From “Liquid Kitchen” to “Shared Kitchen”: Human-Centred Design as a strategy for user experience innovation in shared food consumption

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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 residential and consumption models. As regards the home, flexibility, adaptability and versatility are the emerging characteristics, and they also impact the kitchen environment. In parallel, in the urban space, experiences of participation and sharing are multiplying, and new social practices are spreading which also transform the way of preparing and consuming food. The “Kitchen 4.0” research project can be placed within this macro-context. It aims at delineating a design-orienting scenario, with a short-term timeframe, which affects the way of preparing and consuming food through the definition of a “kitchen-sharing” service, based on the possibility of users sharing the cooking experience in communal areas remote from the home environment.

\textbf{Keywords}: Design, Human-Centred Design, User Experience, Service Design, Sharing Economy, Design for All

1. Introduction: the wellbeing of individuals in “liquid modernity”

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. It is similarly evident that the economic divides are being accentuated and, even more strikingly, that the metropolitan areas consume an excessive quantity of resources. The last ten years have also witnessed significant changes in the traditional family nuclei 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. (Rinaldi, 2013)

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 or to render the them multifunctional, 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. (AA.VV., 2013)

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. The kitchen space too becomes “liquid”, featuring major adaptability in terms of the ease of dismantling the system: flexibility and versatility making it possible to adapt to different

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\textsuperscript{1} The term ‘liquid’ refers to Bauman’s definition of contemporary society. He defines our epoch as “liquid modernity” in which the only constant is change and the only certainty uncertainty. Being modern today means pursuing ad infinitum an improvement that has no aspiration to becoming definitive. (Bauman, 2011)
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. (Rinaldi, 2013)

The “Kitchen 4.0” research project, developed within the Laboratory of Ergonomics for Design (LED) at the University of Florence, intends to delineate a plausible design-orienting scenario for the way of preparing and consuming food.

The project is based on a methodological approach inherent to Ergonomics for 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 welfare of man 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. The project stems from the conviction that cooking in the company of other people exposes the individual to potential social relations and hence potential social supports. This in turn fosters the wellbeing of the individual underlying the close connection between social support and health. (Solano, 2001)

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 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; definition of the design concepts.

2. Methodological approach and development of the research

2.1 The Action Research: the "Well-living in the Kitchen" workshop

The Laboratory of Ergonomics for Design has intensified its research activity in the kitchen sector since 2012 through a research project financed by the Tuscan Regional Authority and developed in collaboration with Effeti Industrie. The guidelines identified within this project were experimented and verified in a phase of action research, based essentially on the organisation of a ‘Design Driven’ workshop and on the elaboration of the methodological tool of participant observation, with a view to observing and analysing 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 therefore involved recent graduates and undergraduates in design who were integrated directly within the premises and 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 use context and to evaluate the complexities of their interactions. (Rinaldi, 2012)

2.2 Human-Centred Design for inclusive services: the kitchen sharing service

With a view to exploring systems that foster the welfare of the individual in the most inclusive way possible, in parallel with the workshop a human-centred design approach was adopted. In this approach the design processes centred on the holistic user experience (standard ISO 9241-210:2010) are defined in accordance with the iterative quality in order to analyse user needs and the context. Attention was focused on:

- identification of “need profiles” (Tosi, 2012), 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 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 Surveys involving users

In order to acquire a picture of the demand profiles, a sample of potential users and professionals working in the catering sector was involved, hypothesising 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 testing 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.

2.3.1 Semi-structured interview (general users)

Starting from the consideration that every type of product that is used has an impact on user experience (Garrett, 2010), 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 in the scenario.

The user sample involved was aged between 15 and 80 years, comprising men and women of different nationalities. It also included persons with motor difficulties affecting the arms and legs, with cognitive difficulties, social disorders and eating disorders. A total of thirty participants were involved. The interviews were based on a questionnaire drafted in the Laboratory of Ergonomics for 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 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 Thinking Aloud (professional users)

The “thinking aloud” technique, which is very effective in this case for conducting a quick exploratory survey (Rubin, J. and Chisnell, D. 2008) in a work context featuring a rapid tempo, was used to grasp the relation between working activities and the reference context. Consequently, the professionals working for the canteens managed by DSU Toscana 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, on the basis of the problems that emerge, solutions considered advantageous in a context characterised 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 minutes were organised for each worker in the course of the most important phase of work for each area of the kitchen.

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.

![Image of the smart table: open and closed.](image1)

Figure 1-2. The smart table: open and closed.

![Image of the smart table: prototype.](image2)

Figure 3. The smart table: prototype. Photo by Flavia Veronesi and Stefano Visconti.

3.2. The variables of the use context 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.
One of the results that emerged was the definition of a design strategy in the field of shared and inclusive services. The process aimed at grasping the variables of the user experience can be synthesised in the following phases:

- initial phase of conceptualising possible scenarios;
- identification of requirement profiles through direct involvement of the stakeholders;
- definition of the variables of the use context aimed at the system/service;
- comparison with the reference markets;
- second phase of conceptualisation of possible scenarios and identification of the dominant scenario;
- 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.

In adherence to the human-centred design approach, the process should be considered iterative.

Table 1. Communication, interaction and nutrition. Main results of the semi-structured interview.

<table>
<thead>
<tr>
<th>SEMI-STRUCTURED INTERVIEW</th>
<th>REPORTED PROBLEMS</th>
<th>OBSERVED PROBLEMS / OBSERVATION (RESEARCHER)</th>
<th>POSSIBLE SOLUTIONS</th>
</tr>
</thead>
</table>
| Relationship between devices and communication | - little experience with notebook, smartphone and PC  
- use of interactive devices only if there isn't any alternative  
- only one interviewee is registered in social networks  
- use of the phone for basic actions only (calls and texting)  
- dissatisfaction with knowledge of digital communication  
- expensive devices  
- help of experienced person needed | - most feel able to use interactive devices but the complexity of the required tasks blocks the effectiveness of the actions  
- Users between 22 and 30 prove to have similar experiences as older people  
- Users between 50 and 65 use less functions of a device but with more regularity and efficiency | - guarantee more communication routes: web, telephone networks, front office  
- guarantee choice of appropriate communication tools or services: smartphone, tablet, PC, notebook, cell phone, landline, front office  
- create user training systems: video tutorials, audio tutorials, tutors (real)  
- minimize the operations required for each communication channel |
| Booking and purchasing online | - mistrust: poor security for personal data  
- inability = people unencumbered to learn to use even when necessary (about 50%)  
- too many tasks required, complex actions and not easy to memorize  
- expiration of the page, failure of the operation and difficulty of comprehension of the requested data | - need: to request help through the intervention of an operator (voice support, and via text)  
- lack of memorizing activities  
- younger users are more active, for other age groups mistrust prevails | - minimization of the required operations and tasks (easier to remember)  
- guarantee choice of help uniqueness of personal data to be entered with multiple layers of security |
| Food organization and management (cooking and organizing meals: context, lifestyles and preferences) | - 30% do not like to cook and does not do it (only for necessity)  
- All have experience just in the home kitchen  
- 70% is quite fascinated by the idea of cooking in the company with other people  
- a user doesn’t like cooking, but likes to eat in the company, he would like to be able to make available to its kitchen for cooking other people  
- a user reported the great pleasure in cooking for others as an element of relaxation  
- The major limitation is the difficulty in cleaning  
- in home kitchen: discomfort and unsuitable tools | - single dish cost 1.5 / 3 euro  
- nobody considers energy costs  
- in lack of time (quick meal): most evaluated to rely on other people, follow the sandwich and the typical service-food. Few choose a quick meal at home  
- in lack of time prefer: to rely on others, use the workplace or a self service  
- In lack of money prefer; more cooking at home; few solutions for takeaways (eg. sandwich)  
- food allergies or special needs are not attended to by the food distribution system | - comfortable environment: it must be more pleasant than home kitchen  
- the service must provide actions for cleaning by the operator and not by the user  
- cooking tools must be specially designed to meet safety, usability and sharing  
- very low cost of the food service  
- optimization of consumptions (water, electricity, waste)  
- the service must reflect the quality of the food at home but beneficial as a food service |

Table 2. Collective food-service. Main results of the Thinking Aloud tests.

<table>
<thead>
<tr>
<th>THINKING ALOUD</th>
<th>REPORTED PROBLEMS</th>
<th>OBSERVED PROBLEMS / OBSERVATION (RESEARCHER)</th>
<th>POSSIBLE SOLUTIONS</th>
</tr>
</thead>
</table>
| Physical context | - only artificial light: no comfort  
- tight spaces (insufficient maneuvering space)  
- inclinations of the floor is not regular  
- grid to the ground for drainage of water placed only in some sides - not for entire perimeter of the instrumentsations  
- the grid on the ground around the instruments allows you to drain the dirty water  
- The floor with slight inclinations facilitates cleaning | - interior design: maneuvering space and high comfort by sunlight  
- grid to the ground for drainage of water placed in the entire perimeter of the instrumentations  
- inclinations of the floor = regular  
- tactile paving | |
| Tools | - random positions of kitchen utensils;  
- cleaning tools is complex  
- kitchen utensils such as ladles, forks do not have a specific position and are placed in not suitable points  
- ovens, big kettles and bratt pans have one main function with few options (such as temperature, time, etc.) - easy to use  
- cleaning tools by hand = uncomfortable  
- good solutions = adjustment of the heights of instrumentations (eg. big kettles and bratt pans = adjustable in the heights) | - main appliances: integrated with the structure of the kitchen to optimize the operation  
- constrained functions = few tasks required  
- cleaning services = professional users  
- customization of the workstations and instrumentation = in favor of sharing |
Table 3. Context of use analysis.

<table>
<thead>
<tr>
<th>CONTEXT OF USE</th>
<th>TYPOLOGY</th>
<th>DESCRIPTION</th>
<th>CAPACITY/EQUIPMENT/ATTRIBUTES/INSTRUMENTS NEEDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>who are the users</td>
<td>- Primary User: Generic</td>
<td>Primary User: all general users who have access to commercial food-service</td>
<td>Primary User: physical abilities of movement for reaching places outside the domestic space; intellectual abilities for understanding the minimum information through the media or through other persons; motivation to share space with other people. Secondary user: physical ability to carry out manual work in the kitchen; intellectual capacity for the preliminary phase of training; skills in the kitchen systems; attitude to help the users</td>
</tr>
<tr>
<td></td>
<td>- Secondary user: professional / operator</td>
<td>- Accessible via booking</td>
<td>- Accessible to as many users as possible. - Cleaning and maintenance by the operator of the service (increase in employment opportunities) - kitchen in sharing (spaces, instrumentation and accessories)</td>
</tr>
<tr>
<td>what is the product</td>
<td>Innovative service for commercial food-service</td>
<td>- Accessible via booking</td>
<td>- Accessible to as many users as possible. - Cleaning and maintenance by the operator of the service (increase in employment opportunities) - kitchen in sharing (spaces, instrumentation and accessories)</td>
</tr>
<tr>
<td>why people use the product</td>
<td>Sharing Wellbeing</td>
<td>- exposes the individual to possible social relationships and therefore to possible social supports - domestic actions in shared spaces</td>
<td>- Shared; cheap; Healthy (freedom of choice); fast; safe; inclusive nearby to food distribution service - Sustainable (resource management) - Alternative forms of commercial food-service - Meal preparation as at home</td>
</tr>
<tr>
<td>where users use the product</td>
<td>Virtual spaces = web + cloud computing</td>
<td>- Booking through the media (web, phone calls, front office)</td>
<td>- Virtual space (web) for reservation and data users management - Telephone network - Front office with specialized skills - Structures able to accommodate large flows of users (urban areas) - Kitchen workstations: stove, sink, garbage collector and surfaces for the preparation - Appliances for cleaning and maintenance managed by operators</td>
</tr>
<tr>
<td>when users use the product</td>
<td>Nutrition</td>
<td>- Main meals: lunch, dinner. - Possible meals: breakfast or overtime meals</td>
<td>- Service available 24/7 - Need for staff shifts</td>
</tr>
<tr>
<td>how users use the product</td>
<td>Sharing</td>
<td>3 phases: booking (via digital media), cooking (in shared workstation), eating</td>
<td>- user data management = cloud computing - shared kitchen reservation for specific times - Eating as in traditional commercial food-services</td>
</tr>
</tbody>
</table>

### 3.3 The Kitchen 4.0 commercial catering service

The Kitchen 4.0 service moves away from the domestic ambit and goes to join the forms of catering present on the market, being 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 conceptualised in line with three fundamental elements: the communication system; the physical sites in which the service is provided and the cooking utensils.

#### 3.3.1 IT and communication system

Consequently, an initial phase was hypothesised in which the user interested in the service is involved in a system of input and output of information. In accordance with the hypothesis, and based on the list of requirements so as to render the service as inclusive as possible, the systems of communication available to the user will guarantee possibilities of choice between:

- interactive systems through interfaces and personal devices connected to a web network;
- interactive systems connected to the web network located in nodal points of the urban area, such as interactive totems managed by the same network that provides the service;
- front office with specialised operators belonging to the service network;
- system 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.
3.3.2 Physical sites and urban scenario

The Kitchen 4.0 service is stationed 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.
3.3.3 Products and kitchen system
The hypothesised 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.

3.3.4 Synthesis of the scenario
The service could be summarised as follows: the user receives information on the kitchen-sharing service; he or she registers; he or she can book a kitchen station in the part of the city that is most convenient; he or she then goes to the Kitchen 4.0 point where it is possible to purchase foodstuffs and access the kitchen station. The personnel in attendance at the Kitchen 4.0 point will proceed to the preparation, cleaning and maintenance of the stations. The user will thus be able to prepare, cook and eat the chosen food, sharing this moment with other people.

4 Conclusions
In both the analysis phase and in that of the concept design, the research has made it possible to identify approaches that can integrate the instruments of Ergonomics for Design with the inclusive approaches inherent to Design for All. Defining the needs of individuals simplifies the understanding and the conceptualisation of user experience, especially if the experience is shared and fosters the wellbeing of the individuals. This approach can also be reproduced in any service project and in the respective macro-areas of operational intervention that determine its application, such as physical context, systems of communication and the “objects of use”.

Moreover, in the era of shared consumption, the natural predisposition of services design to creating innovation scenarios becomes a potential resource for managing the innovation aspect of consumer goods, which are thus supported by systems/services that permit their design, durability and regeneration.

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References