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Multi-actor decision making using mixed reality technologies¹

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Key words: urban project, negotiation, communication & representation medias, collaborative

Abstract

This paper is based on the results of an ongoing research project, IPCity, on the application of mixed reality technologies in urban environments.³ It questions the relevance of traditional language and communication medium such as drawings, perspectives and 3D models in the co-production of urban projects in multi-actor working environments. It then discusses the possible use of “mixed reality technologies” as alternative medium through five workshops organised within the framework of the research project in France between 2006 and 2008.

Urban projects and multi-actor collaboration

Public authorities and urban specialists can no longer lead urban change by themselves, may it be to minimize incertitude, to share the risks involved or to adopt a more democratic approach to the city making practice. Central and local governments are obliged to work with other actors to form power networks, as is attested by different scholars who work on “urban governance”. (Offner 1999; Newman and Tornley 1996) The power of decision and action is becoming multiple, unstable and fragmented with the participation of new stakeholders such as property developers, financial institutions, non governmental organisations and citizens, who represent diverse professional cultures, academic training and economic and social priorities to the city making process This context makes the definition, the programming, the conception, the financing, the implantation and the management of urban projects difficult and makes of the integration of these new stakeholders into the planning/project process an important issue. (Healey & al. 1997)

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³ IPCity (FP-2004-IST-4-27571), Integrated project on Interaction and Presence in Urban Environments, is partially funded by the 6th framework program of the European Commission and has been launched in January 2006. The final reports will be submitted in March 2010. Those institutions that make up the project team are : four research laboratories working on MR technologies (Helsinki University of Technology in Finland, Graz University of Technology in Austria, University of Aalborg in Germany, Cambridge University in England and Fraunhofer Institut für Angewandte Informationstechnik FIT in Germany), two laboratories working on the ethnological and methodological implications of man-computer interaction (University of Oulu in Finland and Vienna University of Technology in Austria), two laboratories working on urban studies (University of applied arts of Vienna and the University of Marne-la-Vallée in France) and one private sector representative (Sony Networks between 2005 et 2008 and Imagination Computer Services GesmbH between 2008 and 2009).

This new context makes of practices such as negotiation, cooperation, concertation and/or co-production more and more a part of the project making process. The evolution of city making practices from a hierarchical and linear scheme into a collaborative heterogeneous and dynamic process emerges as a real issue within this context. (Amphoux 2002) Those actors that have until now intervened punctually are integrated as full partners to the project making process. The participation of citizens and citizen organizations to this process will complete this system of actors: their involvement will enable a better understanding of user's needs, lifestyles and expectations and will enrich the project: this will also facilitate the appropriation of the project, increase user satisfaction and build trust. (Al-Kodmany 1999)

Those first attempts at integrating different stakeholders into project making processes have resulted with more or less success and provide rich material for researchers from different backgrounds. One of the main issues is improving communication processes and diminishing conflicting situations. (Simmie 2001) Stakeholders, their interaction and the power games that result emerge as another issue that has interested researchers. (Bourdin & al. 2006) Decision making process seems to be another topic that arises, its structure as well as its form being the central question. (Joerin & al. 2001) Language and different mediums of communication are other issues addressed by these studies. (Martin & al. 2003) This paper is a contribution to this latter group of research and questions the relevance of traditional communication/design medium such as drawings, perspectives and 3D models to communicate, to discuss and to co-produce urban projects within a multi-actor working environment. It then questions the possible use of "mixed reality technologies" as communication tools in multi-actor decision making processes concerning urban projects.

Negotiation, communication and the question of medium

Communication between different actors who have diverse professional cultures, academic training, language codes and economic and social priorities is a challenge. This is more so if the process concerns the elaboration of an urban project which has its own language codes that are difficult to comprehend for the non-design oriented actors. The subjective nature of communication and the central role of the medium in this process add to this complexity and give rise to ethical questions on its production and use. This is why one of the main issues concerning participative processes in city-making practices concerns the communication media and the use of visual, oral and written expression. Visual material such as sketches, diagrams, plans, perspectives, models, photographs or computer synthesized images play a central role in city making practices.⁴ Oral expression is the most accessible communication medium for all actors and allows for discussion, commentary, explication and narration. Written documents and specifications serve to inform as well as to keep track of the project process and to record it.

Visual material structures the participative process and the discussion themes: they influence the distribution of roles between different stakeholders and the power structure between the participants. They organize at the same time different types of information concerning the site/the project and the relation between the different stages of city making practice. Written documents and oral expression accompany visual material in this quest, but the relation that visual material retains with these other communication medium is somewhat different from other fields where visual material is mainly used to illustrate texts

⁴ We are excluding from this remark the anti-visual approach that has developed among architects and urban planners during the 1970's which criticized drawings as being too simplistic to represent a public realm that houses all the complexity of human life. (Söderström 1996)

or speeches. In city making practice, written or oral expression accompanies visual material to illustrate it, to provide additional highlights or comments; they complement as such the visual material. (Söderström & Zepf 1998)

Visual medium has not evolved over the years to better accommodate the changing project making process and the multi-actor environment (Terrin 2009) even though serious development has been undertaken concerning visualisation techniques (such as computer aided modelling software) and data engineering (GIS) over the last thirty years. These technologies that allow for more precision and realism follow essentially the same representation logic as traditional techniques: the city and its components are basically depicted using plans, sections and elevations, and images of a picturesque character.⁵ The resulting material reveals itself to be efficient when handled by architects, engineers or urban planners, but difficult to appropriate, to understand and to use by non-design oriented actors. This is why they may hinder the transmission of information as well as the communication between different actors and bring about the possibility of false consensus. (Al-Kodmany 1999)

The question of medium arises at the same time some ethical questions: the notion of “negociation” supposes a degree of subjectivity and the research for a consensus. It is as such ethical because it aims to define the common values which constitute collective action. (Paquot, Younés 2000) It entails at the same time different convictions and conflicting views and the will to convince the others in view of one’s economic and social priorities as well as aesthetic tastes. (Morin 1986) There seems always to be a degree of subjectivity in the production and the use of communication material due to the strategies and the subjectivity of each actor: visual material is often conceived to convince, to please and to seduce and rarely to inform and to sustain participative work environments which brings into question its neutrality and scientific character (Estevez 2001)

Participative city making processes are currently in need of new ways of representing the city and urban/architectural projects which will empower participants, support equitable interaction and promote creativeness. The constitution of a common language that improves communication processes between different partners and facilitates the understanding of different proposals is essential to the outcome of a multi-actor project making process. Recent research has concentrated on information and communication technologies as the source of this new language. Mixed-reality technologies reveal themselves as highly promising medium to create a collaborative environment that brings together citizens and other stakeholders to discuss, negotiate and decide on specific urban problems: they offer languages and means that are accessible to everyone and that enable a certain ease of comprehension and expression. We will in the second part of this paper discuss the possible use of “mixed reality technologies” in multi-actor decision making processes concerning urban projects.

IPCity: an experimental process with MR technologies

Mixed reality (MR) is the merging of real and virtual worlds somewhere along the *reality-virtuality continuum* that connects completely *real environments* to completely *virtual* (computer generated) *environments*. MR systems augment either the virtual world with “real objects” (*augmented virtuality*) or the real world with virtual ones (*augmented reality*) (Milgram, Colquhoun: 1999). City making practices emerge as one of the main study fields for MR research: the merging of the past, the future and the actual state of the city being at the root of all urban question, these technologies which allow its users to

⁵ The ever increasing realism achieved by these techniques is raising ethical questions regarding their use as decision making and public communication tools in planning.(Sheppard, 2001)

envision/observe the existing environment while simultaneously modifying and/or augmenting it with virtual elements constitute a novel tool and should be studied as such.

Two main axes regroup most of the actual research done on the subject. Those researchers working on computer sciences and man-computer interaction focus on technical issues such as tangible/collaborative interfaces and immersive technologies, interaction between virtual and real environments, rendering quality and visual realism and/or modification of real/virtual environments in real time. (Seichter & Schnaabel: 2005, Ishii & al. : 2002) The implication of architects and urban planners in recent research has enlarged the scope of these studies to include questions relative to urban studies. Researchers seem to agree that MR systems do not match the sophistication of today's CAD software concerning the realism, the exactitude and the visual quality of the renderings: they have nonetheless great potential as complementary tools for the creation of collaborative environments. They facilitate the participation of stakeholders to debates and work groups regardless of their qualifications and prior knowledge on urban and architectural issues by providing multiple means of expression and comprehension accessible to everyone. (Broll & al.: 2004, Seichter & Schnaabel 2005., Ishii & al. 2002).

IPCity (Integrated Project on the City) is one such research project that aims to develop technical and analytical research on the use of mixed reality technologies in urban environments. The project is made up of four showcases with different application scenarios that structure research work including technical development: urban renewal projects, large scale events, explorative entertainment and storytelling applications. This paper is based on the 'Urban Renewal Showcase' which studies the use of MR technologies as communication and negotiation medium for urban projects and explores questions related to city making practices, stakeholder interaction, language and medium and social action. The aim is to offer stakeholders a number of technologies which allow them to collectively discover the past, observe the present and discuss the future development of their city.

The project team is made up of institutions of the public and private sector working on related fields such as computer engineering, cognitive sciences, social-psychology and cultural-anthropology, architecture and urban studies, industrial design and visual and sound arts. Research focus having being defined as technical development, researchers in urban studies have been invited as "end users" to the project team, to define the general orientation and to participate to the evaluation of new technologies. The initial work done among researchers has served as a learning period between different fields of research and has resulted in the constitution of a collective consciousness regarding the necessity to integrate questions related to city making practices within the project. Existing studies on urban projects, decision making processes, public participation and the question of communication medium, as well as team members' field experiences have been used to deconstruct project making processes and communication issues: this work has allowed researchers to evaluate the potential of existing technologies in relation with recent evolutions in city making practices and to propose a framework for collective work. The technologies have become within this context both the research question and the basis of a reflection on recent evolutions in city making practices.

Methodology

IPCity uses 'the technology probes' method, an action-research method used in the field of human-computer interaction (HCI), to develop its MR systems. 'Technology probes' are simple and flexible technologies that are used in the early phases of the development process to help along the co-design of technologies. They aim to help define the needs and desires of end users, to organize field trials to test the technologies and to inspire researchers concerning new technologies. (Hutchinson et al: 2003) Pre-prototypes that

are being developed in associated laboratories for different projects have served as technology probes for the research team. These technology probes have been put to use during a field trial concerning a simple urban question at the beginning of the project. The results of this trial have served to define the first specifications concerning the MR tools and the use of these tools in city making practices. Three main decisions that result from this work concern the definition of urban concepts that will guide the research work, the main characteristics of mixed reality technologies to be developed and the principals regarding their localization and use.

Urban concepts

Those urban concepts that emerge as crucial concerning city making practices in relation with technological development result from project making experiences of team members as well as the first trial realized with the technologies. They are chosen in relation with recent developments that alter the city and city making practices with specific insistence on those concepts that are difficult to discuss and communicate with traditional tools of representation. The physical characteristics of urban space such as dimension, scale, depth and orientation constitute one of the main issues that concern architects and urban planners and emerge as an important component in the merging of the real and the virtual environments for a better perception of space. (Mangin, Panerai 1999) Temporal aspects of a site, its past, its evolution and its future as well as the different forms and meanings it may entail between different seasons or between different times of the day constitute another dimension that has to be taken into account. The question of mobility arises as an issue that dominates and transforms the urban landscape and thus the city making practice: this is why themes such as accessibility, modes of transport, speed, density have to be taken into account while thinking about the city. (Godard 1997) The question of use and that of ambience are the other concepts that will be taken into consideration, ambience enhancing the modernist approach to “form” and “function” with technical, sociological and esthetic input which allows for a multi-sensorial and semantic apprehension of the built environment. (Amphoux 2002)

Mixed reality technologies and the MR Tent

The technologies will enable participants to work with these “urban concepts” concerning an urban renewal project and favour simple tangible user interfaces that will constitute a collaborative planning and discussion space. The *ColorTable* will be the first application: it is a multi-user digital table which allows project partners to observe, to study and to modify the project site collectively. A physical plan placed on the table will serve as the main work bench: a transparent screen and video projections (real time streaming or preconstructed panoramic views) will allow project partners to have different views on the project site. Small tokens of different shapes and colors that represent different virtual objects will be used to modify and/or augment the urban environment: these tokens that are tracked by an overhead camera will inform the system of the intentions of the participants and will be used to modify the screen views in function of the modifications realized on the table. Another application, the urban sketcher will allow participants to work directly on the screen projections, allowing them to insert objects, to change their characteristics (transparency, size, colour or texture, etc.), to draw on and annotate the real scene with a virtual pen. A Hypermedia Database where a collection of scenario-specific content is stored in advance will furnish the project partners with virtual objects generated by computers such as buildings, activities, flows, sound, etc.

These technologies will be regrouped in a mobile laboratory, *the MR tent* so as to be accessible to lay users in the urban context and in everyday life. The tent will provide

shelter for participants and equipment and serve as a neutral workspace for stakeholders. It will be placed on those sites that are significant to the project discussion at hand and will allow participants to be present *in situ*, surrounded by the urban environment on which they are working. The adjustable openings of the tent will allow participants to observe the site while working with the technologies and to perceive their immediate environment in all its complexity, something that even the most complex technologies cannot reproduce in whole. This real environment will be augmented and/or modified using the technologies and these modifications will be observed in real-time through the multiple visual openings that connect the workspace inside the tent to the surrounding environment.

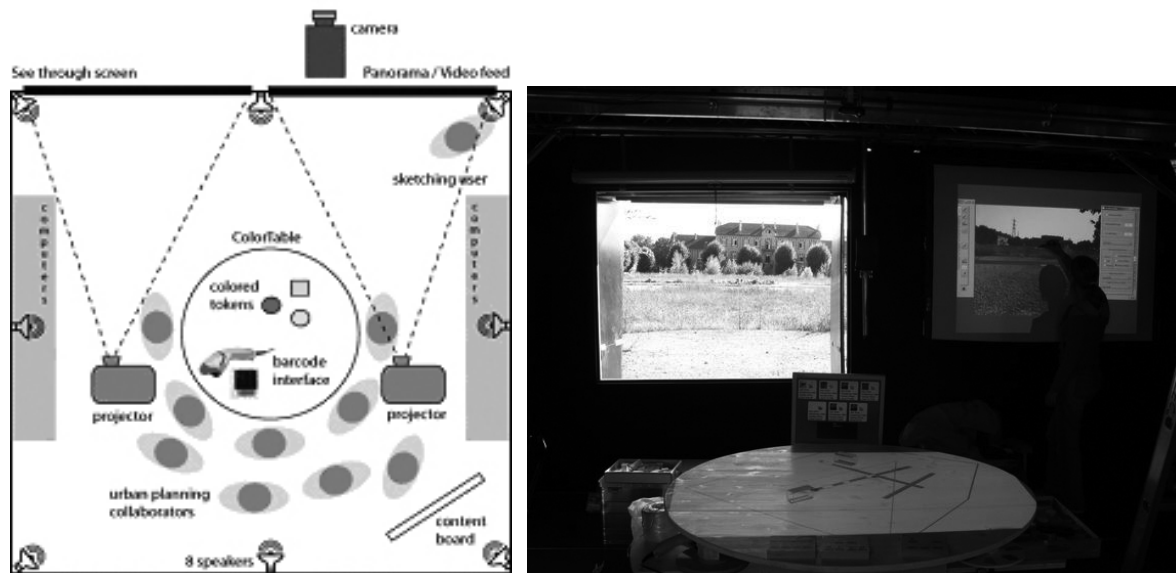


Figure 1&2: The technical setup inside the MR Tent is centered around the two projection walls and the ColorTable

Field experimentation

The project team has adopted a methodology based on periodic field trials that simulate negotiation processes, analysis, and feedback. Each year an ongoing urban project that addresses a specific urban question is chosen as theme: this choice is largely oriented by the need to test the relevance of MR technologies in different contexts and in relation to a diversity of urban issues and by the results of previous field trails. Possible discussion topics and scenarios are developed by researchers in collaboration with stakeholders, public authorities, architects/urban planners, associations and habitants. These scenarios are then thought out in relation with existing prototypes and previous experiences which helps define possible development schemes for technologies. The same development process applies to the conception of the real and virtual environments (experimental content) that are to be used during the experimentation. The field trail is realized *in situ*, in the MR tent that regroups the different technologies.

Participants are those stakeholders that are involved in the ongoing urban project with special emphasis given to citizen participation. They are asked to discuss the project in relation with the proposed scenarios, using the MR prototypes and the experimental content prepared. The experiment is documented through several media: researchers take notes and photos, the discussions are recorded through video-filming and sound recording. A debriefing session organized at the end of the trial serves to get direct feedback from the participants. These serve as basis for the analysis realized by researchers who observe “the negotiation scene”, the use of the technologies, their effect on the social interactions occurring, the collectively constructed scenes and the urban

issues addressed. This allows to identify and address specific research orientations for the different disciplines involved in the project' and serve as feedback for the next field trial.

Five such field trials have been organized in France on ongoing urban projects with the participation of public authorities, urban specialists, private stakeholders, NGO and citizens between 2006 and 2009. The first and second trials (2006) address an architectural dilemma that has impacts on neighborhood scale, the opening up of the gardens of the psychiatric hospital of St.Anne in Paris to public use. The third trial (2007) discusses the implementation of a large scale community facility, the new Paris courthouse, "*Tribunal de Grande Instance*", in the Parisian cityscape. The fourth trial (2008) concerns the requalification of a formerly military site, the *Quartier Bossut* in Cergy-Pontoise and its integration within the urban context. The fifth workshop (June 2009) addresses the question of centrality and connection and uses and ambiances through an evaluation at city and neighborhood of the public gardens of Lavandières in Pontoise.

The *Quartier Bossut* field trial that took place in 2008 in Cergy-Pontoise will be the main focus of the third part of this paper where issues related to participation selection, scenario building, representation issues and content selection as well as the trial will be discussed in more detail.



Fig.3, 4 & 5: the workshops at the psychiatric hospital of St.Anne, the new Paris courthouse and the public gardens of Lavandières in Pontoise

Caserne Bossut Workshop

The research methodology is based on successive field trials and the outcome of each field trial influences the choices made for the next one. The first two trials have been chosen among projects that are in the late stages of the conception phase. This is because the initial project approach foresees the use of MR technologies as visualization tools and the objective is to discuss on alternative project proposals for a given site. 3D architectural renderings of different project proposals are studied by participants who discuss, compare and modify them through collective work with the different MR applications at their service. These trials have shown that the use of architectural renderings leave those participants who are not design oriented unresponsive: the finished quality of the 3D architectural renderings makes them difficult to understand, to examine and to appropriate and the MR technologies do not seem to be compatible with this kind of visualization task. Moreover, the question of project proposals does not seem to interest nor give rise to discussion.

These first results have lead the project team to develop a new strategy concerning trial scenarios and content creation. The question what we discuss, with whom at what stage of the project has become the decisive point for the new trial. Existing research work, former field trials and interviews realised with participants have helped the team to

redefine the main theme for the new trial as general strategies of development rather than design issues. The participants will be asked to discuss on the site and its future in relation with their respective knowledge and experience of the city and their expectations: the objective is to decide on a number of development strategies that will serve the design team as guidelines during their work. This does not demand the use of sophisticated architectural models etc. and should facilitate compatibility issues with technologies. The participants will be using simple 3D models, images, textures, sounds and inspirational objects: this visual material will be generic and/or common enough to make them recognizable for different participants and to ensure a certain level of coherence. They will enable the participants to collectively work on the scenario and to create *mixed reality* urban scenes.



Figure 6, 7 & 8: The MR tent and the Quartier Bossut workshop

The *Quartier Bossut*, is a military wasteland of 13 hectares in Pontoise. Its size as well its location between the new city of Cergy and the historic city of Pontoise makes of it a strategic site for a development project for the Agglomeration Community of Cergy-Pontoise who is the land owner and the city of Pontoise who is the municipal authority. The local authorities want to profit from the central location of the site to develop a much needed centre that will house different functions and that will ensure the connection between the two cities. A new development plan prepared by the Agglomeration Community anticipates the development of a commercial zone with a convention centre and the construction of 2000 housing units with public facilities such as a school and a kindergarten. The development scheme is at its initial stages and the local authorities are in need of input that can nourish their reflection concerning the site and the general strategies of its development rather than architectural issues.

The workshop participants have been chosen among those stakeholders that are directly or indirectly concerned by this new development scheme. Urban planners, administrative body and elected representatives from the local governments as well as artistes from theatre companies that have used the site, policemen, members of citizen associations, representatives of local commerce, and citizens from neighbouring sites have participated to a two day workshop that has taken place *in situ*. The participants have also contributed to the scenario building and the content preparation phases: they have been invited to visit the site with the research team before the workshop and have participated to individual interviews that aim to help them prepare for the workshop. Participants have been asked to think about the site and their experience, to define the main issues that seem important and to collect objects such as photos, sound recordings, and images with which to represent their ideas.

These interviews as well as the preliminary work done with local authorities and previous field trials have helped define the workshop scenario which addresses the questions of centrality, continuity and connectivity. These questions will be studied in relation with certain urban concepts that have been defined by the research team, the concept of *ambiance*, use, mobility and temporality. The central public space, the *Place d'Armes* and

the residential areas will be the main focus areas. The participants will discuss on the site and its future with special focus on the future ambience of the site and the different activities/functions that will co-exist and create this ambience. The conditions of this co-existence with all the conflicting situations that this entails, especially concerning the delimitation of the public and private realm, are other themes that are of interest. The question of continuity and connectivity arises that of movement, accessibility, flows and transportation as well as temporality, the other questions that will be discussed during the workshop.

The workshop content has been chosen in relation with the scenario and the interviews realised with participants. The aim is to provide the participants with virtual objects which will enable them to discuss about the site and its future: they will be used to create mixed reality scenes with which participants can represent their ideas. 3D models, drawings, photos, textures and sounds will be used to represent physical elements such as building types, landmarks and green spaces, activities/uses, flows and ambiances. They will also serve as inspirational objects that will evoke different discussion topics for participants. A photo of solar panels can be used to create a scene: it can also serve as an inspirational object that evokes ecological issues and that provokes a discussion on this theme if the participants wish to do so. Participants are invited to bring their own objects for the workshop and have the possibility to create new objects during the workshop in relation with their objectives.

The workshop has taken place in the *MR tent* that has been installed in the central public space, the *Place d'Armes*, of the *Quartier Bossut*. The participants have been regrouped in two teams with similar participant configuration and each team has worked during one day on the proposed scenario with the MR technologies. The morning session has been used for the initiation of participants to technologies: this is followed by a presentation of the scenario and the main questions that will be discussed. The afternoon session has been reserved to group work: the contribution of the research team to this session has been limited to intervening if and when a blackout occurs and to informing the participants on technical and/or urban issues if and when the participants wish. A debriefing session organised at the end enables the research team to have feedback from the participants on those issues that interest the different research groups. This debriefing as well as the recordings made with different media during the day serve as the basis of the analysis work to be done.



Figure 9, 10 & 11: Participants working with the technologies

The two groups have privileged different discussion themes and have organized their work differently. The first group has discussed on their scenario, chose related content and enacted this scenario with the technologies. The second group has mainly worked around the Color Table with the technologies and has developed their scenario all along the day. There are nevertheless certain similitudes concerning the discussion on urban

issues, the favored communication medium, the reasoning, the use of technologies and content material which are interesting.

The urban issues that have been addressed by the participants are largely oriented by the workshop scenarios that have been proposed by the research team. Certain issues are nevertheless addressed with more interest and incite long discussions contrary to others that do not have the same effect on the participants. The main issues discussed by the participants during the workshop are the urban context, the question of accessibility/flows and uses/activities. This preference may be due to the performance of the technologies as well as the interest scope of participants. The following trials will help formulate a more substantial hypothesis concerning this choice.

The use of different communication medium is restructured during the workshops: oral expression seems to take precedent over visual content which is the medium that normally structures group work in city making practices. The participants discuss on a problematic or a proposition using oral expression: they then choose appropriate content and enact their decision. The visualization of the decision on the physical map and the screens enables them to question its pertinence and to modify it if they wish so. The use of oral expression can create a barrier between specialists and laypeople contrary to what the research team has expected. Specialists favor a vocabulary which can be intimidating and which can close out the other participants from the discussion: the use of terminology such as “flow” and “tertiary industries” has necessitated for example their translation into “bicyclists” and “business” to facilitate the comprehension.

The participants prefer discussing the project site in relation with the city: they define a problem at city scale, propose solutions related to the site, work on the eventual problems that may arise by their proposition and define additional solutions. The participants refine thus their proposition through consecutive questioning and enacting. The first group starts discussing, for example, on what is missing in Pontoise: they agree on the fact that Pontoise does not have an animated place like the port in Cergy where citizens can go in the evening to amuse themselves. They propose to install some leisure activities such as coffee houses, restaurants with small concert halls, etc. on the *Place des Armes*. Once the content chosen, the technologies are used to compose the MR scene. The resulting composition makes the participants arise the question of noise control. They mobilize their knowledge concerning the city and refer to the port in Pontoise where the citizens are not happy with night time activities. The question of proximity and the coexistence of different activities, the delimitation of public and private realm and noise isolation are some of the solutions that are discussed.

Content material seems to play no or very little role in the definition of the initial proposition, but serves to enact and to evaluate the proposition. The content choice is made once the participants decide on an idea: one or more participants study the content material, choose those that seem relevant and explain them to the others. They are eventually asked to find additional content representing other activities for example such as people sitting on a terrace: content material becomes in this context a house with two floors, a park or a vegetable garden and is used in the most generic way. They play nevertheless an important role in the enactment of the decision, its evaluation and eventually its modification: the resulting scenes are far from being realistic simulations generally used in city making practices and are abstract representations which evoke the discussion themes and decisions taken by the participants.

The use of the MR technologies and their contribution to the discussion is similar to that of the content material. Once the participants start discussing on the site and/or a theme, they start enacting their discussions and decisions on the Color Table, a round table which constitutes the central work area: the physical map is used to point out the different characteristics of the site, it is augmented and/or modified by placing flows and colored tokens representing virtual objects and by defining zones. The scenario building is mainly

done around the table and on the physical map. The screen projections are mainly used to evaluate the effects of their intervention and may lead to the modification of the scenario. The Urban sketcher is then used to work directly on the screen projection, this tool is used less often than the Color Table which proposes a user interface that seems to be easier to apprehend.

The technologies as well as the configuration of the MR Tent and the workshop scenario seem to influence the participative work environment in a positive way: the distribution of roles between different participants and the social interaction that results is different from what has been imagined at the beginning. The use of a communication medium that is foreign for all participants and yet easy to appropriate seems to put them all on equal ground and dismantles then barriers created by professional differences. Each participant assumes several roles during the process in relation with the subject at hand: an urban planner working with the local authorities may choose to adopt the role of a citizen when discussing a question that is close to his heart or may mobilize his technical knowledge to back up a personal preference. The participants' contribution to the discussion is thus closely related to their professional and personal experience and know-how.

Urban projects, participatory methods and MR technologies

The IPCity research work allows to deduct certain conclusions which open innovative perspectives on urban project representation methods in multi-actor working environments. The collaboration between actors who have different social and professional backgrounds such as urban planners, architects, local authorities, private investors and habitants imposes the use of an instrumental and methodological framework that traditional tools cannot provide and this because they are not adapted to collaborative work. Founded on a logic of ongoing negotiation, urban renewal projects constitute a place of sharing, of collaboration and of negotiation including different stakeholders before being a place of co-conception where the professionals of urban planning and architecture meet. The collaborative work that results obliges the use of new modes of action that differ from those generally used by professionals such as development plans, perspectives, models and computer synthesized images.

This new approach requires new modes of expression, of representation and communication. MR technologies may prove to be this new approach. They have the capacity to offer negotiation tools that are interactive, contextual, ergonomic and accessible thanks to interfaces that are easy to apprehend by all types of users.

The MR technologies developed by the IPCity team enables stakeholders to communicate using a multi-sensorial language where visual content plays an important role along with other senses such as speech, sound and written expression. They allow participants to annotate directly a scene, to inquire about project, to communicate sensations, to discuss on notions of ambience and to share one's experiences. The capacity of these technologies to gather stakeholders on the project site under a roof (that of the MR tent), around a table (the Color Table) with several direct views of the site (windows, mobile cameras, panoramic views) constitute a plus which amplifies the sentiment of convergence and collective action.

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