From "Liquid Kitchen" to "Shared Kitchen": Human-Centred Design for Innovative Services of Social Inclusion in Food Consumption

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Abstract The world population is progressively ageing with some clear social implications. People will live longer and also the family structure will change. The emerging socio-cultural trends are opening up great opportunities for innovation in the sphere of contemporary living. The need for a greater mobility and the nomadism now demanded by work, influence people's lifestyles and consumption models. As regards to the home, flexibility, adaptability and versatility are the emerging characteristics, and these factors also affect the kitchen environment. In parallel to this, urban space experiences of participation and sharing are multiplying, and new social practices are spreading. These aspects are also connected to the way people prepare and consume food. The *Kitchen 4.0* research project can be placed within this macro-context. It aims to define a design-orienting scenario which affects the way of preparing and consuming food through the definition of a kitchen-sharing service.

Keywords Design · Human-centred design · Design for inclusion · Sharing economy

1 Introduction

The current transformations in socio-cultural trends, lifestyles and needs generated by the emergence of new user profiles and modes of habitation are opening up new visions and opportunities for innovation in the sphere of contemporary living. More specifically, it is a fact that the European urban population is increasingly multicultural and is progressively ageing [1]. Also, the world's population aged 60 years or over will double from about 11–22 % between 2000 and 2050; from 900 million in 2015–1400 million by 2030 and 2100 million by 2050. Europe will have about 34 % of its population aged 60 years or over by 2050 highlighting that 'the old

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continent' will have the oldest population [2]. People will live longer and the ageing population will have some clear social implications [3]. Also the family structure will change. As people live longer and have fewer children, family structures are transformed with important implications in terms of providing care for older people [4]. For this reason population ageing cannot be considered as a process that concerns only the elderly but involves people of all ages [5].

It is also known that as people age they become more susceptible to disease and disability. The prevention of the risk factors such as injury, poverty, social isolation and exclusion, can reduce the burden of ill health among older people [6].

In this framework large Europe with the 'Europe 2020 Strategy' for a smart, sustainable and inclusive Europe by 2020, has expressed 'inclusive growth' as one of the main priorities. This means fostering a high-employment economy delivering social and territorial cohesion [7].

It is a fact that the economic divides are being accentuated and that the metropolitan areas consume an excessive quantity of resources. The last ten years have also witnessed significant changes in the traditional family in favour of new models. There is an increase in single-unit families, irrespective of age; the types of family have become more diversified, and while there is an increase in extended families, there are also couples where each member lives with his or her parents to an advanced age, as well as new forms of co-habitation between *strangers*. Greater mobility and nomadism are now demanded in work and in lifestyles. An increasing number of people work at a distance from where they live and have to travel regularly, using small residential units for five days out of seven and returning home at the week-end to their families and social relations [1].

As regards the home, in the large cities increasingly frequently the residential units are of small size. Destructuring and flexibility are the buzzwords that emerge from the market demand, especially the younger brackets. On the one hand the classic layouts and the distinction between public and private have been superseded, on the other there is the chance to easily convert properties for different uses depending on the stage of life of the inhabitant or the activities to be performed in them. There is a part of the urban population that is pressing for the possibility of using public and communal spaces in new ways which can furnish answers to the emerging social and residential needs, the need for collective practices aimed at integration and the support for sustainability. In this scenario, we are witnessing a progressive passage from convivial consumption to shared consumption. After mobility (car sharing, car pooling and bike sharing), after the workplace (co-working and the FabLabs), the sharing economy is now also investing the way of preparing and consuming food. The generation of the new millennium is making it clear that it does not want to live in a world of impoverished values, that it wants to possess less and be more connected with others, thus aiming at optimising economic and energy resources and strengthening social and community bonds [8]. On the one hand, in the private sphere the preparation of meals features an alternation of the everyday—more fast/individual and limited—and the lengthier, more complex and *cumbersome* preparation for the convivial occasions that are on the increase, although less formal than in the past. This trend boosts expectations in

terms of the multi-functionality of the kitchen area, which is becoming increasingly hybrid and tends to merge with the living area [1].

If the notion of fluidity can be a pertinent metaphor to understand the nature of our modernity, we can define now the kitchen space as a "liquid[1]" space featuring major adaptability in terms of the ease of dismantling the system, flexibility and versatility making it possible to adapt to different requirements over the course of the day and the week, with ample possibilities for customisation and, in general, an improvement in the usability of the accessories and components. In parallel, in the urban space, experiences of participation and sharing are multiplying, and new social practices are spreading which transform the way of preparing and consuming food: from occasions of family reunion, to those of meeting and getting to know the neighbours. Hence a shift from the individual residential units to the urban spaces: collective kitchens, garden cooking, solar cooking, city allotments and practices such as co-housing and shared gardens. The emerging trends and changes in the lifestyles of the urban population, as described, are beginning to find answers in the sphere of interior design, urban design and services design, spawned by projects of experimental applied research [1].

The *Kitchen 4.0* research project, developed within the Laboratory of Ergonomics and Design (LED) at the University of Florence, intends to delineate a plausible design-orienting scenario for the way of preparing and consuming food in a more inclusive and shared way. The projects aims to create conditions for social meetings and possible social cohesions. The project is based on a methodological approach inherent to Ergonomics and Design in its more traditional components of Human Factors—focusing study and evaluation of human characteristics and capacities—and its more recent components of human-centred design, targeting the human well-being and the environment. The idea of *Kitchen 4.0* is a service of 'kitchen sharing' that envisages the possibility of sharing the cooking experience in communal areas remote from the home environment and for the greatest number of people. The project stems from the conviction that cooking in the company of other people exposes the individual to potential social relationships and hence potential social supports. This in turn might foster the well-being of the individual underlying the close connection between social support and well-being [10]. We think that sharing-based contexts that expose the individual to possible relationships with other people could create the condition for social support, therefore in the direction of people being happier and healthier. "Research has demonstrated that happy individuals tend to have larger social rewards, better work outcomes, greater coping abilities, better immune systems, to be more cooperative, prosocial, and charitable and to live longer than individuals who are not happy" [11] and for happiness good social relations are necessary [12].

The *Kitchen 4.0* service also permits a reduction in costs and energy consumption in the home, in favour of a centralised management of services with

[1]The term liquid refers to Bauman's definition of contemporary society. He defines our current epoch as liquid modernity in which the only constant is the changing and the only certainty is the uncertainty [9].

functionally valid features in terms of the possibility of choice of the products and nutritional education. Booking, shared cooking and consuming of the prepared food are the three fundamental phases of the service. The research was carried out in four main phases: definition of the research; identification of the macro-context and the macro-trends of reference; identification of user needs using a human-centred design approach and inclusive approaches; definition of the design concepts. Therefore, the research moves in the direction of the service design as a process that "applies explorative, generative and evaluative design approaches" [13]. Service design is also considered as a discipline that "conceives and develops solution ideas that take into account the quality of the interactions involved" [14].

2 Methodological Approach and Development of the Research

2.1 The Action Research: The 'Well-Living in the Kitchen' Workshop

The Laboratory of Ergonomics and Design has intensified its research activity in the kitchen sector since 2012 through a research project financed by the Tuscany Region and developed in collaboration with Effeti Industrie. The guidelines identified within this project were experimented and verified in a phase of action research. This research phase was based on the organization of a Design Driven workshop and on the elaboration of the methodological tool of participant observation. The aim was to observe and analyze the development of new concepts in a real context and in real time, interacting with the key interpreters involved in the design discourse. The *Well-living in the Kitchen* design workshop involved recent graduates and undergraduates in design who were integrated directly within the productive context of the company, thus establishing a close relation between designers and company personnel for around three months. The design discourse was also extended to various external professionals, including artists, cooks etc. The designs generated by the workshop were based on a user-centred approach, conceived to consider all the variables of the context of use and to evaluate the complexities of their interactions [15, 16].

2.2 Human-Centred Design for Inclusive Services: The Kitchen Sharing Service

With a view to exploring systems that foster the wellbeing of individuals in the most inclusive way possible, in parallel with the design workshop a human-centred

design approach was adopted. In this approach the design processes that addresses on the whole user experience [17] are defined in order to analyse user needs and the context of use. Also, all the process phases were driven according to the vision of inclusive design approach. This approach can make a significant contribution on the desirability of social cohesion and inclusivity and the accessibility of public buildings, spaces and services, that can promote social inclusion [18]. This vision was transferred into the human-centred process, considering a large range of possible user needs with different capability demands both in the user involvement and in the concept design phase.

Attention was focused on:

- Identification of "need profiles" [19], with a view to discerning the variables of the context of use in accordance with more inclusive approaches;
- Market research in the sectors involving the kitchen system and the food chain, with particular focus on the commercial catering sector, in addition to that previously investigated and closely tied up with the kitchen as a product;
- Search for elements of criticality through the active involvement of stakeholders and deriving directly from the inclusive approach;
- Identification of a design-orienting scenario for a "kitchen sharing" product/service.

2.3 User Involvement

In order to acquire a picture of the demand profiles, a sample of potential users with specific needs and professionals working in the catering sector was involved, hypothesizing possible scenarios in which the kitchen system could be meshed with the commercial and collective catering system. Several macro-areas of research were also identified on which planning of the user involvement was then focused, namely:

- Interactive systems of smart communication;
- Eating habits and the relations with the kitchen system;
- Food distribution and catering services.

After this, on the one hand potential users with specific needs were involved through semi-structured interviews, while on the other professionals working in the collective catering sector were involved through direct observation and the "thinking aloud" method. Finally a mapping on the needs deriving from the interview and the think-aloud activities were used to create personas profile with specific needs.

2.3.1 General Users Involvement: Semi-structured Interview

Starting from the consideration that every type of product that is used has an impact on user experience [20], influencing the quality of the interaction, a sample of generic users was involved with the purpose of focusing the main issues on the basis of elements previously hypothesised.

The user sample involved was aged between 15 and 80 years, comprising men and women of different nationalities. It also included persons with mobility impairments, with cognitive difficulties, social disorders and eating disorders. A total of thirty participants were involved. The interviews were based on a questionnaire drafted at the Laboratory of Ergonomics and Design.

The structure of the interview featured an initial section concerning general information about the user. The second part was aimed at investigating the user's relation with the most common ICT, starting with questions on relations with devices such as smartphones, tablets and PCs, through to questions designed for insight into the difficulties encountered by the interviewee during online purchases, and his/her expectations in the case of interaction with systems/services. Finally, the third section of the interview dealt with questions regarding the eating habits of the interviewee from food purchase through to the relation with commercial catering.

2.3.2 Professional Users Involvement: Thinking Aloud

The thinking aloud technique in this case is very effective for conducting a quick exploratory survey [21] in a short space of time. This technique was used to grasp the relation between working activities and the reference context. Consequently, the professionals working for the canteens managed by DSU Toscana (Rights to Higher Education agency of the Tuscany Region) were involved, inside the kitchens where they work every day. The main objective was to bring forth the problems inherent to the activities performed during the preparation of the food in terms of the equipment used and the management of the spaces. Another objective was to identify solutions considered advantageous in a context characterized by short timeframes, large quantities of food to be prepared and constantly monitored conditions of hygiene. The sample of participants was aged between 19 and 57 years, comprising both men and women belonging to two main macro-categories: professional personnel, for example chefs working in the sector for over 10 years, and general workers, including volunteers or non-specialised operators, who have been working in the collective catering sector for over 5 years. More than 15 workers were observed simultaneously, with 8 being involved in a direct manner.

The evaluations were conducted within the different areas making up the kitchen: the area allocated to the preparation of hot dishes, the oven and hobs area, the area for the preparation of cold dishes, the area for the preparation of hot second courses and side dishes, and the washing area. Within these areas, video and photographic material documenting the activities, the equipment, the spaces and the

most important details within all the sections of the kitchen during the preparation of lunch—starting from 8 o'clock up to the end of the shift—was collected. During the observation, interviews lasting on average 20 min were organised for each worker in the course of the most important phase of work for each area of the kitchen.

2.4 Personas

The semi-structured interview and the thinking-aloud data was adopted to represent personas in order to identify the context of use for possible design scenarios in the field of the food consumption. 7 profiles were created to represent target users for the project [22]. These profiles represent typical behavior patterns [21] as a synthesis of multiple people who share similar goals and motivations [23]. They also represent people with specific needs that can help the design phase summarizing user diversity, which also includes physical, social and cultural contextual factors [24]. The 7 profiles were graphically organized and were set according by parameters such as name, age, sex and marital status; occupation; description of lifestyle; general description (including problems, needs and desires).

3 Results

3.1 The Smart Table

The *Well-living in the Kitchen* workshop gave rise to six concepts re-interpreting the kitchen environment by working on optimisation of the areas and the elements necessary for the conservation, preparation and consumption of food; the design brief was to cut down on the waste of space and materials and succeed in delineating the concept of "just enough" in what can be defined a *liquid kitchen*: in other words characterised by transformability, versatility and adaptability.

The designs focused on four different types of product identified as highly innovative for the sector: the *smart table*; the wall unit systems, the wearable utensil and the smart floor. The *smart table*, which has now reached the phase of prototyping and presentation to the market, features a central panel incorporating the functions of wiring, disposal and utensil storage. The hob is made up of plug and play induction plates which can be stowed away when not in use. The sink is also conceived so that it can be closed and folded away, and consists of two basins designed to restrict water wastage and facilitate waste collection. Once everything has been put away, the table can be used as a desk or as a living-room table. A characteristic feature is the insertion of *'assistants'*. Lightweight containers on sliding guides ensuring that everything required for cooking is within easy reach (Fig. 1).

Fig. 1 The smart table: prototype. *Photo* by Flavia Veronesi and Stefano Visconti

3.2 The Variables of the Context of Use for the Kitchen-Sharing Service

The responses that surfaced from the interviews and the thinking aloud observations were collected in tables with a view to highlighting: the problems declared by the users involved; the problems and observations encountered by the researchers, and the possible solutions. Also, the profiles summarized by the personas technique helped to identify the context of use about the possible users specific needs, according to their economic status, their ability to use common information and communication technologies, eating habits, physiological and cognitive impairments.

One of the results that emerged was the definition of a design process in the field of shared and inclusive services. The process was aimed at understanding the variables that can affect the user experience. The process can be synthesized through the following phases:

- Conceptualizing possible scenarios clarifying the right problem;
- Identification of requirement profiles through direct involvement of the stakeholders;
- Definition of the variables of the context of use aimed at the system/service;
- Comparison with the reference markets;
- Conceptualization of other possible scenarios and identification of the dominant one;
- Design alternatives guaranteeing the definition of three aspects considered fundamental: communication system, characteristics of the physical places and products involved and essential to the use of the service.

These phases should be considered as an expression of a part of the iterative cycle of the human-centred approach that consider four activities: understanding, creating, prototyping and evaluating [25].

3.3 The Kitchen 4.0 Commercial Catering Service

Finally, another result is represented by the concept of a new service for the food consumption. The *Kitchen 4.0* service is a sharing-based service for the commercial catering sector. The *Kitchen 4.0* service moves away from the domestic environment and goes to join the forms of catering presented on the market. This are potentially aimed at the greatest possible number of individuals, offering an alternative both to the current forms of such catering and to the possibilities offered at present by the rigidity of the home environment.

Booking, shared cooking and consuming of the prepared food are the three fundamental phases involving not only the end users, but also the food distribution system and that of commercial catering. The service has been conceptualized with three fundamental elements: the communication system; the physical sites in which the service is provided and the cooking utensils (Fig. 2).

3.4 ICT Concept System

Consequently, the initial phase was hypothesized where the user interested in the service is involved in a system of input and output of information. According to the user requirements and with aims to create a service as inclusive as possible. The available systems of communication will guarantee the choice between:

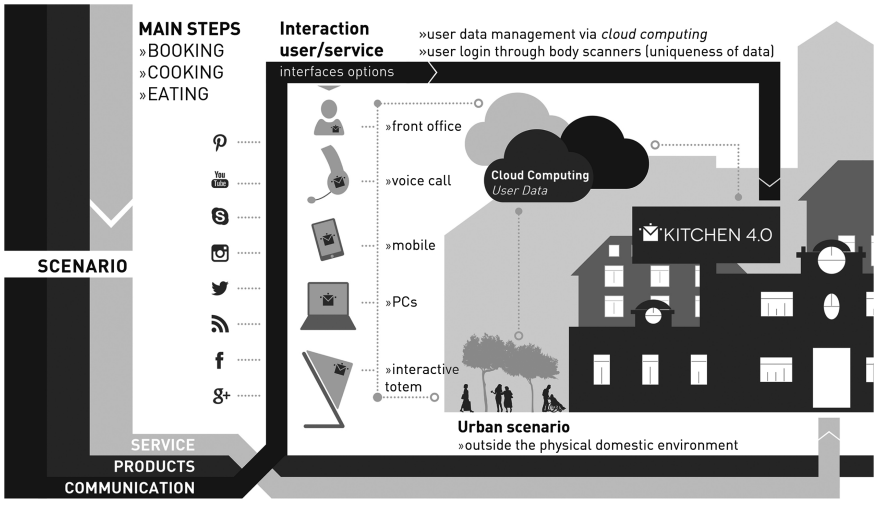

Fig. 2 Kitchen 4.0: design orienting scenario. Interaction phase and urban scenario

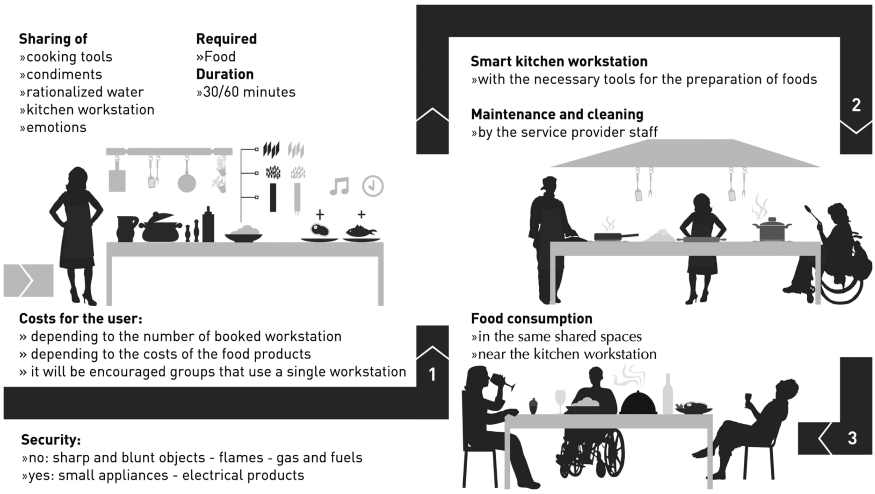

Fig. 3 Kitchen 4.0: design orienting scenario. The sharing phases

- Interactive systems connected to the web and available by personal devices;
- Interactive systems connected to the web located in nodal points of the urban area, such as interactive totems managed by the same network that provides the service;
- Front office with operators belonging to the service network;
- Networks of operators that can be reached via phone and text messaging.

This communication network will allow the users to:

- Receive all the necessary information about the service;
- Record their personal details;
- Perform identification operations for use of the service on site;
- Make payments.
- The user data will be managed by a cloud computing system which is constantly accessible from all points of the system (Fig. 3).

3.5 Physical Sites and Urban Scenario

The *Kitchen 4.0* service could be situated in places within the urban territory that can be easily reached. The idea is to integrate the kitchen stations within or very close to the food distribution locations. This integration would permit an optimisation of costs and consumption. Moreover, a series of operations have been theorised that would render the kitchen stations self-sufficient in energy terms. Starting from the premise that the places in question would occupy a considerable space, flooring exploiting piezoelectric technology and systems of renewable energy

exploiting solar energy could, for example, optimise the flows of electricity required by the kitchen stations.

3.6 Products and Kitchen System

The concept of the kitchen system features smart characteristics, and starts from a base module composed of: two burners for each hob, a sink with energy-saving system for water, a system for differentiated waste collection, a storage system for the basic utensils required for preparing and cooking food. The same container will also be used for replacing the dirty utensils after use. Another theoretical possibility is that the kitchen station is capable of recognising the user via body scan and hence capable of modifying certain formal features based on the user characteristics recorded among the data on the cloud system.

3.7 Synthesis of the Scenario

The service could be summarized as follows: the user receives information about the kitchen-sharing service; he or she registers as a member; he or she can book the nearest kitchen station; he or she then goes to the *Kitchen 4.0* point where it is possible to purchase foodstuffs and access the kitchen station. The service provider staff will proceed to the preparation, cleaning and maintenance of the *Kitchen 4.0* workstations. The user will thus be able to prepare, cook and eat the chosen food while sharing this moment with other people.

4 Conclusions

The identified approaches can integrate the instruments of Ergonomics and Design with inclusive approaches. Defining the needs of individuals simplifies the understanding and the conceptualization of the user experience in a more creative and inclusive way. This approach can involve both the service and the physical context, the communication systems, and the physical products. Moreover, in the era of shared consumption, the natural predisposition of services design to creating innovative scenarios becomes a potential resource for managing the changing aspects of consumer goods.

Finally, this research presents some limitations that enable future opportunities for research in the design field. In particular, the *smart table* is a product prototype now. It should be tested and evaluated to close the circle of the human-centred design approach. Also the *Kitchen 4.0* concept should be tested by a pilot project.

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