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RSD7 2018

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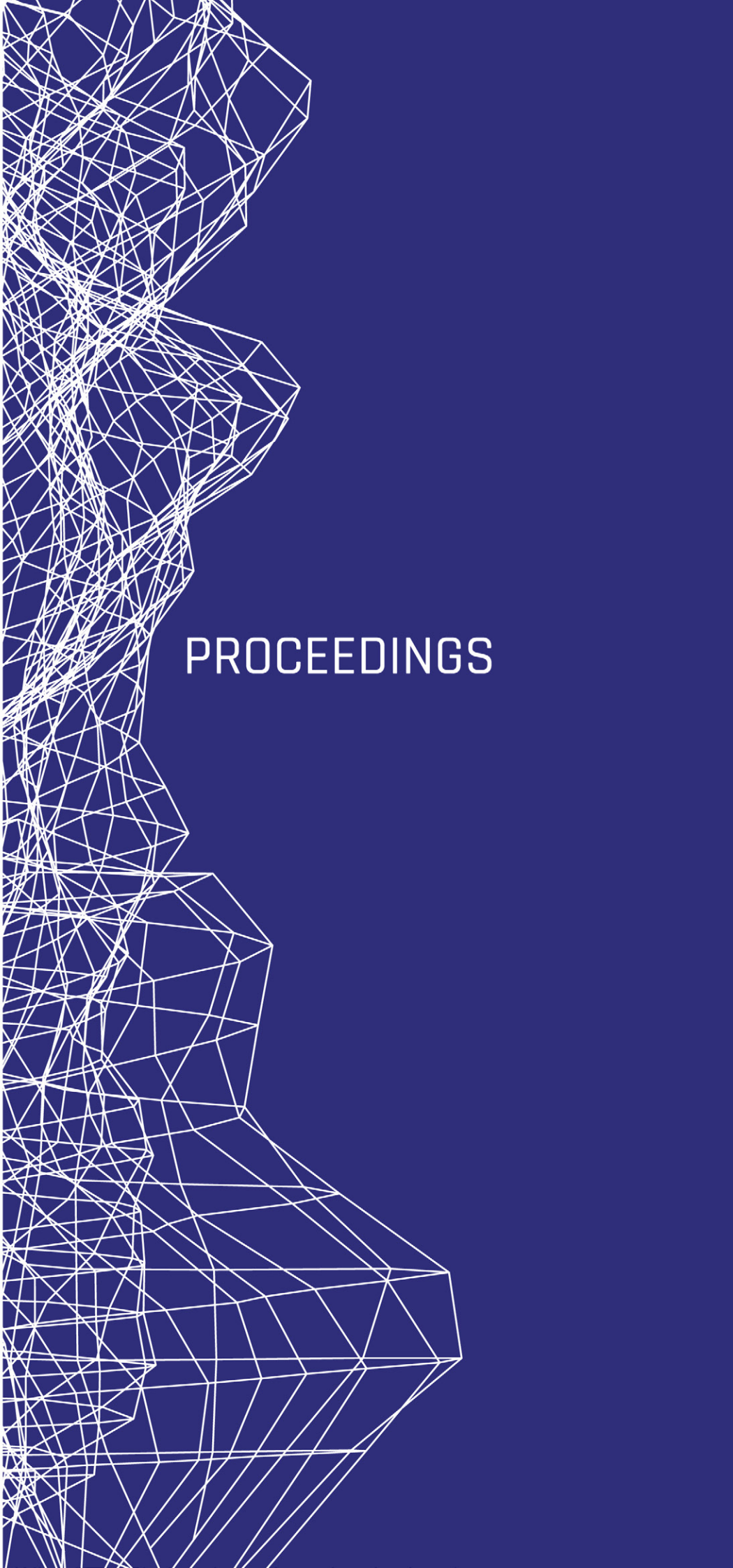
CHALLENGING COMPLEXITY BY SYSTEMIC DESIGN TOWARDS SUSTAINABILITY



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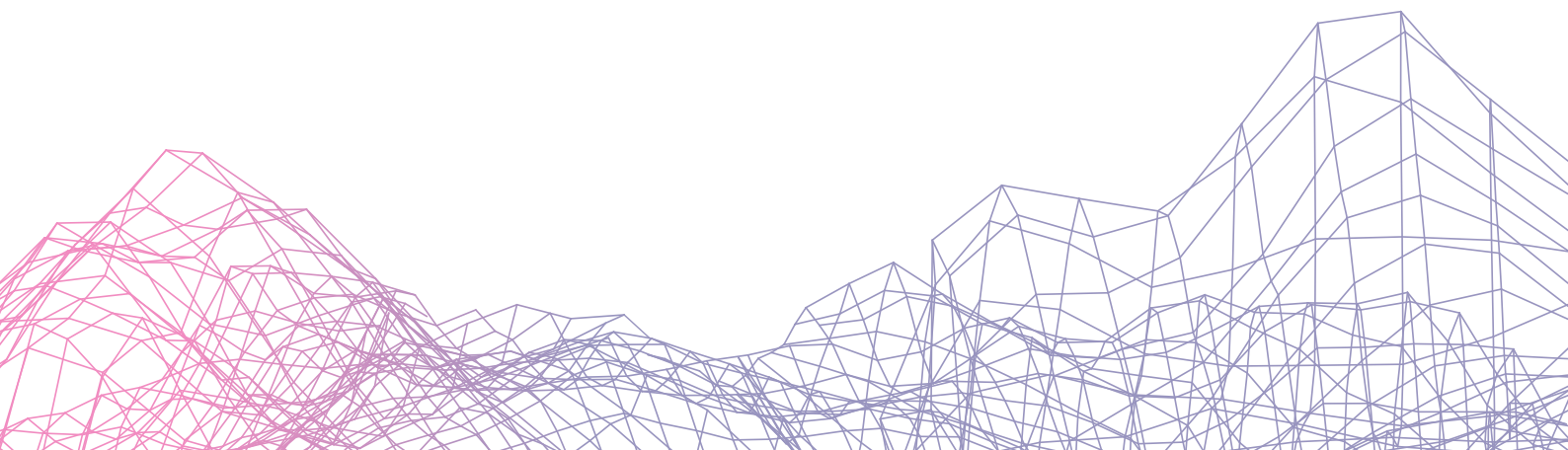

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WORKING PAPER

Cleaning & Facility. A co-design process to create systemic relations from services to products.

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Abstract

The paper illustrates a service project performed with a co-design approach by the stakeholders of a cleaning system Consortium for the contract market sector, with the scope of all the different user's inclusion and creation of a systemic relations toward a participatory economics. This new service aspires to get more effective and efficient the offered performances of the Consortium, combining the cleaning service with some facilities management activities, as the space's control in order to little maintenances. The Consortium who commissioned the research, in particular, has requested to the University Design team, skilled in the development of ICT based services, HCD and ID, to identify and valorise, through the new service, virtuous relationships among actors, processes and tools of the complex supply chain of cleaning and facility activities.

Keywords: co-design, system design, service design, user experience design, cleaning and facility

1. The Cleaning & Facility management sectors: which contributions from Design?

The Consortium that commissioned this research provides services for the professional cleaning sector at different levels, both for the civil sector - from the condominium to the school - and for the sanitation sector - from the hospital to the food company - in this case with hygiene standard much more severe. It includes the entire B to B supply chain (business to business) and consists of a manufacturer of trolleys, manual equipment and cleaning textiles, a research center for the sustainable production of chemical detergents, as well as product distributors and service providers to cleaning companies in terms of technical information, security and training.
Founded in 2014, the Consortium represents an interesting model of support for the activities of cleaning companies and stands out for its high level of sustainability and innovation, both technically and socially.
Just from the activity of support to cleaning companies that participate in demanding public contracts, the Consortium observed how today the professional cleaning sector often find hybridization just with that facility, aimed at managing and maintaining spaces and buildings together with their systems and services connected.

Inside of this flourishing sector, the sub-cleaning sector is therefore a very important component: on average with other European countries, the cleaning sector in Italy represents 2018, a quarter of that of maintenance, both in terms of employees (240,700 part of 1 million) that of turnover (15 billion euros part of 62 billion). This estimate is quite easy to understand, if we take into consideration that the facility system and in particular the cleaning system, recognize the remuneration of the employees as the first item of the financial statement.
In this scenario, therefore, there are many cases of synergy between the Cleaning and Facility sectors, for two reasons:

- the synergy brings with it an economy of scale in the management of each individual site, where in relation to the increase in the quantity of services offered and therefore of man-hours required, the general expenses and management of the construction site decrease. This, in general, translates into a benefit for both the company and the customer;
- the offer, not of a single competence but of more integrated skills, favours the demand for innovation, both of a technical nature both managerial. The introduction of the Facility Manager, for example, is a demonstration of management innovation that acts through an open mind figure formed to provide advice and updated skills on the subject of the organization of corporate services in an inter-related and integrated form, able to relieve the company from the continuous updating required at the legislative, social security, but also for ethical progress.

Acting in this scenario, the Consortium built its own vision based on the sharing of relationships between the various actors of the system, supported by a selection of objectives in terms of innovation. He also embraced the Design Thinking approach, which presupposes defining objectives with limited actions over time and the resources used, and has called Research Design as a consultant, engine and director of personalized innovation processes (Celaschi, 2008).

Processes in which, in the wake of nature, other knowledge is called to participate: cognitive ergonomics and psychology as regards evaluation methods in the UX context; management engineering for the development and strategic/economic evaluation of co-design processes;

project Design for the conscious and creative development of new product and service activities; while the technical aspects remain the responsibility of the Consortium's know-how.
The priority was given to "co-design processes", addressed in two phases (Figure 1):

- in the first phase they found application, for the first time in the experience of the Consortium, the HCD and UXD assessment methods for the quality measurement of leading consortium products (trolley and related equipment), through the direct involvement, as evaluators, of the site operators in the workforce cleaning;
- in a second phase, the most illustrated in this article is still underway, has come to life a new "digital platform", with the aim of improving the management of the cleaning service on site, the measurement of the performances offered by materials and equipment for cleaning and the integration to the cleaning activity of some tasks related to logistics (small maintenance).

It is therefore a digital service that provides a participatory approach (co-design), from all the actors in the supply chain, able to trigger shared relationships between: the consumer, the site operator, the site coordinator, the cleaning company, the supplier/manufacturer.

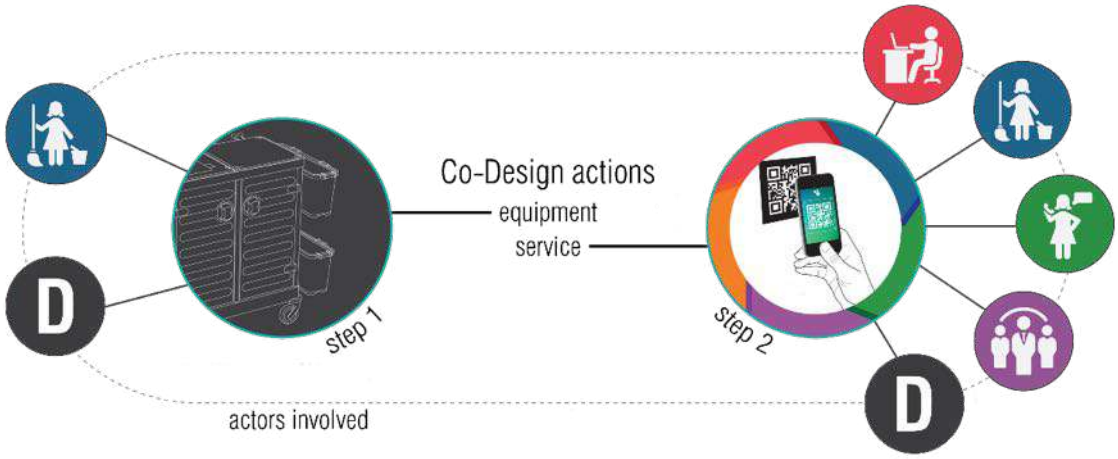

Figure 1. Co-design actions and related actors involved in the project.

2. The question changes: from the "how" to the "what"

The two phases of action show how the Consortium has immediately formulated, in line with the instinct of the company, a first question about "how" products could be innovated, especially those already considered leaders. The Design has responded to this first solicitation of the product by introducing inedited evaluation methods that see the participation of the cleaners as evaluators and suggestions for improvements (co-design), then shifting their gaze to the "what" between the objectives innovation was more attractive and not expressed either as a customer requirement or as a market offer (Germak & Bozzola, 2010).

The strategic objectives of innovation presented by the Consortium are divided into 5 points (fig.2):
1 - Ergonomics: development of equipment with ergonomic and technically performing solutions;
2 - Hygiene: development of innovative and efficient cleaning processes;
3 - Sustainability: product certification, welfare and worker participation;

4 - Speed: accelerate and optimize cleaning operations for greater economy and profit;
5 - Management: computerization and integration between cleaning and logistics services;

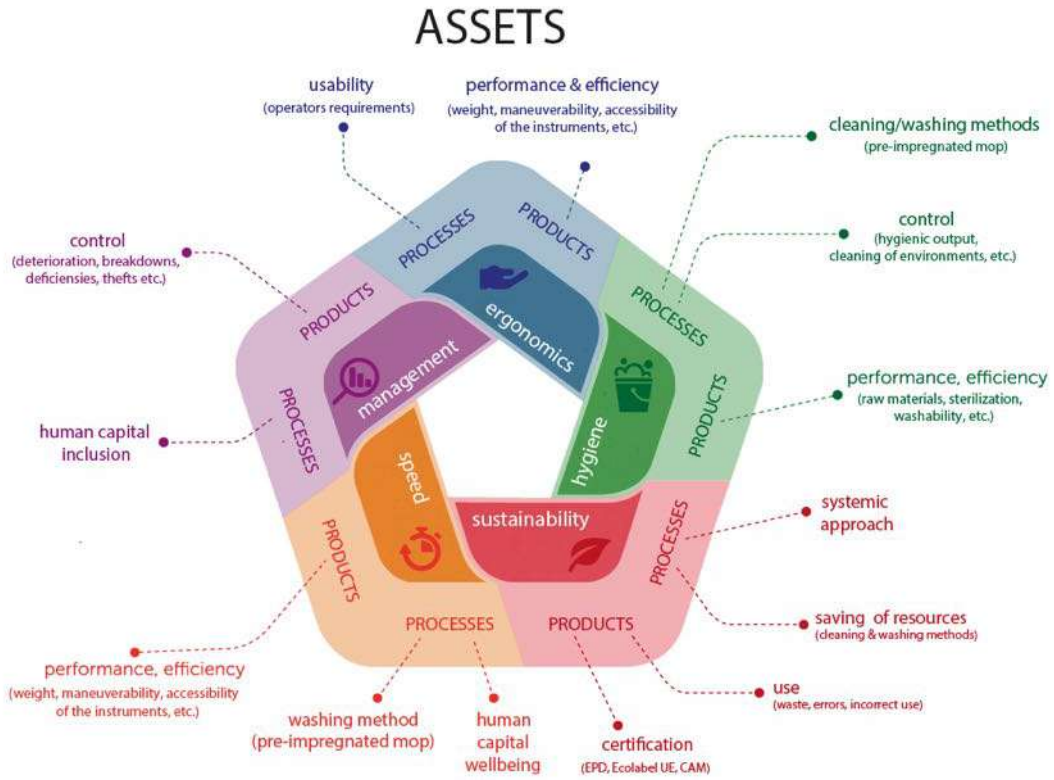

Figure 2. The 5 innovation directions identified by the Consortium. In a clockwise direction, the first 4 relate to the product, the fifth to the cleaning service.

In the first phase, "how", the UXD (User Experience Design) team considered that the new collection of cleaning trolleys is of value, a perception confirmed also by the operators in the role of evaluators, because it introduces the method of cleaning floors with pre-impregnated polyester strips, instead of washing with water. This method is not new, but it certainly deserves for the high level of sustainability, efficiency and practicality of use, to be promoted at the cleaning companies.

This because, as says Norman the "User experience" encompasses all aspects of the end-user's interaction with the company, its services, and its products. The basic requirement for an exemplary user experience is to meet the exact needs of the customer, without fuss or bother. (Norman & Nielsen, 2007)
The clinical investigation carried out on the new family of trolleys has highlighted many strong points and some weaknesses at an ergonomic/functional level, but not the need to rethink a new product today. While the co-design method with which confirmations and/or new needs have been identified represents a real innovation for the Consortium.

Therefore, since the margins of innovation on the trolley product are reduced, the interest has shifted to the strategic efficiency of the "process" that regulates the cleaning service and has led reflection on the evaluation of effectiveness and efficiency of the relationships that could be established between the different "subjects" involved in the activity, if these links were seen as systemic elements.

The activity in question, called Cleaning Design Process, therefore represents the second phase of the research/project carried out in collaboration with the Consortium and is aimed at developing an innovative design solution for the service, aimed at integrating the role of cleaning with that of the facilities.

3. The cleaning trolley. Product's performance evaluation techniques in co-design.

The method of co-design based on evaluation processes shared with users was presented to the Consortium as an element of innovation in the approach to the 4 objective parameters listed in fig.2, i.e. Ergonomics, Hygiene, Sustainability, Speed.
The evaluative analyzes conducted by the UXD interdisciplinary team, made up of designers and psychologists, focused on measuring the performances offered by the prototypes of the new collection of "trolleys".
They contributed to the evaluation of the total quality of the prototype, an analysis of "benchmarking with multicriteria indexes", from which the trolley was a highly evolved product compared to the competition, as well as the only European model with EPD sustainability certification referring to materials and components, both for the Ergonomics and Operability speed parameters, through tests and surveys on the prototype conducted with the participation of the cleaning operators themselves.
In fact, it is known that "The good practice of a co-design approach results from the union of the skills of designers and researchers together with those of people whose work will be influenced by change: a project approach based on experience and personal skills of workers" (Bødker, 1996).

The methodological objective of this phase is the detection of "explicit" and "tacit" needs, but also of "latent" ones, emerging from sessions of ethnographic interviews and repeated tests of operability, where operators can freely express themselves, denounce and suggest (Rizzo, 2009).
In addition to the "explicit" ones, the first to be highlighted, the tests are able to detect the "tacit" needs, i.e. those that are not explicitly expressed but easily understood by various indications, as for example the result of the question addressed to users to put the cleaning operations in hierarchy in relation to the fatigue required by them.
We knew that some cleaning operations were tiring and that they had repercussions on the health of the worker, as already expressed in the literature for example in the report for Expo Milan 2015 written by ASL (Local Health Authority) with the title "Safety in cleaning companies" (Cattaneo, Borello & Cassinelli, 2015), in which the indications to construct biomechanical validation tests in cleaning operations on large sites are very useful.

But we did not know how to organize them in the hierarchy, which the operators first conducted individually, then collectively returning a shared list of strenuous activities, to which the Consortium is following up with improvements in feedback.
As an example, we report the most difficult activity by operators, especially female: squeeze in the appropriate lever container, about 60 times during its turn, the Mop, the stick with soft fringes used to wash with water the floors.
From here the search for alternatives for the operation, from which emerged pedal systems, with opposed rollers, also electric.

But perhaps it is precisely the difficulty of using the Mop that has led the cleaning operators to point out that the use of pre-impregnated strips for a washing without water, is far more effective and easy, so applying the Mop to retirement.

Finally, the survey, perhaps the most interesting, relating to the "latent" needs: those that can only derive from the spontaneity and creativity of the witnesses, who in this case not having an object to be evaluated, change the role of evaluator with that of co-designer.
In some cases only latent needs have emerged, in others the co-designer, urged by the UXD team, has suggested and discussed possible solutions (fig.3).
A condition, well described in the literature: "Users can become members of the design team as "experts in their experiences", but in order to take on this role they must receive the appropriate tools to express themselves" (Sanders & Stappers, 2008).

Operators_TUT Trolleys Usability Prototyping Test		
Operator's Attitudes	**Definition of Attitudes**	**Detected Attitudes by the Cleaning Trolleys test**
DOING	Being aware to do an experience	The desire to tell once's own experience
CUSTOMING	You can do things by yourself	The ability to customize your work
MAKING	Creating with your own hands	Problem solver with own hands
CREATING	Feeling inventor	The desire to suggest solutions

Figure 3. The measure of experience through the attitude detected by the tests on the prototype cleaning trolley.

As an example there is an anecdote told by the Consortium. The idea of the pre-impregnated strip that has revolutionized the field of professional cleaning, was actually born from the intuition of a female cleaning lady who had wrapped the fringe of her broom with a light cloth, just moistened, fixed with two strips of velcro. What enabled her to wash the floor without water and sliding the broom smoothly.

Also in our case, the evaluators coming from medium-sized cleaning companies are predominantly middle-aged women, without a real specialization if not the experience gained over the years carrying out this task. The women took turns, inside the laboratory yard (a university campus), in the guide of the trolley, carrying out all the cleaning operations known to them, evaluating and bringing out:

- weight and fatigue during the push in a linear way and in change of direction;
- accessibility to the various sectors in which the trolley is organized;
- ergonomics of use of the main components;
- spaces available for personal effects (smartphone, water, cigarettes, personal gloves, etc.);

- safety for the person in relation to the parts in use;
- strength and durability of the components;
- expressiveness and significance of shapes and colors.

The test with the trolley was repeated 3 times by 40 operators and some site managers, in order to achieve credible results that depend on the knowledge of the tool or machine by the person. A knowledge that gradually matures with a learning process in which the user can encounter more or less large difficulties, depending on the complexity of the instrument (Polillo R., 2010).
Overall, the trolley, characterized by closed compartments for order and safety against accidental contact with cleaning products considered dangerous and dirty tools, proved to be a very convincing product, obtaining results of total quality evaluation more than positive by of the evaluators, respectively: excellent 20%, great 60%, good 15%, discrete 5%, sufficient 0%, mediocre 0%, poor 0%, seriously insufficient 0%. On the other hand, limited usability gaps have emerged that are already undergoing revision by the manufacturing company, including: the control and protection against impacts against walls and passages, the placement in an inaccessible place of detergents for the purpose of security against third parties, the guide with a horizontal handlebar and the need for spaces to devote to the recovery of the personal effects of the operator.

4. Data collection. An inclusive service to data management of cleaning and facility maintenance.

The second phase, whose object of innovation is the creation of a data collection service to check the efficiency of the building site where the cleaning takes place, opens access to the "latent" needs of user and awareness of having an active role, with the ability to take or suggest decisions.
Redirecting the supply chain process, to understand all the relationships that are established between the various subjects involved in the "cleaning" activity, also extended to some operations that today compete in the maintenance service of the large collective spaces (facilities), given life to a virtuous "systemic cycle" that has effects of return as well as service also on the product.
It is important to organize and optimize all the parts within a system so that they evolve coherently with each other and to accompany and manage, at all stages of service development, mutual dialogue between the various actors in this field (Bistagnino, 2011).

The products, designed and constructed, will therefore not only be the object of an isolated activity conducted by the Designer and the Producer, but the result of an activity directed by new relationships based on the sharing of experience. In which way? By recording the perception that different users have of the activity and planning the possibility to signal and organize "data":

- the collected data serve to improve the service in real time;
- the collected data, object of a reading by competent subjects and with responsibility on each specific phase, are used for the improvement of the product.

A further innovation is represented by the inclusion in the customer satisfaction and data collection process, for the first time in these service areas, of the end user, who lives in the spaces.

It is thus created a process of sharing the activity on the part of all the subjects who live and share that activity; subjects that previously positioned themselves, according to a linear chain of relationships, downstream of the activities of conception and realization of the product.

4.1. A digital service 4.0

The cleaning operator is a professional figure with a low specialization, subject to migratory phenomena in the past as recently, with a massive entrance today of foreigners; has a high incidence of female labor (65%), also demonstrated by the fact that for 70% it is still held in part-time regime, sometimes also as a double job: one of the motivations is that it takes place (75%) in anomalous hours, outside the opening hours to the public. It is a profession that seems to have flexibility because of the aforementioned characteristics and probably, according to the experts, it will be subject to considerable changes in the future. It is our opinion that it could also be an opportunity for those who have lost their jobs in middle age and who have entered here, perhaps temporarily, could guarantee a higher cultural level; even greater knowledge and familiarity with digital technologies.

This was a conviction of the opportunity to design a service based on relationships and the exchange of data, also focusing on obvious economies of scale deriving from the synergy between "cleaning" and "structures" operations. Specifically, it involves using the "cleaning" activity aimed at spaces as a complementary activity to the "maintenance" one, detecting faults, defects and improvements to the service in order to have a return on the operation of the service and on the design of the products.
The cleaning/facilities 4.0 therefore wants to put the person in the spotlight: both the operator responsible for cleaning the space and to which a more active participation will be required, and the client, who can thus take advantage of a more efficient and quality service, in which "to count". But the new systemic process will also involve the employer in terms of increasing productivity and staff satisfaction.

The new digital approach has a structure designed in such a way as to make the staff work better, with greater efficiency and professionalism. The operator will already know where to go and how to equip his trolley. No more empty trips and no more overloaded trolleys. In this way work will be less stressful and more rewarding. The time that will be saved, will allow to focus more attention on the controls, raising in this way the quality of work and stimulating the motivation of the operator. The collected data will then be used to check the performance and performance of the service provided.

In relation to the state of the art and the future it is therefore important to understand how this new activity configures as a Smart Service, i.e. "a new generation of IT and technical infrastructures that help manage and monitor systems, exploiting the logic maximum integration between all the players in the supply chain, including customers" (Agrawal, Mani & Minsok, 2001). In the years to come, companies will have to take courage and direct their planning and economic attention towards the efficiency of services. While it appears that in these two sectors, especially in small and medium-sized businesses, the potential associated with the digitalization of services is almost completely unexplored, and the advantage linked to faster and simpler data sharing, especially at the supply chain level, is not yet understood.

4.2 The digital service architecture

The service is the result of a systemic approach to the relationships between the players that are highlighted within the cleaning yard (end user, cleaning operator, site manager) and, outside of this, expanding the circularity of information, the data, to the subjects that make up the entire supply chain (cleaning company, supplier, producer).
From this perspective, the HCD and in this particular case the HCI provides for the design, implementation and evaluation of interactive systems in the context of the task and work of users (Dix, Finlay, Abowd & Beale, 2003)
The possibility of having "information and data" will allow both to positively affect the management dimension of the cleaning yard, encouraging greater efficiency and effectiveness from the point of view of processes and economy of resources, both on the activities of the actors in the supply chain positioned outside the work sites, in terms of managerial management for cleaning companies and product innovation for suppliers/producers.

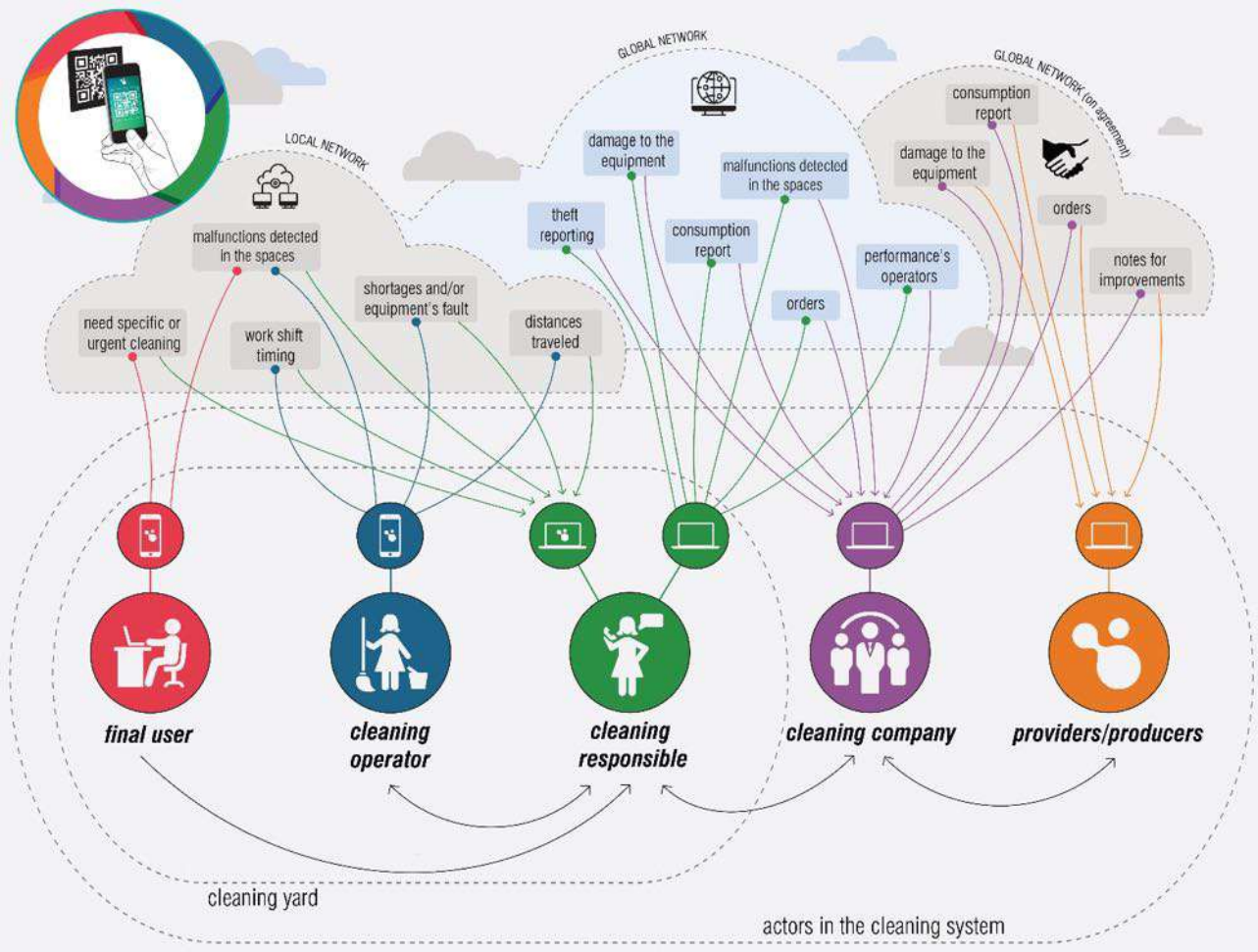

Figure 4. The actors involved in the cleaning system and the relationships that are created at the network level

The QR-Code is the key to accessing the functionalities of the service. Chosen for its simplicity of access, as well as easy and economic planning, this key can open both the entrance to the environments that make up the site (the rooms) and equipment (trolley, equipment, supplies).

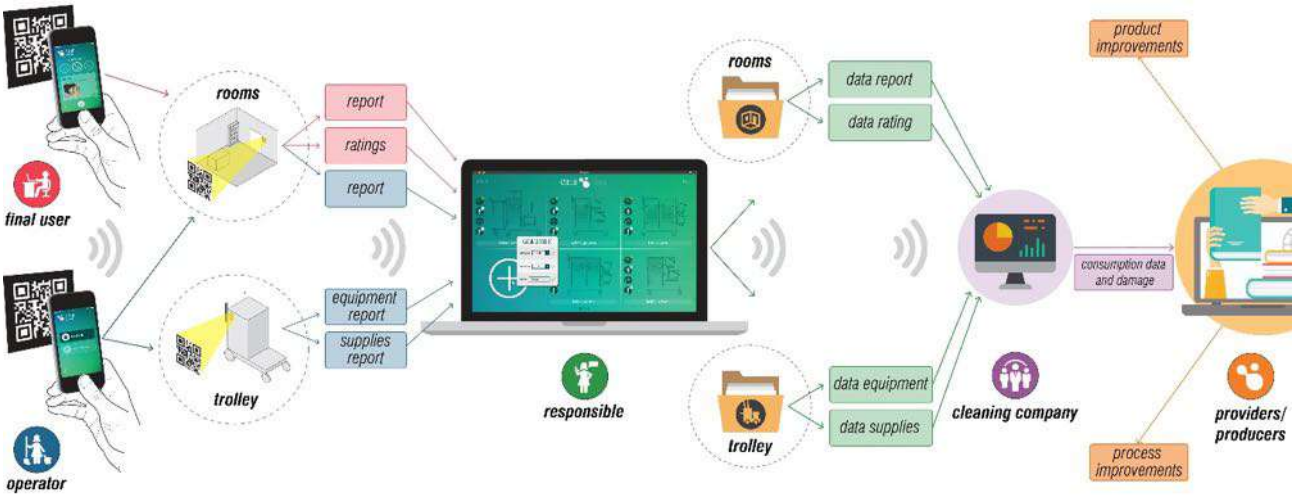

Figure 5. The various types of access to the service and the features it offer

It is accessed with tools for both personal and professional communication. The end user and the cleaning operator, within the construction site, will use their smartphone (even if the issue is still under discussion for the operators) to access a series of interactive screens where the contents will refer to the room or trolley in question.
On the other hand, the site manager will have at his disposal a tablet, configured to receive and send simple data with the operator and the end user, subsequently processed in a more complex form for sending to the company.
The data and the information that in passing in passing are extended, are managed by a digital platform with controlled access, for the sole exercise of the responsible of yard. This figure therefore assumes a crucial responsibility within the system: it can improve in real time the efficiency of the cleaning service, including the speed of service, the level of hygiene, sustainability and customer satisfaction, with regard to building site environment; has the task of collecting and cataloging, in the first instance, the data collected from communications with the end user and operator, sending them to the company.
The company is the fourth subject involved in the system: it has the task of analysing the data collected by the responsible of yard, distinguishing between those that can be used for the improvement of their service and those concerning malfunctions of components or products, together with new potential needs to be sent to suppliers/producers.
Obviously, the feasibility of the system provides for forms of alliance in terms of agreements between the company and the supplier/producer.

The User, i.e. the inhabitant, accesses the "communication platform" connected to the site manager only, to request urgent interventions, to indicate additional needs for cleaning, furniture and system malfunctions. But it can also provide evaluative feedback regarding the cleanliness of the room in which it is located, both in the form of a "text" note and a "photographic image", to date the most direct and easy tool for orientation and reference.
The cleaning Operator has the possibility to access the application in two different ways, one for the rooms and one for the trolleys. Accesses the room interface to communicate to the site manager the presence of any faults within the room and, by selecting the "feedback" item, check for readings and/or requests made by the final user.
Instead, it accesses the trolley's interface, by selecting the item "equipment" and "supplies", pages through which it can report failures to the equipment or components of the cart,

qualitative or quantitative deficiencies, already present or coming, referring to consumer products supplied.
For easier accessibility, even multi-ethnic, the pages in question have simplified lists of icons, captions selectable in different languages, in addition to the usual textual spaces and photographic images.
The responsible of yard can access the "trolley" page where he can update the service status of the trucks, monitor the reports provided by the operators regarding the equipment and supplies, keep an inventory of the daily-equipped consumer products and implement the yard fleet trolley. In a similar way, access the "room" interface, where it is inserted in an interactive site plan to verify the effective passage of the operators inside each room, monitor the reports from these and the users, checking the periodic trend of the assessments received.
The third and last mode of access for the cleaning responsible is that relating to the item "data collection". From the contents on this page the manager can perform, by selecting one or more filters, archive searches of the received messages, view infographics reports related to the chosen time interval, organize the data transaction, upstream, towards the cleaning Company.

5. Conclusion and future developments

On the basis of what has been tested, it is presumed that within a period of 6 months it will be possible to verify the feasibility of punctual proposals by evaluating the dimensions between "local" and "global" networks.
It is probable that the end user, interfacing with the cleaning operator, aspires above all to enrich himself through the proposed activities as "local network", in addition to possible contacts. Meanwhile, the cleaning company operates in what is referred to as its "global network".

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