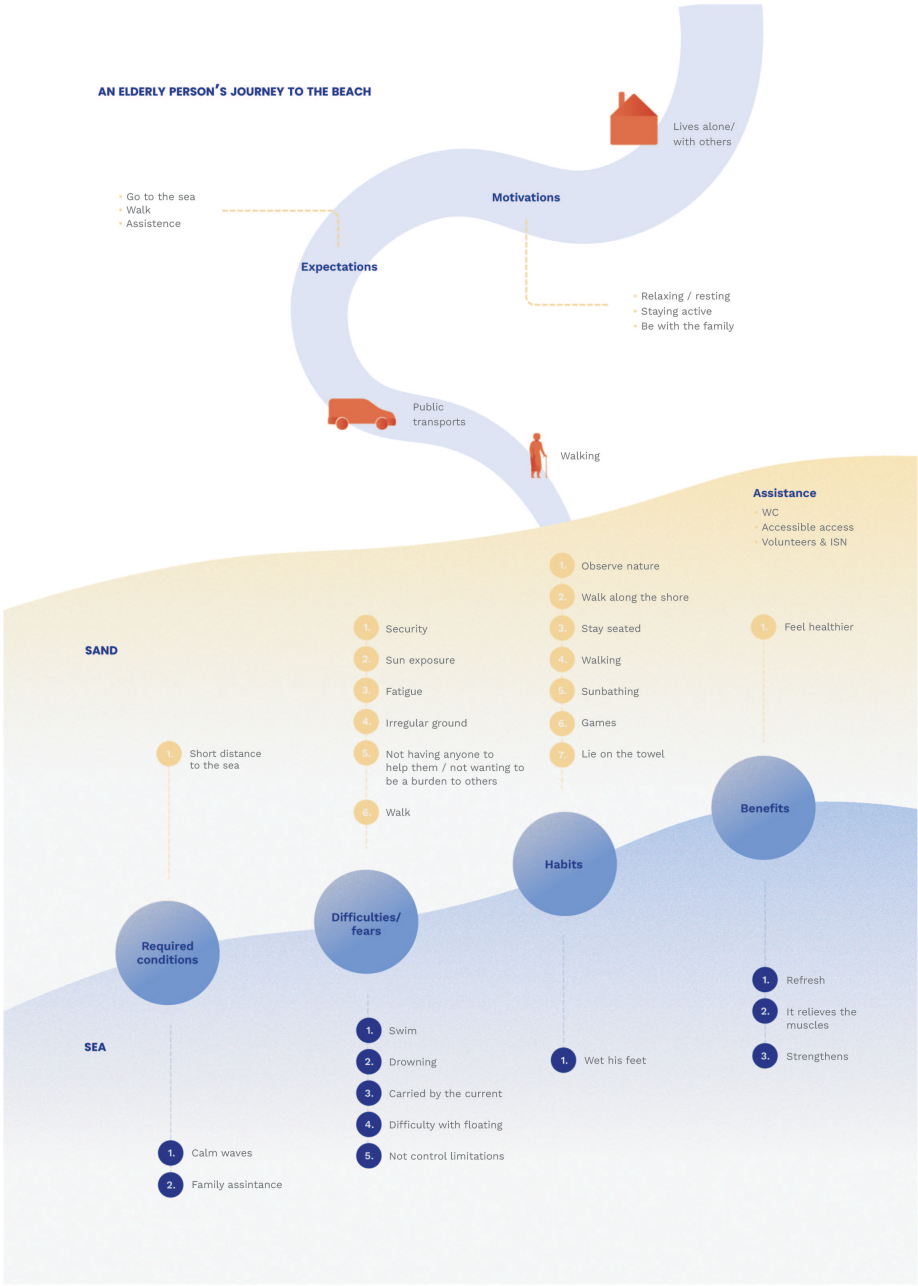
**Fig. 1.** Observations and field sketches.

The results of the card sorting were used to formulate the user journey (Fig. 2.), which synthesises the difficulties, motivations, preferences, habits and needs of an elderly person during their beach experience.

Participant 5 remarked: 'My doctor told me that I had the best physiotherapy on the beach, walking on the wet sand'.

It is worth highlighting some aspects of the experience of these elderly: for many, their family, especially their grandchildren, are their encouragement to carry out certain activities, as they are the ones who make it easier for them to do some tasks in a more comfortable way and without feeling diminished or inhibited, i.e. without stigmatisation. They also say they feel the same when the activity is carried out in a group with the institutions or with other elderly.

Through the User Journey map, different profiles of potential elderly users were created, according to the degree of autonomy, motivation and expectations at the beach (Table 1).



**Fig. 2.** Elderly user journey of going and staying at the beach.

**Table 1.** Users' profiles.

| User type                      | Level of disability                                                                                                              | Motivation and expectations                                                                                            |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Institutionalised              | Occasionally goes to the beach accompanied.<br>With autonomous mobility or with occasional assistance.                           | Wants to walk on the beach with assistance and be by the sea.<br>Needs support when walking.                           |
| With mobility limitations      | Moves around in a wheelchair and walk short distances with support                                                               | Would like to experience the beach, don't always want to go to the sea, dream of overcoming some barriers.             |
| Autonomous                     | Condition with fewer limitations to activity and few physical impediments.<br>Moves independently or with occasional assistance. | Likes going to the beach and wants to enjoy walking on the beach and swimming in the sea, but is afraid of falling in. |
| Informal Carers/Family Members | Autonomous, often with advanced age or conditions that make it difficult to help the elderly and add physical effort.            | Want a support service that makes it easier and less strenuous to use and provides an incentive for an active life.    |

Despite the categorisation, these users vary in their ability or desire to be at the beach, regardless of their physical condition, mobility and autonomy. However, creating these profiles made it possible to focus the project on concrete objectives.

Regarding the preference for aid products, it was realised that few older people have tried assistive equipment on beaches. Of the products shown, the two mostly chosen were a float divider used in the sea to delimit areas and create a barrier (72%), and platforms placed on the sand to make walking easier (40%). A third of respondents also chose a floating walker, which involves the person walking in the water (36%), the rolling chair that takes the person into the water (36%), a floating belt (28%) and an inflatable chair for the water (28%).

These floating aids were selected for the increased safety they offer in the sea. These elderly felt that without these aids, they wouldn't go into the sea at all. However, even with the support of any of these products, they feel safer with the help of a person at their side. It was also pointed out that most of these floating aids do not completely satisfy the elderly because they do not offer enough stability to ensure that they are not carried away by the force of the sea and because many of them provide support at the level of the upper limbs, which requires the elderly to make an effort that they may not be able to fulfil due to the loss of strength characteristic of the ageing process.

In their relationship with the object, they feel more able to use products such as straps and floating support waistcoats, compared to amphibious chairs, because they are more discreet. Referring to amphibious chairs, one of the interviewees said: 'Something I can use autonomously causes me less stress. That is an apparatus!' (Participant 4). In other words, reducing stigma is an important feature.

When it comes to helping people get around on the sand, preference is given to products that allow you to walk upright, with the help of someone safe so you don't fall, and that provide greater autonomy rather than sitting in a chair. Users' preference is for platforms placed on the sand (40%), the rolling chair (36%), and a walker suitable for the sand (32%). Particularly with these products, the importance of the social dimension and a user-product-environment broader relationship was realised. The elderly showed concern about the perception of others when they use a product that reveals disability, restrictions or is associated with ageing, for example, a wheelchair or walker: 'I am not going out in a wheelchair' (Participant 8). They prefer products that are less disruptive, easier and more discreet, and that can fit into the environment. However, when products are used collectively, they are better accepted: 'With friends for partying and if everyone used it. I would go straight away' (Participant 6).

The comparison of the results of the card sorting with the results of the questionnaire to carers and therapists revealed a perception on their part that many users don't want to go to the beach, which is contrary to the users' perception. The choice of assistive products by the carers is also contrary to the preference previously expressed by the elderly. The carers selected products as the most suitable, which in the description of the elderly are those that expose their frailties, namely the amphibious chair. The carer's choice of these products could be explained by the fact that they reduce the physical effort involved in helping the elderly, but do not represent the expectation of the users.

### 3.2 Generative Phase

The first method of the generative phase was a competitive analysis of design solutions tackling similar issues (Table 2). The search revealed that the design process approach for people with mobility disabilities has been mainly focused on wheelchair users. Therefore, the selection the products and projects to analyze was based on how these innovate in the different ways they approach the problem. The competitive analysis included: An architectural structure on the beach that simulates the shape of sand [23]; A chair with a treadmill that moves to the water (SEATRAC) [24]; The walking stick Stand of Kong [25]; A mobility scooter for the elderly that can be used as a shopping trolley (The Scooter for life) [26]; A wheelchair with walker integration (EPICURSUS by Kao) [27]; A bicycle for transporting the elderly on outings (TRISHAW) [28]; The OMEO body-movement wheelchair [29]. Some focus on the problem of integration into the landscape by playing with the visibility/invisibility, using materials that adapt or camouflage the product to the beach environment so that it becomes socially acceptable. Others focus on corresponding with the elderly needs without excluding other users. Common to the majority, is the goal of empowering and promoting user autonomy, even if it is presented as a disguised aid. The products allow the task to be carried out entirely by the user's actions without deviating from the regular format of how they carry out usual tasks, sometimes adding an attractive dimension of novelty and fun to the use of the product.

**Table 2.** Analysis of products and projects addressing similar issues.

| Products                                                                                               | Suitability for elderly* | Suitability within the beach environment** |
|--------------------------------------------------------------------------------------------------------|--------------------------|--------------------------------------------|
| An architectural structure on the beach that simulates the shape of sand [22];                         |                          | 1, 2, 3, 4                                 |
| A chair with a treadmill that moves to the water (SEATRAC) [23];                                       | 1                        | 3                                          |
| The walking stick Stand of Kong [24];                                                                  | 1, 2, 3, 5, 6, 7, 8      |                                            |
| A mobility scooter for the elderly that can be used as a shopping trolley (The Scooter for life) [25]; | 1, 2, 3, 5, 6, 7, 8, 9   | 1                                          |
| A wheelchair with walker integration (EPICURSUS by Kao) [26];                                          | 1, 3, 6, 7, 8            |                                            |
| A bicycle for transporting the elderly on outings (TRISHAW) [27];                                      | 2, 4, 5, 6, 7, 8         |                                            |
| The OMEO body-movement wheelchair [28].                                                                | 1, 2, 5, 6, 7            | 1                                          |

**\*Suitability for elderly:** 1. Promotes increased autonomy and capacity. 2. Introduces a new status and dissociates itself from the usual stigma. Usable by anyone. 3. Based on regular habits of the elderly. 4. Allows collective use. 5. Has a non-hospital aesthetic. 6. Provides comfort and ease of use. 7. Safe. 8. Encourages active aging. 9. Combines multiple functions.

**\*\*Suitability within the beach environment:** 1. Unnoticed in the environment and the way it's used. 2. Adapts to the sea (materials and technologies). 3. Adapts to the sand (materials and technologies). 4. Does not interfere with the natural landscape. 5. Helps the user throughout the entire beach journey.

The results of the analysis concluded that innovation is seen as dissociating aid stigma from the actual suitability of the solution for the elderly user. Moreover, from an active ageing perspective [9, 12], the analysis highlighted a methodological gap in design processes, and the need to address body and motor activity that continues to include extreme users but also widens the scope to include a variety of elderly people's experience.

To generate the design concepts, the forms of use and different attributes were defined by interweaving the insights of the competitive analysis with the identified needs of the elderly and their experience of the public beach space in the exploratory stage. In this view, the following indispensable attributes of the project were defined: Adapt the project to autonomous elderly, as a starting point; Do not exclude the carer and create a personal service that is close to the user; Allow people to get around on foot; Harmonize with the beach environment and not disruptive (being able to make use of common situations and regular habits); Safe and demarcate the area; Encourage autonomy; Reduce the effort of carers; Reduce the obstacle of going to the beach; Be flexible to the tides and sand. Most

of these attributes are also justified in the literature review, i.e. a project for older adults that aims to promote autonomy must balance not only the differences between groups, and their levels of capacity, it must also include the presence of a carer, who is another important user [14, 15, 16]; it must mitigate ageism, that links elderly with disability [17], it must consider engage in 'context dialogue' [18], for the specificities of the beach landscape and experience are of crucial influence and importance to the design process decisions and solutions.

After settling on the project's mission and values, decisions about possible design concepts were made between designing a product for individual or group use; being something that the user picks up at the start of the beach or bought in the shop. The dynamics of interaction between the sea and the sand were also considered, based on the type of support and function that could fulfil the suitability of the two scenarios in terms of materials and shapes. Other possibilities would be to develop a fixed product with a greater structure, or a removable one, which could be a single structure, or something organised into modules and products organised into a product system. Similarly, in terms of maintenance, one could think of a permanently fixed or removable system.

The final concept was based on the beach landscape and the experience of elderly users on the rock area of beaches; thus, a rock-like shape was explored to create a modular path with different integrated functions and attributes.

### 3.3 Product Design Development

The final project (Fig. 3.) consists of a modular walkway and seating modules combined with support handrails. The route is built from the start of the beach sand to the sea. Modularity makes the product system adaptable to the distance of sand on each beach. The activity area around it is signposted with floating tapes. At the same time, modularity allows for the replacement of single parts when damaged, so that the system is easy to repair and maintain.



**Fig. 3.** Modules system, pavement and handrails.

The modules are made from polypropylene, which has thermoplastic characteristics and can be UV-treated, and produced by the roto-moulding process.

The seating modules (Fig. 4.), after being filled with sand inside, are fixed with spikes. They have a filling cap and a pouring cap to make them easier to place and store, and have perforations attached to the base through which accumulated water can drain. The pavement is fixed the same way as the modules. The handrails are always on the same side to create a passageway for the elderly person who wants to get to the sea with handholds.



**Fig. 4.** Seating modules integration.

When designing the product, it was considered the movement of people standing or in wheelchairs, considering the 5th and 95th percentiles of height and width, with the aim of accommodating a higher percentage of users. The maximum reach distance between the different handles of the route relative to the 5th percentile was also considered. The height of the handrails was defined according to the position relative to the elderly person's hand, providing a neutral posture and minimal trunk flexion or deviation to the side when supporting the arm. The size and shape of the handrail was defined to allow gripping with a closed hand. Intuition of use is provided by the arrangement of objects and the colours. The height of the seats would have to consider the force needed to change posture from sitting to standing on the sand or in the water. Therefore, the height initially defined for the seats (45 and 35 cm) based on a perspective of continuity between the sand and the module, proved to be too low. This dimension must be adjusted by testing with prototypes.

The layout of the seats allows other people to pass between the modules and safeguards enough distance for a wheelchair to stand to the side of the seat. The

seats' shape has been structured so that they remain in contact with the sea, prevent them from sinking, and ensure safety for those moving around the object.

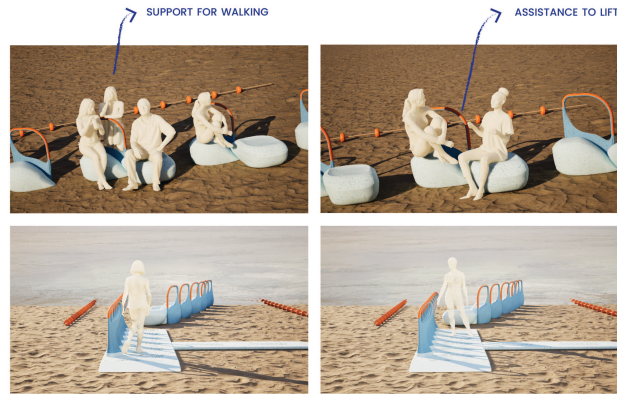
In addition to the non-slip material, the use of the colour orange in the areas of contact with the handles serves to signal the accessible area on the beach.

The route and combination of modules has been designed to suit different functions for each user, and to adapt to changing tides (Fig. 5.). For this reason, the difference between small modules with handrails and large modules lies in the need for parts of the product to always be in contact with the water, even being submerged at high tide, and others that will only be used for sitting and getting your feet wet and will be out of the water at low tide. Thus, the combination of smaller and larger modules is only realised in the area that will always be visible and out of the water. An area where there is a permanent sea, which varies according to the tide, has been considered, making use of the smaller modules, where the handrail will serve to increase safety and support floating, like the edges of a swimming pool where the elderly can hold on.



**Fig. 5.** Adaptation to the tides.

The combination of the modules makes it possible to sit in different positions, or to stand with the support of the upper limbs, to sit in a non-formal format, such as sitting on sand or rocks, in different ways, with the feet resting on the module or on the sand (Fig. 6.). The layout of the handrail also provides support for getting up from the seat, which can be difficult for elderly people. Many of them, even take a chair to the beach, and this would also reduce the number of objects to be carried to the beach by the elderly.



**Fig. 6.** Perspectives for user' interactions.

The product system aims at different user integrations (Fig. 7.). In the first instance, it serves the autonomous elderly user. They can travel the entire route, either alone or in a group. Another user, who is less physically able, will be able to get from a wheelchair to at least the first seat. The spaced-out shape created by the arrangement of the seating modules allows the wheelchair or amphibious chair user to move to the first seat or to remain in the chair to the side of the seat. These modules can support carers, family, or friends, forming a convivial area where the user fits into the environment and is included. Additionally, some wheelchair users may walk short distances to the seats or to the sea with assistance, thanks to the modular configuration.



**Fig. 7.** Functions for different users.

The project's concept allows all beach users to use it, prioritising those with greater difficulty but showing flexibility and versatility. The space created is integrated into the beach environment and promotes interactions between families, carers, and elderly or groups of elderly. It can also be a space for socialising and using the beach in a way that suits the situation. It allows the groups to carry out the same activities they practice using a format that is already an empirical experience, the rock areas, and introduces a discreet aid that remains part of the routine. From previous research, the elderly socialise and go to the beach with their families and grandchildren, a source of motivation. Consequently, this space allows them to carry out this practice with their grandchildren, and to carry out simple activities as sitting, chatting, a socializing.

### 3.3 Evaluation Phase

As an overall result of the discussion, the product was something that the user would like to use frequently, easy to use and easy to learn. The panel concluded that an assessment of comfort and safety could only be made based on field tests with a prototype.

However, there are possibilities for improving the product, mentioned during the discussion with the experts:

- The route presented makes no provision for rest and shade areas, and the organisation of the modules does not allow for a free route, which could be facilitated by modifying and simplifying the pavement modules.
- The structure of the route could provide for variability in the side of support for those who walk upright and have greater upper limb strength on one side only.
- The pavement system would have to be restructured to withstand the variability of the slope and provide for less frequent maintenance, while also allowing for the best passage for sand without jeopardising walking.
- The simplification of the shape and production method, as well as the materials chosen, would have to be tested to better adapt the product to the abrasion resistance caused by the sea and UV degradation.
- Better-integrated modularity would also allow for new functions and personalised adaptation to each beach and environmental situation.
- Simplifying the seat modules to just the largest shape, i.e. having just one repeatable seat module, because it is stable, would allow this combination and reduce production costs by using just one mould.

The discussion validated various options presented in the project:

- It is a solution that is designed for a wider range of people who have other reduced mobility conditions, even if they are temporary. The project has found a niche in the market, where there are few well-developed products, and those that do exist are not national.
- Inspiration from the area of the rocks is an innovative point in the project, recognising that this habit recurs in the elderly but goes unnoticed.

- Both groups of experts considered the project suitable for river beaches, where the variables of large tides and sea waves are removed, where there is no great change in the volume of water and sand and where, due to the nature of the soil (earth), people prefer a place to sit.
- The project could also be used for quieter beaches, bays and areas with little waves, which are also the places most chosen by the elderly. It could be proposed to use only the seating modules on this type of beach and the walkway structure on beaches that allow it.
- It is part of the routine, giving the user autonomy, while helping them and recognising that they have limitations.

One specialist remarked: 'Older people aren't playing ball on the beach. Most older people aren't super worried about whether they're getting the right tan, or whether they're doing this or that. They're not clutching their mobile phones. They want to see. They want to be. They want to socialise. Are sitting and watching. It's an activity, even though it doesn't look like an activity, it's an activity for these people! I think this will fulfil a need.'

## 4. Discussion

In this chapter, the process and the project are analysed globally based on the research question: How can Product and Service Design contribute to improving the elderly user's experience at the beach?

Due to temporal limitations of the research, it was not possible to carry out prototype tests, which would have been relevant to support and probably iterate on design decisions, in terms of concept, production technologies, materials and ergonomics, in the transition to implementation. Likewise, a larger number of participants in the research phase, especially in the card sorting and the survey, would have provided richer information.

Based on what was accomplished, the design research project was structured around three guiding pillars: the user, the context and the purpose. These three axes defined the innovative aspects of the design project. On the one hand, to match the elderly user, with the aim of improving accessibility and mobility on the beaches. On the other hand, to provide conditions for active ageing, by focusing on the experience of well-being and designing from inclusive principles that promote quality of life and autonomy for the elderly.

The main aim was to respond to the characteristics, needs and expectations of the elderly users, using research methods that allowed to get to know them and deepen their perspective and attend to individual and contextual differences [14-15]. Starting by characterising different users based on the beach experience of the elderly made it possible to understand different levels of ability and observe differences in interaction with the context [3, 6]. This process proved to be the best way of thinking about a user-centred product, finding the principle of flexibility of use, and engaging with the beach landscape. It was thus shown that universality and equity find their fulfilment in dissimilar suitability, which leads design action to the individuality of each user in interaction with the specificities

of place. This idea is supported by Lee and Moore [14] who argue that a product does not need to be something special, but better for everyone, and Parker [18] who highlights the importance of listening and corresponding to landscape as a complex web of dynamic relations and experiences.

The second axis, the beach context, introduced into the project aspects of variability typical of this environment, such as the daily changeability and unpredictability of the difference in tides and atmospheric conditions, which is dynamic even between moments of the day. The most effective way of putting into practice the adaptability and flexibility essential to the user-context relation was resolved in this research by means of modularity. The diverse product-user relationship, as mentioned by Grieg et al. [17], finds its solution in the integration of a system of corresponding products and not in separate, individualised products for each type of user. In addition, the modularity of the solution's implementation in the context has made it possible to create a project that can be adapted to different beaches, varying the number and type of modules depending on the size of the available beach space and the different depths at the sea entrance. These features make it possible to overcome the obstacle of limited use by a more restricted type of user with disabilities [3] and to promote the socialisation of these elderly users on the beaches [30], an essential value for the dignity of older users with mobility limitations.

Inspiration in natural forms, respect for natural space and visibility were also three topics that were shown by the research to be key to fostering the user-context relationship [17] and expected to promote an immersive experience [18].

On the third axis, it expects to reduce the stigma that the elderly and other people associate with old-age assistance products at the beach, and to balance design decisions between aesthetics, function and suitability, bringing the sensory relationship and emotional experience of the elderly as central factors in the fulfilment of the project's purpose [6, 18, 20].

## 5. Conclusions

The integration of Inclusive Design and Product and Service Design principles made possible to better correspond with the elderly by designing a solution centred on their real needs and expectations, while at the same time adapting the solution to the beach landscape and other users. From this perspective, the research enabled the development of an innovative product that differs from existing solutions by addressing a methodological gap in mobility-oriented design. The study broadens the scope of users' needs and lived experiences considered in the design process, and integrating diverse perspectives that are often overlooked.

In Portugal, there is only one project dedicated to this cause, developed by INR [2] which is considered a good practice [3], however insufficient to guarantee good accessibility to beaches for all users. It is therefore extremely important to continue this work to generate more and better accessible public services.

This new concept contributes to the mobility and experience of the elderly on the beach, moving along the sand, staying on the beach and entering the sea, while

also allowing access for all other users. It makes it possible to increase the range of experiences older people have on beaches, reducing stigma, promoting active ageing and creating a solution that harmonises with the beach landscape. The concept contributes to overcoming the lack of integrated solutions on Portuguese beaches from a perspective of inclusive design for all.

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