

New Method of Collaborative Architectural Design: The impact of mixed reality on users' interaction

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Abstract

Stakeholders who are now interested in architectural and urban project are increasingly numerous and are playing increasingly important roles in the design process. This paper aims to discuss the potentials of novel modes of participatory design in relation to the latest developments in Information and Communication Technologies (ICT). The first part of the study involves the extraction of the basic principles that describe an enlarged design framework that could hold in two words: collaborate and innovate. It will build on the founding positions of Donald Schön and Herbert Simon, take up the distinctions between design and creation made by Robert Prost, and draw inspiration from Christophe Midler's research on design and innovation in different Industrial sectors. In the form of a synthesis, it will conclude by proposing a theoretical model based on the idea that every design process takes place in different spaces that are both independent and interconnected by artifacts of various natures that make up the designer's new methodological toolbox, a multi-tasking toolbox, both participatory and collaborative.

Key Words: Design process, participation, collaboration, innovation.

Introduction

The social, economic and environmental requirements dictated by the challenges of sustainable development over the next three decades are difficult to achieve. They represent an enormous challenge for those concerned with architectural and urban design. The answers that society expects from them impose an immense capacity for innovation, a formidable creative energy, but also an important methodological effort and adapted means. Their projects can only be the result of a shared work by all stakeholders. The practices of various project disciplines do not agree well, the language differences multiply the misunderstandings, even the conflicts. To be more precise, architects and engineers vision of the world, remain too distant and fuel misunderstandings, ambiguities that distract the respective points of view, sometimes making them irreconcilable. After having denounced these anachronisms and dysfunctions, this paper proposes to describe an enlarged design framework whose principles could hold in two words: collaborate and innovate. It will build on the founding positions of Donald Schön and Herbert Simon, take up the distinctions between design and creation made by Robert Prost, and draw inspiration from Christophe Midler's research on design and innovation in different Industrial sectors. In the form of a synthesis, it will conclude by proposing a theoretical model based on the idea that every design process takes place in different spaces that are both independent and interconnected by artifacts of various natures that make up the designer's new methodological toolbox, a multi-tasking toolbox, both participatory and collaborative.

Methodology

The hypothesis that we retain in this study is based on the generalization of methods and tools promoting the participatory work in many industrial fields. The practices of architecture and town planning have always been a feedback by the circulation of ideas, innovative projects and new experiences, most often on an international scale. Concepts such as « the garden city », « the functional city », « the global city », or emblematic urban projects such as those in Bilbao or Barcelona have become models that have spread across borders to influence local practices. New reflective processes have often contributed to the reformulation of modes of action. The dissemination of models from different political, economic and social domains is not a new phenomenon: the transfer of strategic planning model from the management sciences or the public-private partnership in the field of finance is, among others, at the origin of important recent developments in architecture and town planning. This study proposes to continue this tradition and to study the methods and tools that are mobilized in different industrial fields and to check their adaptability in the field of architecture and town planning. This study is structured around four axes: first, it gives a general picture of current design methods in architecture and urban planning, in the second place, it analyzes the difference between design and creation, relying on the founding positions of Donald Schön and Herbert Simon; it will take up the distinctions between creation and design made by Robert Prost, and will be inspired by the research of Christophe Midler. In the third place, it analyzes the methodologies of participatory work in the industrial environment and finally it observes the collaborative practices that are currently being developed in the field of architecture and town planning, explaining the new collaborative and participatory design tools developed from information and communication technologies. One of the tracks proposed in this paper is to suggest that mixed reality, as an intermediate object and a shared language between project participants, can constitute a new language of representation of architectural and urban project that would encourage dialogue and negotiation between different actors, professionals and neophytes.

Current design methods: A disturbing situation

Generally, it can be safely asserted that the methods that now frame architectural and urban design tasks no longer function properly. They are not in a position to meet the economic, social and environmental requirements dictated by the challenges of sustainable development. They date back to a bygone era when knowledge was limited enough to be mastered by a small team, or even by a single individual. To put it another way, most current modes of architectural and urban design still belong to a paradigm which dates back to the Renaissance and which was gradually structured and formalized throughout the classical period and lasted until the period of the Beaux-arts teaching. Throughout this period, the architect, assimilated to an artist, behaved like an autonomous hero, conductor of a small group of specialists who surrounded him respectfully. However, stakeholders who are now interested in architectural and urban project are increasingly numerous and are playing increasingly important roles in the design process.

Emergence of new Actors

For several decades, these actors have steadily multiplied, greatly increasing the knowledge and know-how that are involved in the same project. Many professions, more or less sophisticated expertise, consultants of all kinds appeared. Some have established themselves to respond to new missions or new regulation requirements. Thus, programmers, and more generally all the professions grouped under the name of « the client's consultants », have been created to help improve the performance of projects from their preliminary studies steps.

Process fragmentation and intelligence dispersion

The lack of organization and management are too often chronic in the field of architecture and town planning. They are accentuated by a fragmentation of intelligence among these many actors. Today, the points of view between the stakeholders of the architectural and urban project remain too distant, the organizations too fragmented. Even if all or almost all the protagonists see the need for increased collaboration, this fact is poorly assumed in practice. The sequence and sequential phasing of the design does not facilitate synthetic visions. The separation imposed by the regulations between designers involved in project problem seeking and those who are in design solution, whether they are contractors, industrial, facility management or simple users, contradicts any collaborative approach.

Partitioning of education curricula.

The work framework does not explain everything. The education of the different professional disciplines, segregated in closed curricula, is too far apart. The architect is still more often trained as a solitary creator who is accountable only to the criticism of his peers. The engineer thinks he possesses a technical knowledge that he believes to be indisputable and which nevertheless escapes him, as he is constantly renewed. Each one learns specific methods and means of expression, mainly through image and metaphor for the former, by calculation and modeling for the latter. And no significant effort is made in their respective schools, with a few exceptions that confirm the rule, to bring together teaching lessons and propose common collaborative tools. A young student, whether he is an architect or an engineer, will in most cases have never encountered during his studies a future professional from another discipline than his own, and he will have worked even less with him.

Unfamiliarity with usage.

Today architecture and town planning are too often illustrated by a misunderstanding of usage. We no longer count the number of architectural and urban achievements that respond badly to the use for which they were programmed. Their economic, energy, environmental, safety, or simply functional or even aesthetic performances are too often below the expected requirements. Sometimes they are deplorable. The frequent extra costs of construction and maintenance, put at risk the financial balance of their builders and then of their occupants. Bold technical solutions, sometimes adopted irrelevantly, are not always economically viable or adapted to the intended uses. Will the world of design ever know how to manage its contradictions between its legitimate desires to express its creativity, formalism that often frieze academicism and responsible responses that society expects from them?

Unsuitable modes of representation

The increasing number of stakeholders who revolve around the architectural and urban project need to exchange and share information, to participate in conflicting debates, to negotiate points of view reconciliation. To enable them to communicate around the same project, they must adopt common languages and have appropriate representation tools. Architectural and urban spaces have long been, and still are most often, represented by a two-dimensional geometric system consisting of maps, plans, sections and facades. This efficient system has been designed by professionals and is primarily intended for them. It can be completed by a simulation in three dimensions, perspective,

axometry, model, rather intended for the uninitiated, whose expression is more or less realistic and seductive, but sometimes source of misunderstanding. The necessary representation modes for multi-stakeholder negotiation are of a different order. On one hand, they must facilitate collaboration between professionals in charge of the project. On the other hand, they must support interactions between these same professionals and the uninitiated persons to whom they are addressed. This second dimension is essential to the negotiation process.

Change of paradigm: Differentiate design from creation

The above observation may seem disturbing. On one hand, traditional architectural and urban design processes do not appear to be able to cope with the challenges they will face in the coming decades. On the other hand, the stakeholders of these processes are still far too scattered to deal with these challenges. Is it therefore useless to redefine design framework in the light of contemporary urban changes? And is it necessary to differentiate the design from creation, or is it a single action?

In 1964 Christopher Alexander had already attempted to do this by describing what he meant by *Design Process* in an essay entitled *From the Synthesis of Form* which began with the following sentence: «This essay focuses on the «design» process, The process leading to invent physical elements which, in response to a function to be assumed, propose a new physical order, a new organization, a new form» [1]. C. Alexander wanted to model the design process by developing a deterministic method (Figure 1) distinct from creation, which he has done in his famous *Pattern Language* [2]. While rejecting this posture by too scientific, Philippe Boudon also observes that design can be considered as a process (he prefers to use the term operation) which he differentiates from creation. Creation «remains unspeakable, » he writes, while design «can be posited as an object of knowledge. [3] » The first remains mysterious, the second is intelligible. In fact, this distinction appears to be an essential prerequisite for approaching design.

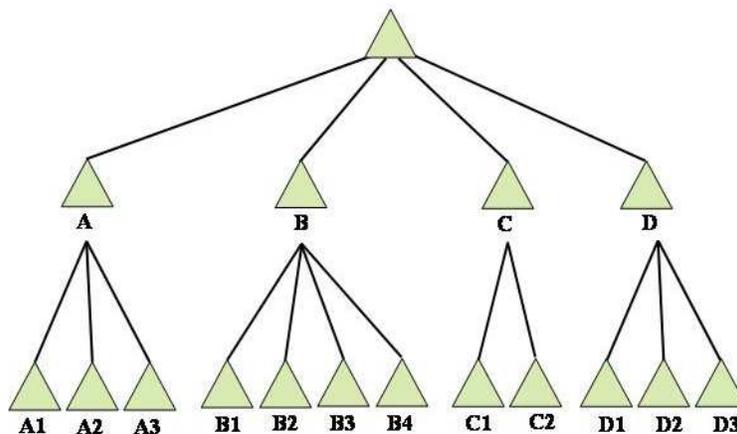


Figure 01: Analysis of independent subsets (Christophe Alexander 1964)

It is probably Robert Prost [4] who most clearly differentiates the processes of creation and design. For him, creation «establishes the most explicit reference with culture, the artistic, with talent» while the design, which «generally underlies a rationalization», is more distributed in space and time, more shared also. The design, according to him, cannot be dissolved in the myth of any black box which would be the metaphor of a hermetic and illusionist creation. While creation is the «

most magical, the most individualistic act » [5], design is an act of collective intelligence based on learning and sharing knowledge and know-how. Design has long been considered to be an iterative system that Jean-Pierre Boutinet describes as follows: « The purpose of design must be materialized in realization design, which will modify, correct the initial design, the last leading to a new shape [6] ». But beyond this iterative character, the current design processes are also collective and they can only be distributed. To design is to put « knowledge in action » Donald Schön wrote in 1982[7], or, according to another of his formulas, it is « a conversation with reflection » Christophe Midler goes in the same direction when he speaks of « conversation with the situation » [8]. This idea of « conversation » between stakeholders in the same design process might seem archaic, scholastically inspired. It nevertheless responds to the contemporary context of design which calls for promoting exchanges, mediation and negotiation.

Double Interaction: participation and collaboration

Interaction is central to the challenges of contemporary architectural and urban design and the notion of reflexivity mentioned by Donald Schön fully applies to it. The design draws on the interactions that are established, or should be, between all the protagonists of a project. « There is no more, those who think but cannot pretend to action, and those who act but do not accede to knowledge, but an obligatory and complex articulation between these two planes [9] » While creation is, and will undoubtedly remain, par excellence, the act « the most magical and the most individualistic »[10] , design evolves into more cooperative forms. The shared design process is both collaborative and participative. This collaborative and participative character of a design process depends on the degree of integration of the various knowledge and know-how that the project-team brings together and the mobilization of stakeholders that compose it throughout a project [11]. However, as has been shown above, this integration is generally far too weak in teams currently involved in the field of architecture and town planning. A contemporary design approach tends resolutely towards two objectives: to collectively innovate and to put the user at the center of its preoccupations.

A new methodological and instrumental device for mastering usage

The user cannot design a project instead of the designer of course, and it is not his role, but he is able to give his vision of the project, to elaborate a representation generally blurred but based on his experiences. This representation, personal as it is, can also be a reflection of a collective approach. It can be shared by a community that is rarely homogeneous but which tries to negotiate reconciliations, to propose optimizations. Whether acting individually or collectively, the user can convey a mental image, communicate abstract concepts mingled with practical experiences. This material can be valuable in guiding programmatic choices or in orienting architectural and urban solutions. Sometimes it happens that the user takes his destiny of inhabitant in hand and plays a more important role in the production of his environment. But this case is exceptional because it requires conditions that are rarely met, in particular a favorable political, economic and financial context, an enlightened, stable and predominantly motivated community, and a charismatic leader, as in the case of Tafelit- Tajdit operation in Ghardaïa, whose realization is carried out by a collective of inhabitants despite the innumerable obstacles habitual to any operation of this type.

Collaborative and Participative Work Methods in Industry

Many industrialists are implementing participative design practices and are using innovative methods and tools to take into account usage and share their projects with future consumers. This is particularly the case for automotive and aeronautical manufacturers. This is also true in the hospital sector, where the practice of collaborative work has made it possible to carry out effective optimizations thanks to reconciliations between the nursing staff and those responsible for realization or transformation of hospitals [12]. In these different professional environments, sometimes very important investments are made to better understand the desires, needs and requirements of their future customers and to put them at the center of the design of a new product or a new project. Sociology of work, sociology of action, ethno-methodology, psychology, marketing, management sciences are most often mobilized to develop methods for understanding the relationships between an artifact and its users. No luxury industry, no innovative information and communication technology (ICT) company would embark on designing a new product without thoroughly testing, verifying and validating with their future users the acceptance capacities of the innovation of which it is the bearer. These differ according to the type of product and company culture, but are generally based on rigorous scientific disciplines. They also rely on user learning processes and are aimed at accessing users' daily experiences, their needs, identifying their capacities to act, helping them to generate creative ideas, to consider with them new uses, to experiment collectively innovative proposals in a realistic context. In the field of ICT, manufacturers often use pre-prototypes or mock-ups, simple and easily adaptable, have only a few functionalities, but representatives of the finished product, to test with their users the first hypotheses of innovation and refine specifications. The incomplete nature of these products facilitates the interaction between designers and potential users and can become an interesting breeding ground for creation and innovation [13].

Christophe Midler Innovation route

When describing these co-innovation processes (Figure 2), Christophe Midler and his CRG team [14] put forward the concept of « innovation routes » (Figure 3), project trajectories that go beyond the restricted framework design of a single vehicle to deploy on other projects within or outside the company.

To explain these routes, C. Midler evokes different « spaces » that he lays out: supplier project space, constructor project space and a third space that he defines as « the space for vehicles projects ».

Innovation routes include an initial exploratory stage and a second step to contextualize the innovative offer in the vehicle project. These first two phases lead to the industrial development cycle of the vehicle. Then can start a redeployment of innovation on other projects. This study leads to an important observation: a co-innovation process requires a beforehand implementation of learning strategies for all involved stakeholders of the project.

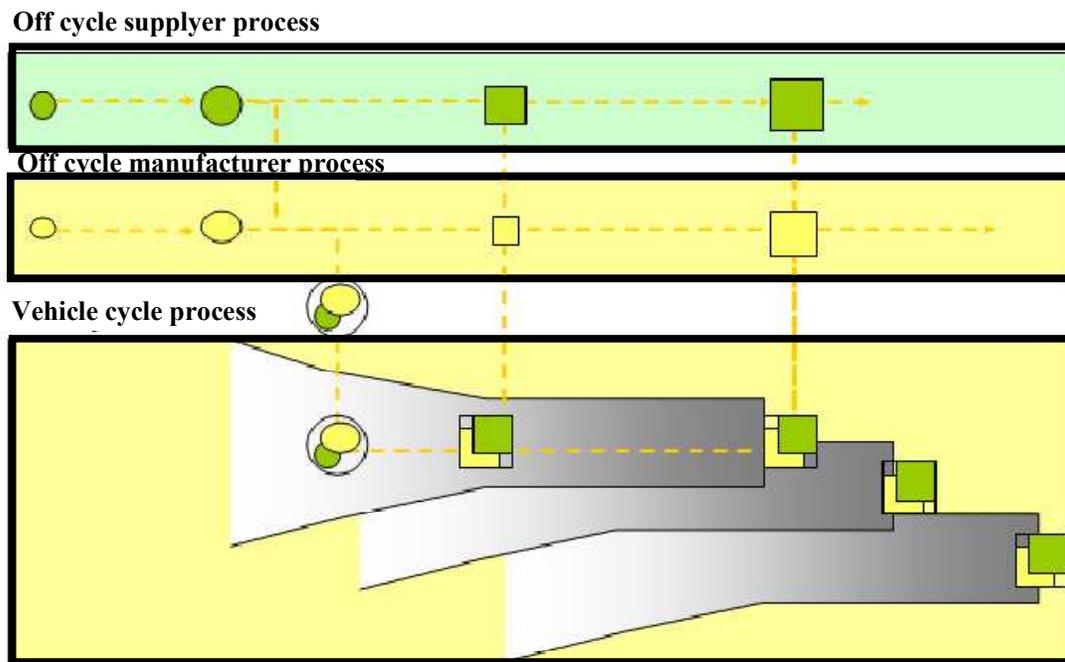


Figure 02: Co-innovation routes (C. Midler, R. Maniak et R. Beaume, 2005)

Discussion of the C. Midler model

Christophe Midler's previous scheme describes a design process specific to the automotive industry that takes place in different spaces, some of which are seen as part of the design cycle of a vehicle, while others are off-cycle.

His scheme also specifies how an innovation route is taken by the designers to move from one of these spaces to the other throughout its development. To justify the use of this metaphorical notion of design space, C. Midler refers to the differentiation between process and product [15] that management experts do, to identify two types of skills in an industrial production activity : On one hand, «process-oriented» skills which have as objective the realization of a project, optimizing its quality, controlling costs and deadlines and concentrating on tasks related to the project management; and on the other hand, «product-oriented» skills (Figure 4) that emphasize the user's point of view and focus on defining the object to be realized, its formal and aesthetic characteristics, performance and behavior throughout its life cycle. The stakeholders are mobilized differently in each space: in some, it is rather the managerial, technical and economic expertise that is summoned; in others, rather social skills and creativity. Each one of these spaces has its own tools, languages and codes. Between them, translators are needed to facilitate dialogue, promote negotiation, and optimize compromises

Analysis perimeter of innovation performances: the innovation route

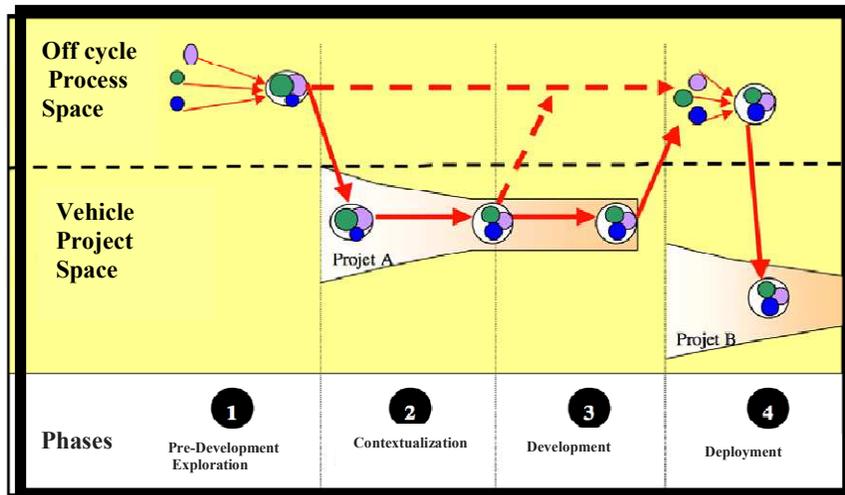


Figure 03 : Innovation routes (C. Midler, R. Maniak et R. Beaume, 2005)

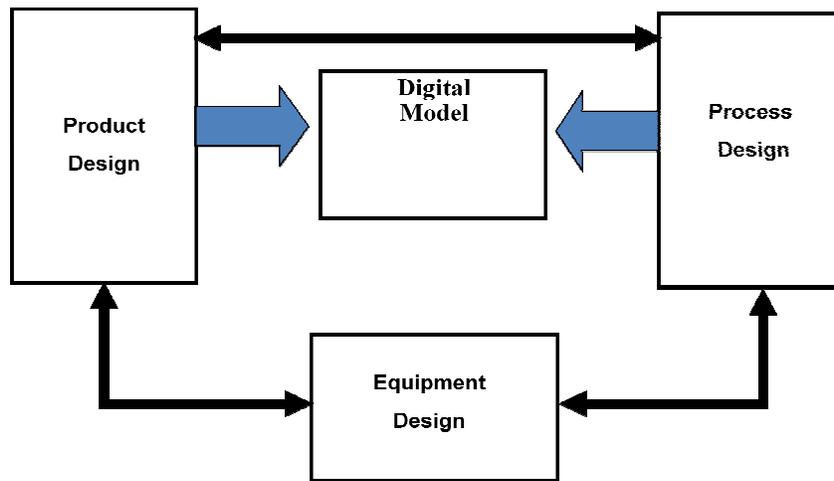


Figure 4: Dynamic Process (l'auteur 2008)

Transposing Midler's Model to Architectural and Urban Design

We consider, for our study, that the C. Midler's model is partly transposable to architectural and urban design. Several researchers and practitioners working in this field, refer to the concept of «design space» when they talk about multi-actor project practices. Thus, in an epistolary exchange with Philippe Boudon [16], Herbert Simon affirms that it is necessary to differentiate process and product (Figure 4), because these would not belong to the same design space. «The product is the sculpted piece, the process is the hammer blow sequence that leads to this result, » he writes. On the occasion of this discussion, Philippe Boudon also introduces the concept of *design space* to which he associates to the « representation spaces » which he specifies that they are «carriers of design operations». To illustrate his reasoning, he evokes the work of the musician and compares it with that of the architect: the musician's score, he explains, is his design space, as the drawing is for the architect. It differentiates this design space from the real space or the realized work [17]. The approach of H. Simon's and P. Bourdon's converge and lead to the idea that design would take place simultaneously, as in industry, in different spaces and these spaces would require adapted modes of representation. The proposal made here is inspired by these different points of view. According to this hypothesis, illustrated by the diagram below (Figure 5) (J.J. Terrin 2012) [18], architectural and urban design would take place in several very specific spaces, each one them has its sets of actors, its rules and its purposes.

Findings : The emerging model of collaborative & participatory process

Through our exploration of collaborative and participatory design theories in the world of industry and project management and our theoretical studies on the reflective thinking of Donald Schön, we have tracked the success factors or requirements that must be the foundation of an organizational model and a collaborative, participative, integrative and efficient architectural and urban process (Figure 5). These requirements highlight the importance of the complex thinking of architecture and town planning, of an interdisciplinary structure and of the trans-disciplinary functioning of the project team, in order to break the individual and collective psychological inertia that brake creativity. Old visions of architectural model are no longer sufficient, a re-evaluation of the role of the architect and a new way of « thinking » architecture are necessary in the current context of disruptive ICT. This is what we have tried to demonstrate in this work; the collaborative and participative process model (Figure 5) is based on the idea that any design process takes place in different spaces that are both independent and interconnected by artifacts of various natures that make up the designer's new methodological toolbox, a multitasking toolbox, both participatory and collaborative. So the reconnection of nowadays disparate factions (ie user, client, architect, designer, engineer, contractor, craftsman and machine) is permitted by informal relationships and the exchange of knowledge in a digital environment. The architectural and urban design is being transformed from a traditional linear and segmented process; Which focuses on the physical object of the building / city and the autonomy of the designer, to a holistic process of a life cycle that breaks down the autonomy of the design into a collaborative and participatory team with knowledge exchange between the user, the client, the architect, the engineer, the expert, the contractor, the craftsman, and the machine, thus producing an integrative architecture and urbanism.

Explanation of the emerging model (Figure 5):

Space (project) off cycle: Is a space of previous acquisitions and capitalization. It is a space for knowledge management and continuous learning. It constitutes the receptacle of knowledge and know-how and is gradually enriched from project to project.

Space of uses: Is a space of «creative density», to use Ina Wagner's expression[19], that is to say it is thought to stimulate the imagination by its environment; its methods and tools are dedicated to exchange and debate. It is oriented towards usage, and the user is an essential actor. It allows all project stakeholders, directly or indirectly involved, experts and neophytes, to share their vision of the future at the earliest stages of the project.

Collaborative Space: It is multi-actor, multi-task and multi-layered space. It is a space of performance common to all the stakeholders in charge of the project process. It connects the different stakeholders of a project in a shared environment, in which they have tools and databases, as well as all technical, legal, normative knowledge necessary for the design and evaluation of the project. Designed as a common work platform, it is interactive and can accompany the project throughout its design, construction and life cycle.

Real space: Is space of the territory where a project is implemented, then the site on which the work is realized, and then renovated, transformed, recycled and finally deconstructed. Real space is the physical, inhabited and evolutionary space of the building or urban space, to which all actors refer, not only before and during its realization, but also throughout its life cycle. Its description must therefore be able to evolve over time, to be accessible, to be consultable, to be modified, and to evolve throughout the life of the work.

The representation modes of the different spaces

To each of these spaces belong methods, tools, languages and, more specifically, different representation modes. The first space, information is organized to store acquired knowledge, and transmit it to form and inform. In the second one, the representations are intended to facilitate narration, dialogue and exchanges that facilitate the participation of external actors in the development of a collective project vision. They carry utopias and fuzzy, imprecise formulas that the project will later reveal. In the third one, representations are designed to facilitate professional collaborations, performance descriptions, and progressive syntheses between the various data that inform the project. In the fourth space, real space, representations are designed to manage the life of the project, its location in the site, its realization, its maintenance, and its subsequent transformations until it's recycling. They are anchored in reality, in tune with the physical characteristics of the site, the construction and the life cycle; manage the inputs and outputs of flux, material, energy, etc

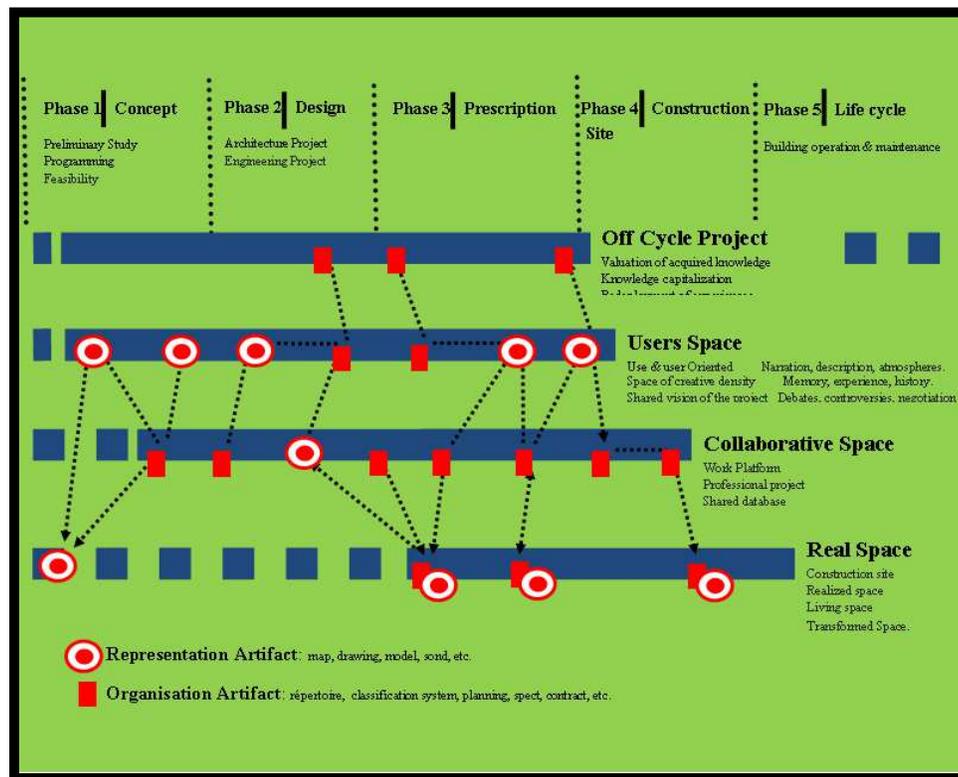


Figure 05: the emerging model: Design spaces and innovation routes (J.J. Terrin 2012)

Intermediate Objects and Shared Languages

When designing a project, designers follow routes that differ according to the characteristics of the object to be realized and its context, but which depend mainly on their working methods and the degree of innovation sought. C. Midler refers in this connection to the notion of the « innovation routes ». The previous scheme (Figure 3), shows that these routes, circulating from one design space to another, can be random and iterative, and they no longer respect the sequential and hierarchical nature of traditional processes. [20]. They must have translators, passers, intermediaries or, adapted tools. An intermediate object performs a triple function of transferring information, translating from one language to another, and mediating between different points of view [21]. It can therefore be an effective negotiation means while playing an important role in the transmission of ideas or concepts throughout a design process. As Bruno Latour explains, intermediate objects are artifacts « whose distinctive features are to be mobile, but also immutable, presentable, readable, and combinable among them». [22]

An intermediate object can be an organizational artifact such as a directory, a classification system, an agenda or a work schedule. It can be an artifact of representation such as a map, a plan, a drawing, a model or a mock-up. It can be more suggestive to stimulate imagination and creativity, such as a sketch, an image, a prototype. It can be concrete or abstract, or hybrid. It can be purely visual, but also involve a part of multi-sensoriality, associating it with sound, oral and writing, because, as Michel Lussault observes: « iconography plays the role of speech shifter without contest. [23] ».

Mixed Reality: a paradigm for user interaction.

Concept of mixed reality

The term mixed reality refers to a set of new technologies that articulate various virtual and real elements. The notions of real space, virtual space and mixed space that participate in the MR are defined in a relatively coded way by computer scientists and are mainly intended for digital technologies. Generally speaking, what is generated by computer is considered virtual. Nevertheless, images (photos, videos ...) that would simply be picked up by a digital camera without being reworked are assimilated to real elements by the specialists of these technologies. Therefore, the major technical challenge of the MR is to associate a real scene and digital elements that are intended to « augment » it. According to Ronald Azuma (1997) [24], the founding elements of mixed reality are the ability to interact and the responsiveness of tools in real time. Another widely accepted definition is that of Milgram (1994) (Figure 6) [25]. According to the latter, mixed reality would cover the whole intermediate space included in a continuum between « all real » and « all virtual ».

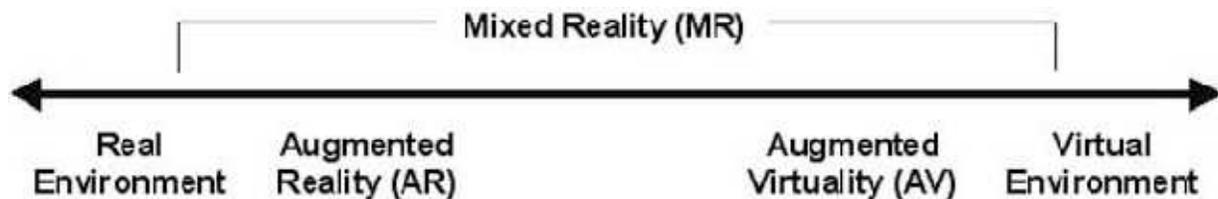


Figure 6: Mixed reality in a continuum between reality and virtuality according to Paul Milgram

Mixed reality contributes to establish a collective intelligence.

Applied to architectural and urban project, mixed reality can contribute to enrich the reflection on the correlations between real and potential context of the project to come. Moreover, it is based on principles of interaction between stakeholders, and in particular tests the relationships that are established with the users. According to Michel Lussaut (2007), [26] «the image presents what it invents, what it makes happen». The representations resulting from mixed reality allow us to superimpose and study the passages between the present reality, the scene that exists before the eyes of those who observe it, with its charge of memory and its uses stratified over time, and the virtual potential of future developments, a project charged with expectations and constraints arising from debate and negotiation between multiple participants, involved in various ways in this transformation (technical, political, operational, etc.) Beyond the more individual activities of creation, these interactions (explicit and implicit) contribute to the creation of a « collective intelligence » capable of producing real and explicit formulations expressing values and shared objectives (Terrin 2005) [27]. Architectural and urban project becomes both object and support of negotiation and can be considered as a mixed system (as we speak of mixed reality) in which the present / real and the potential / virtual find a balance through an interactive process that produces an architectural and urban environment.

Experimenting participative architecture and urban planning.

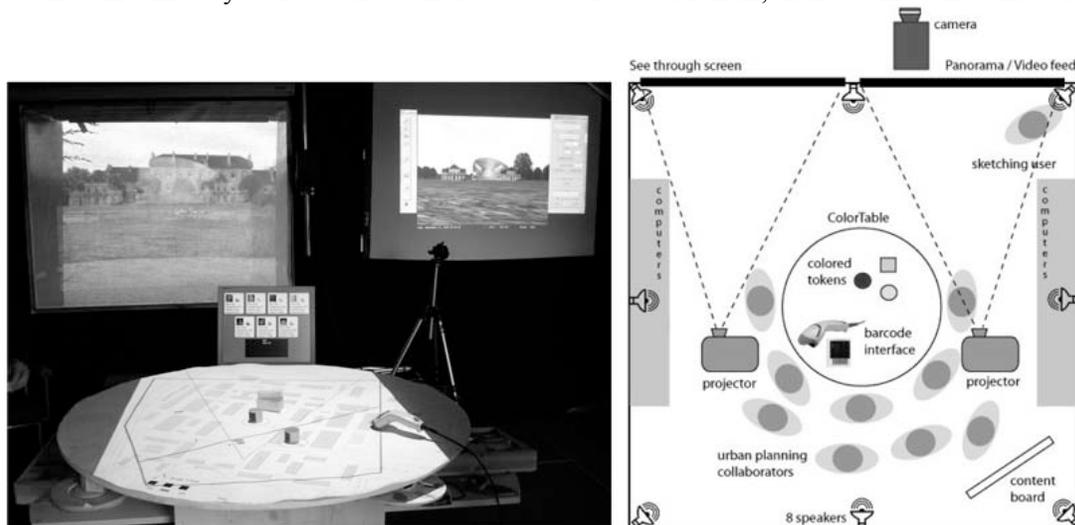
The organization of the experimentation of participative architecture and urban planning requires awareness of environmental issues, through games, and history of architecture and the city. These experiments are conducted in several workshops [28]; they explore and develop portable, mobile and lightweight technological environments. Experiments involve ethnographic observations and assessments, at the intersection of disciplines such as cognitive sciences, socio-psychology and cultural anthropology. Currently, the « toolbox » of this technology is made up of the following prototypes

The MR Tent (mixed reality) (Figure 7) is a mobile urban planning laboratory that can be installed on a site under study and in which actual scenes of the city can be « augmented » by digital images that allow different participants of an architectural and urban project to visualize them in real situation and thus to debate and act on some of their components.



Figure 7 : The MR tent houses several mixed reality technologies

The Color Table (Figures 8; 9) is a multi-user digital table that allows architects and urban planners and their interlocutors to observe together the changes generated by an architectural or urban project. It allows users to integrate computer-generated virtual elements into a real-world environment (the tangible user interface), by projecting onto a transparent screen, a video sequence, or a panoramic photographic projection, and manipulate them in real-time. The manipulation of these virtual elements is done on a site plan of the project placed on a digital table, by means of colored disks to which the objects of the project are associated: buildings, infrastructures, people, vegetation, etc. Scale, color, texture, the degree of transparency and position relative to the ground of these objects can be modified by users. Sounds can also be associated with them, their volume can be modulated.



Figures 8: The Color Table (the tangible user interface) can be used in conjunction with the Urban Sketcher, a mixed reality application designed to facilitate communication between the actors of an urban project. The Color Table can be used in conjunction with:

Urban Sketcher (Figures 10, 11): A mixed reality application designed to facilitate communication between the actors of an urban project. The Urban Sketcher combines several layers of virtual

information that can be developed jointly by its users [29]. They can insert objects into the scene and manipulate them by changing their size and transparency, or by applying colors or textures to them. They can also draw directly on the actual scene, or annotate it and create collages between real and virtual elements.



Figures 8, 9: The Color Table can be used in conjunction with the Urban Sketcher, a mixed reality application designed to facilitate communication between the actors of an urban project.



Figures 10, 11: the Urban Sketcher is a mixed reality application designed to facilitate communication between the actors of an urban project.



Conclusions

In the world of industry, to have recourse to users does not come from any pressure of opinion, nor from the « political correctness », or from any legal or administrative framework binding. Contrary to what happens in the field of architecture and town planning, the motivation of an industrial design team is to mobilize all means that are within its reach to further develop its knowledge about the project environment which is entrusted to them. His conviction that users are innovators prompts them to consult them in one way or another (Akrich 1998) [30]. Moreover, the success of its project constitutes a real economic challenge that depends directly on the decision to purchase as many future consumers. It is therefore not so much the acceptability of the project that is sought as is the case in the field of architecture and town planning, but to evaluate the consumer's desire for acquisition. If these industrial circles work with users / consumers, it is not because they are forced to do so, but because they have strong expectations from these exchanges. It is important for them that these expectations are specified by the project team from earliest stage of their design as long as they allow to make methodological choices, adopt the corresponding tools, schedule, in short to structure the course of the whole project. The theoretical model we try to present in this paper is based on the idea that every design process takes place in different spaces that are both independent and interconnected by artifacts (intermediate objects) of various natures that make up the new methodological toolbox of the designer, a toolbox multitasking, both participative and collaborative. One of the tracks proposed by this work is to suggest that mixed reality, as an intermediate object and a shared language between project participants, can constitute a new language of representation of architectural and urban project that would encourage dialogue between different actors, professionals and neophytes. By their dynamic vision of architectural and urban scene, by the interactions that they would facilitate, by the fusion that they would operate between the real space and the virtual space, by their capacity to apprehend architecture and the city on a real scale, these languages would constitute a real break with the present modes of representation. The new mixed reality technologies could be used to develop syntheses, to make dialogue between different strata, to work on interfaces, to show what is invisible, both in technical and cultural terms, especially when discussing with actors not accustomed to the classical modes of representation of the architectural and urban project.

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