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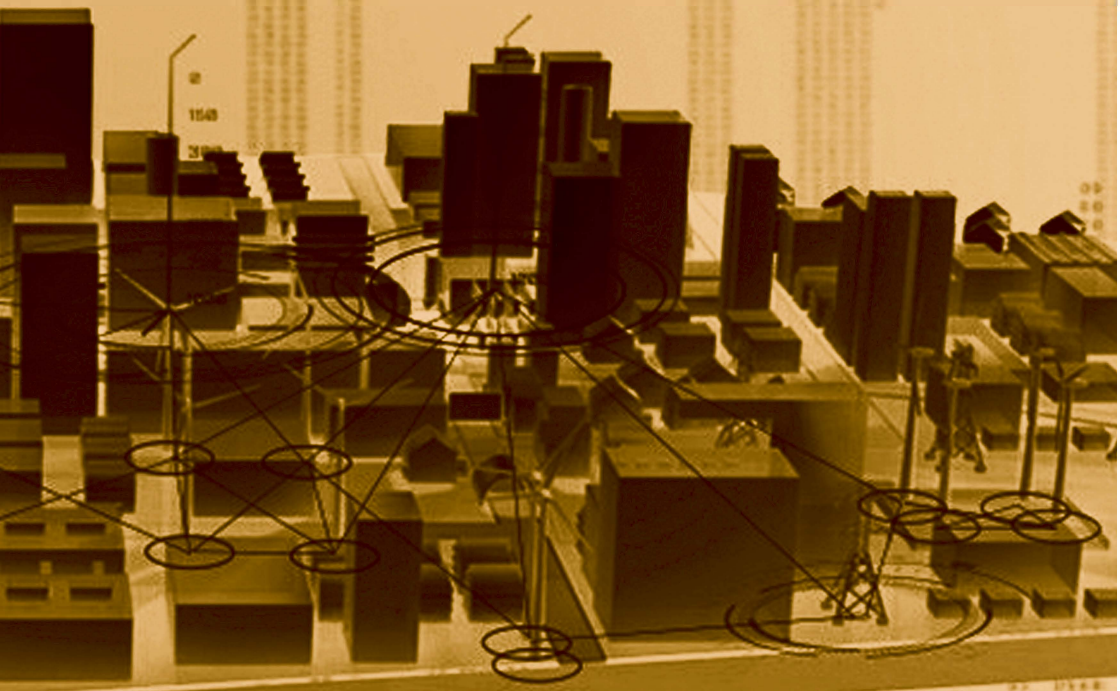
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19 November 2026

Producing Project

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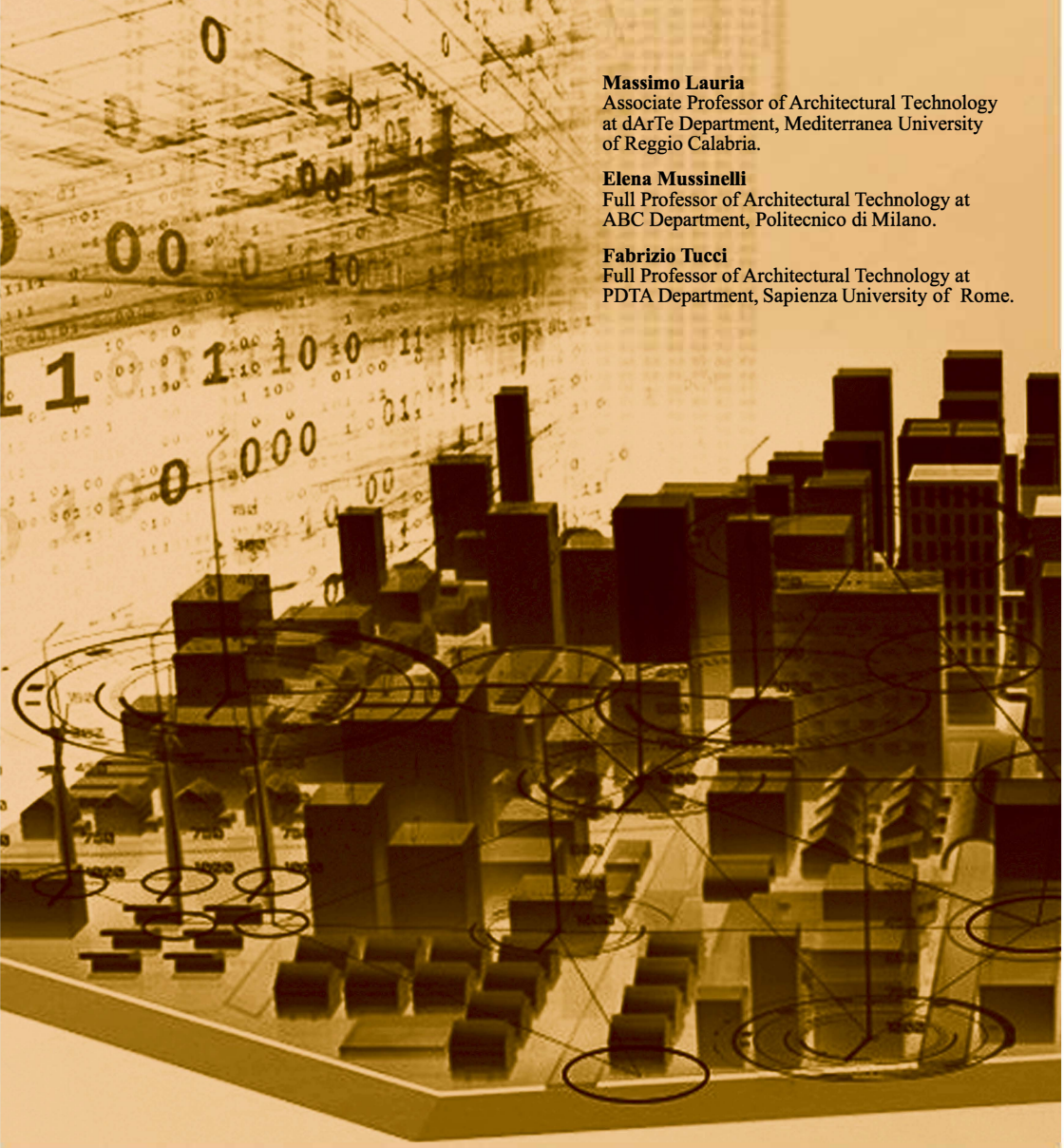


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The transformations created about the design activity by the several challenges started by the economic crisis, climate change and environmental emergencies, together with the impact of the Web and ICT on social and productive systems, highlight many critical issues, but also significant prospects for updating concerning places, forms, contents and operating methods of "making architecture", at all levels and scales.
In this context, the cultural tradition and disciplinary identity of Architectural Technology provide visions and effective operating practices characterized by new ways of managing and controlling the process with the definition of roles, skills and contents related to the production chains of the circular economy/green and to real and virtual performance simulations.
The volume collects the results of the remarks and research and experimentation work of members of SIT*d*A - Italian Society of Architectural Technology, outlining scenarios of change useful for orienting the future of research concerning the raising of the quality of the project and of the construction.

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Massimo Lauria
Elena Mussinelli
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2.15 NEW TECHNOLOGIES AND DESIGN: INNOVATIVE CO-DESIGN TOOLS

Grazia Giulia Cocina[*], *Gabriella Peretti*[*], *Riccardo Pollo*[*], *Francesca Thiebat*[*]

Abstract

Co-design has always existed, although in various forms. However, tools and methods have recently changed, including an ever-increasing number of new technologies used to encourage and simplify participation by all the users involved in the various design stages. Tangible User Interfaces (TUI) is one such technology that has not yet been sufficiently studied. These interfaces make digital data not only visible but tangible so that they can be controlled using physical objects that are easy to manipulate. This contribution will provide a more in-depth analysis of these tools, highlight their potential, and theorise their use in the design of complex projects such as hospitals.

Keywords: Co-design, Hospitals, Tangible User Interfaces, Participatory tools.

Framework

Several factors - including multiple users, decision-makers and relationships - make architectural design and the building process extremely complex. For hospitals in particular, these factors include the technical, managerial, and functional aspects of the activities in question.

The ethical, social, and economic importance of these activities means that consideration has to be given to the special needs of the patients, health workers, technicians, or simple citizens who use these services when they work.

There is in fact ample proof that the quality of the environment can not only influence the therapeutic outcome (Ulrich et al. 2004), but also affect the costs of the services and management.

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As a result, an extremely thorough design process must be adopted to establish the present and future needs of those who use these spaces so that users can use and perceive them as suitable environments.

Appropriate tools are the ones that provide an in-depth analysis of users as part of the demand-performance metaproject.

Depending on how they are employed, they should present specific ways to involve the users, medical workers, technicians, and patients in order to identify solutions that will satisfy the predefined objectives.

In fact, all too often, once construction of the buildings is completed, they do not fulfil the function envisaged during the design stage. Proof comes in the following form: numerous post construction interventions not only spark considerable direct costs, but also affect the efficiency of the health centre.

To avoid this risk, designers must accept the challenge of involving the final users in order to meet their needs. This dual objective can be achieved by adopting the methods developed to optimise the design of services and products and using them in the field of architecture.

These methods can be divided into two big categories: User Centred Design and Co-Design. Despite the fact that the prime focus of both methods are users and their needs, they differ in the way they interact with the users.

User Centred Design considers users as being predominantly passive, i.e., designers study their needs either through observation or interviews. Instead Co-Design focuses on how to actively involve users in the design process. The main difference between these two approaches is therefore to shift from design "for users" to design "with users" (Sanders, Stappers, 2008).

There are several ways for users to be involved in the design process, depending on whether the designers act as interpreters or play a supporting role. As an interpreter the designer involves users as much as possible, but he is still the person who will later implement all their inputs. Instead if he plays a supporting role, he will tend to put himself on a par with the users involved in the overall organisational process.

When a hospital is designed the interaction between the design of the spaces and the activities performed there must necessarily be governed by qualified designers so that users – above all health workers with their knowledge and specific expertise – can express themselves to the full and be part of the design process.

In other words, the role of the design team is crucial, as is the involvement of specialists (organisational health, architecture, technologies, and environmental and clinical psychology). However, it is always the designer who plays a leading role and takes the responsibility for the choices that are made. They use their disciplinary expertise to steer user involvement.

This contribution will use case studies and examples illustrated in literature to identify innovative co-design tools that can be applied to the design of hospitals.

Co-design: tradition and innovation

Not many documented architectural projects have fully exploited codified user involvement methodologies, especially in Italy. This approach tends to be more prevalent when designing patient services or care pathways from a medical point of view. For example, Experience-based Co-design (EBCD) developed and disseminated in Great Britain in 2005 and strongly supported by the local health system. The EBCD is an approach used to improve the quality of health services through user involvement and experiences. In a co-design process staff and users work together in partnership; they discuss their experiences and then decide the priorities that need to be changed and how to implement them (Donetto et al., 2014).

The EBCD has become popular beyond the borders of the United Kingdom, so much so that from 2005 to 2013 numerous user involvement projects implemented in six different countries have produced excellent results.

Despite the fact that highlighting users' experiences is undoubtedly one advantage of this approach, it was not invented specifically to be used in architectural design.

Nevertheless, the benefits of co-design in the field of hospital design have been acknowledged in international literature, as underscored by Steen et al. (2011). They state that the key to a successful patient-staff relationship is to recognise that patients are the "experts of their experiences" and must therefore be taken into consideration during the design phase.

The Pharmacy of Whittington Hospital (London) is an interesting example of a recent co-design process. The hospital employs 4,000 staff who care for more than 500,000 people across north London. Although not a big project, the pharmacy is a strategic hub in the hospital. The project involved thirty-eight medical staff and used affinity mapping techniques[1] and *experience prototyping*[2]. The Urban Hospice designed by Nord Architects (Copenhagen) is another example of hospital co-design. The participation implemented by the studio envisaged close collaboration between the architects, patients, and users; this approach impacts enormously on the final design which is always first class. The architects organised workshops where the actors involved established their needs and then created scale models.

Although these projects are important examples of co-design, they use traditional methods which do not lead to a real, beneficial involvement of operators and users. In fact, traditional methods such as mock ups (ranging from a schematic scale to full scale) are based on personal interviews and the not always symmetrical sharing of documents and physical models.

---

1 Affinity mapping techniques involve a creative process to gather and organise a large amount of data, ideas and proposals and then highlight their relationship and stimulate a discussion.

2 Simulation of the service /space/activity capable of envisaging and assessing certain performances using physical interactive experiences.

These characteristics are the reason why little use is made of co-design when it comes to designing hospitals.

In recent decades efforts have been made to solve these difficulties. Co-design tools have been radically revamped thanks to new technologies which have drastically changed that way in which information is transferred and shared; they have also added interaction and simultaneity to the active participation of users in the design process.

There has been significant progress in the design of some tools that use immersive environments, including Augmented Reality (AR) and Augmented Virtuality (AV). Augmented Reality makes it possible to visualise a scenario in which the real world is virtually embellished with additional information generated by specific software programmes. Users are completely immersed so that they cannot tell what is real and what is not. Augmented Virtuality instead creates a virtual space in which real elements are integrated into the environment and users can interact with them in real time.

Tangible User Interfaces (TUI) are another kind of tool (still experimental) that could play an important role in co-design since they would allow greater sensorial and interactive user involvement. They use innovative interfaces that make digital data not only visible but tangible so that it can be controlled through physical objects and allow multiple users, even if they are not experts, to collaborate and participate fully in the simulated design process.

Tangible User Interfaces: possible tools to enhance co-design in hospitals?

In 1993 a special edition of the magazine Communications of the ACM entitled Back to the real world presented a provocative hypothesis: computer graphics and virtual reality would distance people from their environment and as a result the real world would increase its digital functions rather than oblige users to participate in a virtual world (Shaer, Hornecker, 2010).

This inspired the Tangible User Interface concept, an alternative to the usual computer interfaces known as Graphical User Interfaces (GUI). In fact, the latter provides data in the form of pixels on a display; this means that the user interacts only with a mouse or keyboard, making the relationship null or non-existent since it is mediated only by vision and not real interaction.

Instead TUI use physical devices to interact with the digital contents; they manage to exploit our haptic sense and activate an interaction between data elaboration and manipulation that can be instantly and directly re-elaborated.

Professor Hiroshi Ishii, founder of the MIT Tangible Media Group defines Tangible User Interfaces as follows: «user interfaces that augment physical reality by combining digital data and everyday objects»[3].

[3] https://tangible.media.mit.edu/.

TUI can be used in many fields and in many ways; they can facilitate the cognitive processes of users with specific needs or be used in architectural design projects, again to facilitate the mental efforts that are required, especially the efforts needed to succeed in tangibly representing a problem.

Tangible representation can be particularly effective in urban planning and architecture because it can facilitate the designers' cognitive perception of space and provide a more creative immersion in the problem, thereby enhancing sharing and collaboration between users.

TUI can be either passive or active, first generation or second generation. The so-called "tangible workbenches" are one of the most important first generation TUI. They are interactive surfaces developed to support co-design in which tangible objects are manipulated and their movements perceived by the workbench. This kind of TUI also uses dynamic representations thanks to video projections accompanying the manipulation of the tangible objects.

The Urban Planning Workbench (Urp) (Underkoffler, Ishii, 1999) developed by the Tangible Media Group is one example of a Tangible workbench. The Group uses physical models of buildings to simulate shadows, reflected sunlight, wind flows, and other parameters that can be controlled using several interactive objects.

The Urp is a first attempt to involve users in the design process. However, it does have some rather important limitations: users have to necessarily use a predefined set of objects (in this case architectural models) and can only modify their spatial relationship but not their form.

Based on these considerations the Tangible Media Group designed a second generation of organically-shaped TUI. This generation uses other tangible materials, such as clay and sand, that are easier to shape and manipulate. Illuminating Clay and Sand-Scape (Ishii, 2008) are two excellent examples. These two materials are used to shape and facilitate comprehension of complex topographies, otherwise difficult to create using conventional 3D modelling tools. The characteristic of the TUI known as PICO (Pattern, Ishii, 2007) make it the most appropriate for use in architectural design. This interface has an interactive table surface where small objects can be positioned and moved; the objects can be used to tackle the problems associated with complex layouts. PICO combines the advantages of relatively simple mechanical systems with the power of computerised calculus. There are two ways to move the objects: either using electromagnets controlled by the software, or by the users around the table who can physically intervene in the computational optimisation process. A comparative study of several co-design tools has shown how, compared to other proposals, users have solved the spatial problems of complex layouts more efficiently when they use this tool (Shaer, Hornecker, 2010).

Other TUI use tangible interaction in other fields such as logistics. Tinkersheets is a simulated environment that exploits simulation parameters to manage a warehouse. Users establish the parameters by positioning small magnets.

This not only allows office work to be planned and monitored by visualising the activities, but also permits alternative scenarios to be developed.

The key feature of TUI is that they go beyond the limits created by the boundary between physical and digital due to the strong link between tangible objects and intangible representations.

Using familiar objects facilitates the cognitive development of new ideas through psycho-sensorial perception and body movement (Turkle, 2007). In fact, gestures are not just a means to communicate but play an important role in the cognitive development of ideas and concretisation of what is verbally expressed (Goldin-Meadow, 2003).

Early experiments used TUI as support tools to experiment with participation in the design process; they exploited social interaction and dialogue between groups of users, first and foremost designers and future users. This collaboration is enhanced by some of the unique features of TUI such as familiarity, use, and intuitive interaction with everyday objects; these features boost the active involvement of users thanks to the possibility of multiple system access points; this allows simultaneous interaction and something more than just mouse and keyboard mobility. This is the reason why the platforms are very often like round tables where people can meet.

Using these mechanisms TUI allow users to exploit their thoughts and kinaesthetic memory and turn them into non-binding gestures. Actions such as pointing to objects, changing their arrangement, and transforming them can serve as epistemic actions that reduce the mental work load of a certain task by making use of non-mental resources and simplifying them vis-à-vis traditional user interfaces.

All the characteristics of TUI, and the examples presented here, lead us to believe that these tools could well be used to enhance user participation in the design of a complex building such as a hospital. More specifically, the flexibility of TUI, ease of use, and adaptability to different situations, could be exploited during the various stages of a hospital design, in particular:

- during the first concept stages to stimulate ideas from all users;
- during elaboration of the design to simplify communication between the professionals involved;
- during the modification and verification stages to receive feedback from future users;
- during the final design stages to illustrate and successfully explain the design choices;
- while the building is being used in order to help manage the workload.

Alla luce di quanto detto sino a ora, possiamo sostenere che le TUI, pur In light of all the above we feel confident that even if TUI are technologically complex they are important tools with which to experiment, study, and comprehensively apply in the field of co-design so that the final designs satisfy the needs of future users since they are based on a joint, collaborative effort.

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