Supporting Community Engagement in the City: Urban Planning in the MR-Tent

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ABSTRACT
Urban design today faces complex demands. It has become a necessity to negotiate between stakeholder objectives, the expectations of citizens, and the demands of planning. In this paper we describe how we use a set of participatory technologies in combination with methods for preparing and enabling a heterogeneous group of participants to create a vision of an urban project. Our observations show how space, materials, and different types of content affect participants' collaboration and their debate of the urban issues. We discuss how these participatory technologies and events may help build a community of practice around an urban project.

Categories and Subject Descriptors
H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems – Artificial, augmented and virtual realities; J.5 Arts and Humanities - Architecture

General Terms
Design, Experimentation, Human Factors.

Keywords
Collaboration, community of practice, participatory design, mediated communication, mixed reality, tangible user interfaces, urban technology.

1. INTRODUCTION
Urban design today faces complex and heterogeneous technical, political, economic, and social demands. One source of this complexity is the large number of stakeholders implicated in urban design, each of them representing diverse professional cultures, academic training, and economic logics. The designed artefacts, whether buildings, infrastructures or open spaces, are also becoming more complex; they are embedded within more and more sophisticated technologies and offer numerous services. Risk is present in most aspects of urban planning: economic, political, social, financial, environmental, and interaction between these different fields adds to the complexity as a whole [2]. Life cycle analysis has an augmented importance in decision making. Moreover, final users, their cultural background and values [20] play an increasing role during all phases of an urban project.

Given this complexity, negotiation between stakeholder perspectives, political objectives, the expectations of citizens, and the demands of planning, becomes a necessity.

It involves considering the local and the global, the short and the long term, the private and the public, the collective and the individual, etc. [16]. In the absence of negotiation the uncertainties and risks intrinsic to an urban project turn into a source of inertia, a restraint to innovation and decision-making [4].

Figure 1: The MR Tent is a portable lab for using Mixed Reality in urban planning on location

Traditionally, urban design is facilitated through the use of non-participatory media, which allow urban planners express and explore their design concept, as well as to carry out complex tasks, through various means of representation and simulation (CADD, parametric design, photorealism, animation, etc). While these tools add to the possibilities of urban planners of explaining and envisioning, their communicational aspect, which is so crucial to urban projects, is quite limited.

Recently we can observe a trend towards interactive, often tangible interfaces in urban planning. Projects such as the

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C&T'09, June 25–27, 2009, University Park, Pennsylvania, USA.
ACM 978-1-60558-601-4/09/06.

Luminous Table [12], the Envisionment and Discovery Collaboratory [5] and MouseHaus [11] deal with the integration of digital and physical representations to create a collaborative urban planning and design space. Urban topics being addressed by these systems cover spatial implications of architectural geometries or influences on traffic and light. In this spirit we have developed a prototype of an integrated framework of tools, an MR application supporting a range of devices for collaborative multimodal interaction and individual expression. These tools allow groups of stakeholders in an urban project create and manipulate visual and auditory scenes, and mesh these scenes with the real environment of an urban planning site as an integral part of expressing and experiencing an evolving project. The technical infrastructure is housed in a specifically designed *MR Tent* (Figure 1), which allows bringing technologies that are normally available only in laboratory settings to the site of an urban project.

On top of designing these tools in a user-centered design process, we have also developed an approach to supporting multiple interactions among the various agents (professionals, as well as lay people, referring to different temporal and spatial scales, representing various cultures) in real complex urban environments. We contend that when introducing participatory technologies, methods are needed that facilitate the constitution of multidisciplinary teams founded on public-private and local actors-global operators partnerships [3].

In 1991 Lave and Wenger introduced the now widely used concept of 'Communities of Practice' (COP) – 'groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly' [22]. Members of a COP share resources, experiences, stories, tools, and ways of addressing recurrent problems. We argue in this paper *that a prime goal of participatory technologies is to help build and sustain a COP*. Of the 'seven principles for cultivating' COPs put forward by Wenger et al. [22] we find four particularly useful for thinking about the context of urban planning: 'different levels of participation'; 'open a dialogue between inside and outside perspectives'; 'focus on value'; and 'combine familiarity and excitement'. We will take up and reinterpret these four principles in the discussion.

We start by describing the urban project we selected as the site for the most recent of (up to now five) participatory workshops with users. We then proceed to demonstrate how the use of the MR-Tent and tools is (and has to be) embedded in a process of a) identifying a project, site, and the urban issues at stake; b) enabling participants to create a vision of the project-to-be; c) preparing scenarios as well as visual and audio content. After presenting the MR-Tent technologies we describe participants' interactions and negotiations on site. In the focus of this analysis will be the role of space and materials for participants' collaboration, as well as the relevance of different types of content (3D, 2D, sound) for how they address the urban issues at stake. The discussion addresses the question of how participatory technologies and events, such as the workshop we describe, may help build a COP around an urban project.

2. The urban project

We already have reported on design issues [14] of earlier prototypes, as well as on collaborative aspects and issues of representation [15] identified in previous workshops.

The most recent participatory workshop was organized within the context of the urban planning project of the *Caserne Bossut* in the city of Pontoise. The site was chosen in relation with the urban issues addressed by the Agglomeration Community of Cergy-Pontoise and the Planning and Urban Design Summer Workshops organized by the Ateliers with Cergy-Pontoise University.

The barracks of the *Caserne Bossut* (1914-1916) are nowadays a wasteland situated at the borders of highway A15 that crosses Cergy-Pontoise, one of the new towns created 40km away from Paris in the '60 (Figure 2). Since the facilities were no more used for military functions, the 13-hectare site was sold to the local authorities in the '90s. It is now owned by the Agglomeration Community under the municipal authority of the City of Pontoise. During the period 1999-2004 the site was handed over to the artistic association *Usines Ephémères* that transformed these, architecturally speaking, original military buildings into artists' studios. Since 2005 the area is hosting a police department and is used as a training field by the fire brigade.

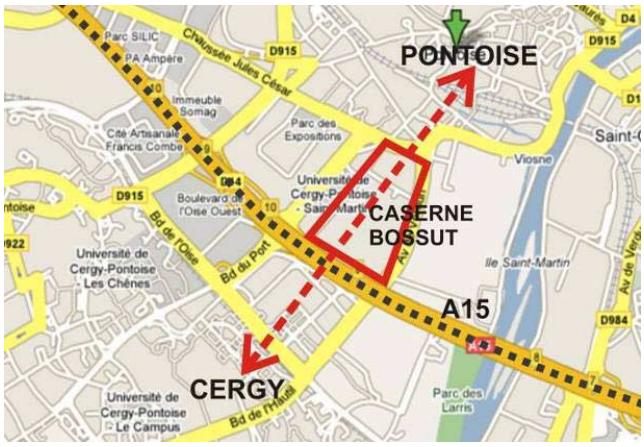

Figure 2: Location of the site in Cergy-Pontoise

The *Caserne Bossut* corresponds to the big mono-functional entities typical of the New Towns. Nearby there are other facilities with a similar introvert logic: the private school Saint-Martin and Cergy-Pontoise University. However, since the casern was not open to public life, it is perceived as a sort of huge hole in the urban texture. Being owned by military services for almost a century the site was not affected by evolutions, and in particular by the creation of the New Town. This time gap can be taken as an opportunity to reflect on urban issues calling out to artistic creation. This is one of the reasons why the experience with *Usines Ephémères* was particularly interesting. It was also the only period when the site was somehow integrated into the ordinary urban texture and it is nowadays one of the last large land reserves in the city of Pontoise.

A development plan was prepared for the area under the guidance of the Agglomeration Community. It anticipates the construction of 2000 housing units and the development of a commercial zone including a convention and exposition center. The future district *Bossut* will also be equipped with a school and a childcare center. The new constructions will be replacing 90% of the existing buildings but the streets will be conserved. The *Place d'Armes*, the central open space, will become a major public space and a place of lively community interaction.

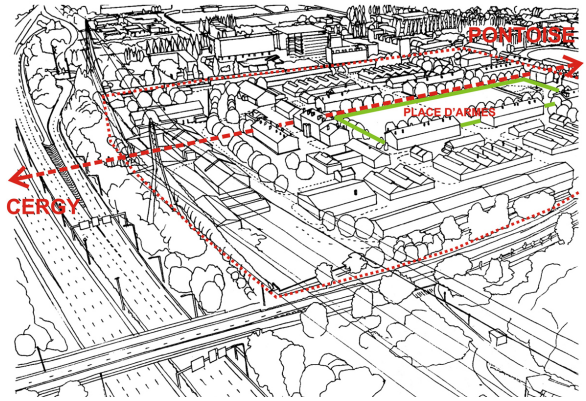

Figure 3: Urban issues for the Bossut district (image from Guegeuen [8], p. 25)

The main urban stakes concern different scales and the point of view of several stakeholders. The City of Pontoise, for instance, is careful about local effects (the nearby residents, the relation of a historic town such as Pontoise to the modern centre of Cergy, etc.), while the Agglomeration Community has both the point of view of the owner, responsible for the site itself, and a larger vision due to its metropolitan competence. In this perspective, an important urban issue concerns the identity and the uses of the site: will it be a transit space with vivid activities or a place for rest and leisure? Therefore connections and public transportation are very important elements: the site is at equal distance from the two main train stations of Cergy-Préfecture and Pontoise (400m), so the possibility of creating a new centrality has to be discussed (Figure 3). Moreover, the highway A15 acts as a border at the moment: another element for the discussion is the possibility and the way of crossing it. Should it be a bridge or an underway path? Where? For pedestrians or also for cars? Technical constraints, such as the levels of the ground on the two sides and the presence of high voltage electricity pillars, must also be taken into consideration. With respect to the main urban planning issues, it was decided to organize two urban scenarios: the first one focussing on the central public space and the second one on the issues related to the residential area and the streetscapes.

3. Engaging and preparing the participants

Different types of stakeholders were selected by the French team in cooperation with the director of urban planning and members of the local administration of Cergy-Pontoise in the intent to cover a broad range of competencies and interests. Participants included four urban specialists with a strong connection to the city; three members of the local planning authorities; a policeman working on the site; a non-seeing woman engaged in the local association of pedestrians and cyclists; two members of local commerce; two students whose rooms overlook the site; and two theatre people who had been organizing events and performing on the site while it was open to artists in the region.

In July 2008 we invited all to the site to distribute a cultural probes package [7] to them. This was also an occasion for them to visit the site itself, which not all of them knew and one had not even been aware of. We used the cultural probes method in combination with a narrative interview technique (the interviews were conducted a few days later) for stimulating participants' imagination and to help them prepare for the urban planning workshop. The cultural probes consisted of two maps of the site (and surrounding area) of different scale, three panorama pictures, and a CD with 99 sound files to select from. Participants were asked to think about connectivity, about the central public space, and also about housing types and activities they would like to see at *Caserne Bossut*; as well as collect and bring objects with which to represent their ideas.

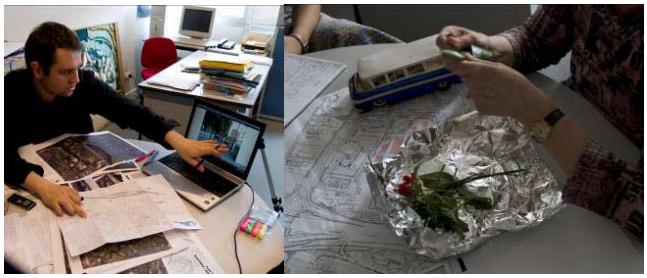

Figure 4: Using cultural probes for creating a vision of the site

Participants brought printouts of Google Earth maps, reference images, pictures from a walk around the site (Figure 4 left), as well as small objects with them. They annotated the maps and told their stories of the site and its connections. For example, central to the vision of E., an urban specialist, was the relationship with nature, the connection with the river Oise: ' ... this nature space, with its small forest, birds, natural life'. He imagined a 'vie de quartier' created by different types of people, with different sections for different uses and ambiences. D, a theatre person, brought tools and metaphors from drama with him, including a poem by Rimbaud, representing the ambience of 'a place, which invites you to perambulate, with your hands and your pockets'. L., the non-seeing participant, not only gave us ideas on how to annotate map and tokens so that she could more easily interact; she also brought some flowers with a fine perfume from her garden along (Figure 4 right). One of her main topics was protection - to protect pedestrians and cyclists from the traffic; to have a protected place from where the children cannot move out so easily; a protective wall of trees against the highway that keeps out the noise. G., the specialist for water and environmental risks explained his idea of 'ecovillage' using a series of images of complex water systems. Opening up was an important theme for him – 'the walls have to be torn down'. He for example brought an image of a housing complex with terraces that 'invite neighbours in for an aperitif'.

From the visions participants created in the 'participatory interview', we extracted two scenarios, as well as visual and sound content. Figure 5 shows two of the numerous 'content cards' we created for participants to select from. In addition, we prepared four photographic panoramas of the site from different viewpoints and two physical maps of different scale (1:500, 1:1000) to be placed on the ColorTable (Figure 6).

The importance of these extensive preparations, not only for the lay people but also for the planning experts, was confirmed during the workshop itself. Participants arrived with their knowledge of the site, their own vision of the kind of interventions they would like to explore, and they found the content they needed for entering the debate.

The workshop started on Sep 10, 2008 with a two-hour training session with the non-seeing participant for whom we had annotated the map of the site as well as the tokens and 'command tablets' in Braille, as well as a demo session for interested people

from the municipality and an architectural summer school. The next two days were spent with two different participant groups, starting in the morning with a tutorial after which the group built their vision of the site, and ending with a feedback and debriefing session. Participants also filled in a small questionnaire with free comments on a range of key research issues. The workshop ended with an additional demo session on Sep 14. All sessions were moderated by one of the urban specialists of the team and supported by the developers. They were videotaped. In addition we took pictures, focusing on participants' interactions both, with the technologies and with each other, and saved relevant scenes.

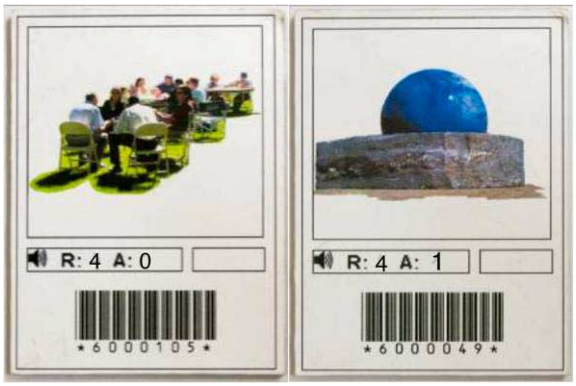

Figure 5: Content cards with image, barcode, and information on associated sound files – R (realistic), A (artificial)

4. The MR-Tent

The technical infrastructure (Figure 6 top) is set up outdoors in the MR Tent on the site of the urban project. The MR Tent provides shelter for workshop participants and equipment while its adjustable openings give view to the surrounding side. It supports the creation and modification of 3d mixed reality scenes by placing or changing visual elements into an existing background.

The *ColorTable* is set up in the centre of the MR Tent (Figure 6 bottom) and provides a top view of the site. It presents a collaborative planning and discussion space – users are motivated to share their ideas and visions by moving colored tokens of different shapes and colors on the table. The tangible user interface uses computer vision based tracking from an overhead camera to detect the positions, shapes, colors and sizes of the objects on the table. Users can move and turn existing objects, while an overhead video projection onto the table provides interactive feedback. This table view is composed of several layers combining real and virtual elements forming a common interactive space. A physical map representing the urban site is placed on the table to define the scale of the interaction. For the workshop we prepared two maps of different scales that can be exchanged.

The *ColorTable* uses multiple interactive views to convey and encourage the urban design process. Inside the MR Tent, two large screens show perspective views of the urban site. The views are alternatively fed by a live video stream from a remote controlled camera, a panorama image prepared previously, a direct view seen through a half transparent screen. These vertical screens show perspective views as seen by a pedestrian, while the horizontal surface (table) shows an overhead view inspired by maps. In order to navigate in the panorama, users can change the orientation of the viewpoint with a rotating disk. We also pre-register different panorama viewpoints that can be loaded individually. For each viewpoint, a barcode is fixed on the physical map, representing the corresponding position of the panorama.

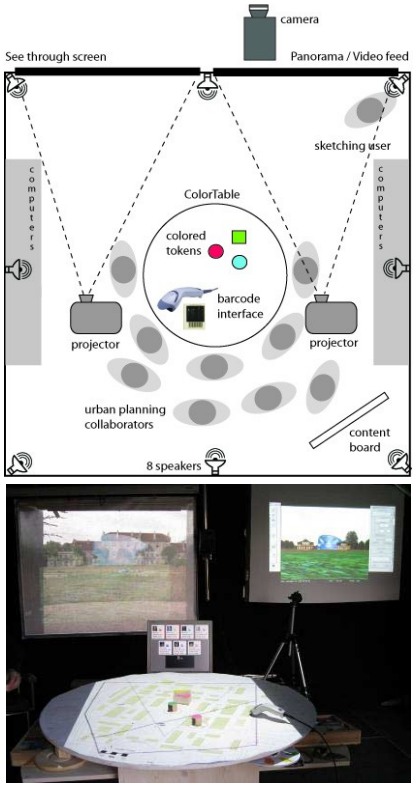

Figure 6: The technical setup inside the MR Tent is centered around the two projection walls and the ColorTable

A collection of scenario-specific content is stored in advance in the Hypermedia Database (HMDB). We use 2D images, some originating from the cultural probes, 3D models representing different building types and bridges, animated flow objects and sound. To make the content available to the users, we arranged the small, magnetic 'content cards' (Figure 5) on a whiteboard (Figure 13 right).

Placing objects: To decide on the type and locations of future elements of the project site, participants place colored tokens on the map. For example, a triangular token produces a single virtual object, shown as 3D model or as photograph billboard. Each object being placed onto the table is also shown in the perspective views.

Users can change object properties such as color and transparency, and associate tokens with new objects selected from the hypermedia database. They select a token of a specific color with the tangible selector and use a barcode reader to assign object properties from printed menu sheets. An additional info screen displays detailed information on a specific object being manipulated (Figure 7 left).

To facilitate the construction of rows of identical objects, e.g. to build a residential area of a certain housing type, we offer the possibility to define a line by setting its both end points. Square objects of a color previously loaded define the end points of such

a line and are filled up with identical objects, spaced at adjustable distances.

Adding roads and flows: To decide on the types of transport, speed and concurrency, we let users define different types of roads and flows of animated objects moving on a given path.

In a first step, a network of streets and paths is defined. To create roads, rectangular objects have to be positioned at both endpoints. Colors differentiate highways, normal roads, footpaths and waterways that are visualized as textured stripes of variable width. The second step consist in users defining a start and endpoint of the flow. Pedestrians, bicycles, cars and boats advance on the closest, suitable connection between both points. In order to animate the moving objects, we store view dependent cyclic flip-frame animations.

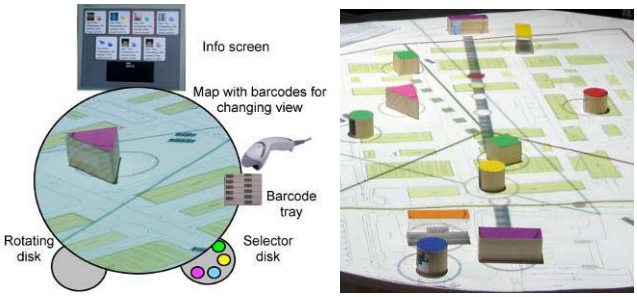

Figure 7: Setup of the tangible table and example of a composed scene including objects, rows, land use, roads and flows (top view)

To discuss the ***allocation of land use***, we implemented an automatically computed Voronoi decomposition using circular tokens put by the users as anchor points. The cells are visualized as wireframe in the top view and textured in an abstract manner in the perspective view.

Sketching: An additional possibility to express ideas is provided by the sketching tool. Users are provided with a special pen to annotate or paint directly onto the perspective view.

Exploring Soundscapes**:** Sound is much less exploited than visual perception in everyday life and in urban studies. We started out with the assumption that working with sound is expected to have a profound influence on users' experience of mixed-reality scenes. We decided to work with sound as an expressive medium (rather than based on simulation). Each object on the *ColorTable,* as well as each panorama has, next to each visual representation, a 3D sound associated to it. The resulting soundscape can be explored in three different manners by activating a different hearing position. Users can switch to the *camera view* as hearing position and listen to the sound which corresponds to the panorama or video feed. Another possibility is to activate the hearing position as part of the *flow*, the resulting soundscape corresponds to the path of an element moving in the flow. Finally, the hearing position can be interactively controlled by a *sound token*, defining the virtual listener's position and orientation.

History and persistency**:** When the users agree that an interesting scene has been composed, they can trigger a 'freezing'. All color tokens currently placed on the table are permanently added to the scene, and the corresponding tokens can be removed from the table. This configuration is then stored in a history file to be loaded at a later time. A frozen object can only be removed with a special 'eraser token'. In addition to the freezing capability, users can take snapshots of their compositions at any time. The current views are then saved as an image and automatically printed. The history function does not only allow to go back in time to a previously obtained interesting state, but also allows to use temporality as part of the inspirational process by looking at the evolving scene over time.

There are some common traits between our work with the MR Tent framework and previous work on collaborative interfaces for urban planning. Some of which make also use of a planning table based on tabletop interaction, the combination of multiple input and output facilities and the simultaneous engagement of multiple users. In contrast to these related projects, we do not primarily focus on finding possibilities to represent urban projects in a novel and stimulating way. With the MR-Tent, we take a step beyond issues of representation. We seek to provide a collaboration space for heterogeneous groups of stakeholders in an urban project in combination with a participatory approach to urban planning and novel working methods.

5. Co-constructing a vision of the site

The workshop was designed so as to put all participants on 'equal footing', irrespective of their competencies, each bringing the vision of the future site that they had elaborated before. They were asked to settle on 2-3 questions they would like to address together to then convene around the *ColorTable*. Members of the research team occupied different observer roles without interfering in the negotiation process. To give a flavor of participants' interactions we focus on one session with six participants (architect, specialist for water and environmental risk, policeman, student, representative of commerce). During the morning tutorial the group had quickly appropriated the MR technologies. After that they decided on the questions they wanted to focus on: how to connect the site with the two towns, the university and the river Oise; how the centrality of the site should be defined; and what kinds of housing and activities to envision.

Figure 8: Setting flows (left); Flows and one family houses as seen against video stream of site (right)

As soon as participants had assembled around the table, they started explaining the site and its environment to each other, with the policeman (P), who is stationed on site, describing his view. There was an animated discussion and the group decided to start setting paths, beginning with the 'transversal' ones (Figure 8 left). They first checked all the tokens they needed and placed them on the edge of the table. Road setting was done in a cooperative way, first on the map 1:500, and embedded in an intense discussion of the territory, issues of access, and the central axis. Each step was checked if everybody agreed. Participants tried to exactly position three parallel roads (50km type). The next step was to set 'flows',

step by step (Figure 8 right), looking at them from 'the blue tower' panorama. This involved a debate about the kinds of traffic to invite and how this would affect the site. They also set a path for pedestrians and cyclists along the main axis. E (the responsible for commerce) suggested placing a bridge across the highway (large enough to also allow a small bus to cross) and a bus stop nearby. A blue arch appeared in the panorama taken from the roof of the nearby university. After that participants examined the area close to the Oise, with again P explaining, and E engaging in a long conversation about this area, the traveling people who live there, and they finally decided to set a pedestrian path from the site to the Oise.

The next scenes are to do with participants selecting and placing buildings. They first looked at different types of residential buildings placed on the whiteboard, later they also added images representing ambiences (e.g. streetscapes, facades) and scenes (e.g. children playing). They discussed all the time, taking an image, placing it back, sometimes all together, sometimes two of them. At one point, JM (from the municipality) took over and placed the cards in front of him on the table. He started by presenting an idea and all the others joined. There was a moment of vivid simultaneous pointing and explaining. They created a row of 3D buildings close to the viewpoint of the panorama – the blocks looked gigantic and the participants rearranged them and placed another row symmetrically. E lifted up a card as a reminder – these are one-family houses, which they arranged in the corner left to the entrance. They also added a texture to cover the ground. You could see the houses along a 'real' path (in the panorama). Someone had placed the image of a library just in front of the first house to denote use (Figure 9). You could also see the pedestrian path crossing. Participants now really started 'filling' the scene. They also worked more on details, like G and E, who discussed the corner left of the entrance, with G mentioning that there should be more housing and he also pointed out paths and vistas from this point into the central place.

Figure 9: Rows of housing blocks in panorama with image of library denoting use

5.1 The role of space and materials

Through activities, such as placing tokens, moving them on the map, changing their parameters, directing flows on the map, and so forth, participants 'perform' a mixed reality configuration. The material artifacts we have designed take a key role in this process. It is argued that 'natural collaboration' is supported when people assemble around a table, reach out and touch with their fingers [10]. To see each other's physical action increases awareness and makes coordination more fluid.

In the MR-Tent participants convene and collaborate within the 3D spatial arrangement of table (on a physical map placed on the table), whiteboard, and projection, content cards, command tablets, barcode reader, and they produce printouts of the scenes they see on the projection (or see-through) screen. Research on the use of tabletops shows how spatiality - size, shape, proportion, location in space and arrangement in relation to other artifacts and people – matters. As Patten and Ishii [17] and Stanton et al. [19] observed, a large working space encourages or even enforces collaboration since there is no way for a single person to manipulate all objects.

Figure 10: Co-constructing through gesturing and talking

The scenes, some of which we briefly described, show patterns of dense cooperation around the table. Participants stay around the table most of the time as a spatially closed group. They use table and map for conducting a debate. They do this quite literally *on* the table, around which they assemble, through gesturing while explaining and setting actions, sometimes simultaneously and in parallel, sometimes cooperatively. There is a rhythm of discussing, using hands and arms to demonstrate on the table by pointing, drawing lines, occasionally reaching over the table (Figure 10). In the foreground is a common goal and the group is directed towards acting/creating. Each step is first discussed, then implemented, and after that participants often remain silent for a little while before getting to the next step. The overview provided by the map, together with the footprints of their interventions, supported conceptual work. From time to time they look at the panorama to then eventually carry out some modifications.

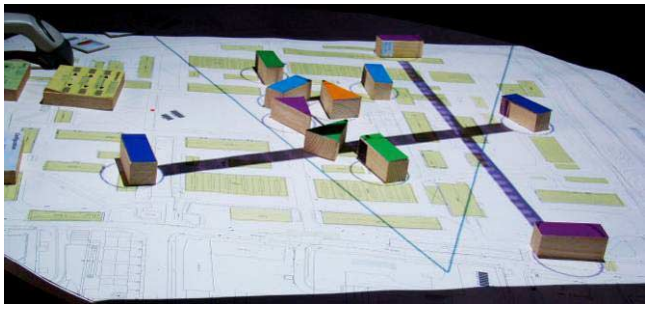

Figure 11: View of scene (and active viewpoint) represented by different tokens and interactive feedback

The table/map arrangement draws them into a debate that is mediated by a representation of the site by a map. Interventions are on the one hand represented by the physical tokens. On the other hand interactive feedback is provided, which shows the objects placed in the scene, represented by circles (indicating if an object has been recognized by the camera), dots and bars (roads and objects), as well as moving dots/flows (Figure 11). After a scene has been saved, participants can check all the elements even when the tokens have been removed.

The tokens themselves, which have undergone several cycles of re-design, are central to participants' interactions. The basic geometric forms and materials are familiar to participants. The different forms – circles, squares, triangles and rectangles – represent different uses while the color refers to a different content. The tokens for connections and ground textures have square printouts of the content mounted onto the side face.

Having a non-seeing participant had spurred our focus on hapticity. Apart from annotations in Braille printed out on transparent material, we made use of different materials (wood, Plexiglas, cork) to distinguish the different types of tokens (in addition to color and shape). To further support the haptic orientation an additional layer of transparent paper was fixed on top of the areas reserved for buildings on the physical map. This enabled our participant to place the tokens accurately while the other hand could feel its way (Figure 12 left).

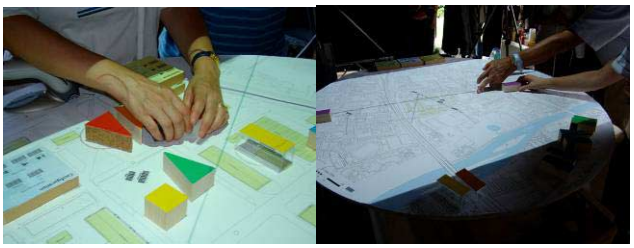

Figure 12: Feeling the difference of material, form and surface (left); inactive tokens in the shadow (right)

Typical patterns of working with the colored tokens emerged during the different discussion and interaction steps. When searching for the right tokens to perform the next interaction step, participants took care not to obstruct the tracking and placed the inactive tokens into the 'shadow' area of the table (Figure 12 right). A quite common observation was that some participants work collaboratively with the tokens on the tabletop, while others wait for their turn with a token and content cards in the hand (Figure 13 left).

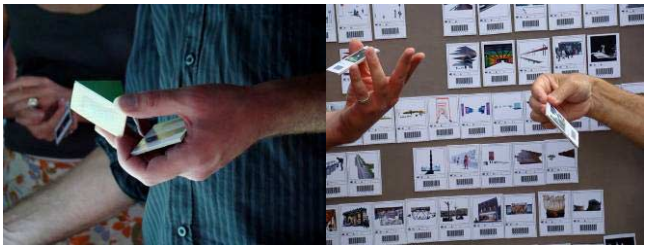

Figure 13: Holding tokens and content card (left); two participants selecting content cards (right)

Participants liked working with the small content cards representing content (Figure 13 right). At the beginning they sometimes positioned them directly on the table, but after having understood the need to link them with a token, the cards they had selected remained on the edge of the table, signaling 'this is a pile of our images'. 'Command tablets', with which to manipulate objects, including sound, freeze a scene, print it out, go back to previous scenes, etc. complete the set of tangibles. Participants' interactions with this set consists of selecting and placing objects, as well as 'reading' with the barcode reader.

When comparing the MR-Tent set-up with the currently much discussed multi-touch screens that 'enable fluidity of interaction and switching of roles between co-located users' [10], we clearly emphasize the hapticity provided by physical objects, building on haptic directness (meaning that there is no 'interface' other than the shape, texture, temperature, and moisture of the object itself; Hornecker and Buur [9]). What not only touching with one's fingertips but grasping brings is maybe best captured by the notion of 'engaging objects', which Verbeek and Kockelkoren [21] define as the capacity of objects to absorb people's attention, thereby increasing their engagement with each other and the world.

Hapticity is only one aspect of participants' engagement. Specific to the MR Tent is the mixing of many elements – views onto an urban planning site, a diversity of materials and forms of content – in one application. Participants engage with maps, projections, content cards, they sketch directly on a scene (an additional functionality described in [18]), switch between different panoramas, video view or see-through. For example, although participants often forgot to print out a significant step themselves, they were pleased to receive the printouts, which show the scene together with the table view.

5.2 Addressing the urban issues

Many authors suggest that visualization is the key to public participation (see e.g. King et al. [13]) but the question remains how to enrich the available repertoire of representations – from sketching to 3D renderings - with visualizations that enhance stakeholders' understanding of an urban situation. We provide 2D (billboards) and 3D objects, animated flows, and sound. Our observations of how this material was used permits some conclusions on how to help participants, among them lay people, to express and co-construct their ideas.

3D objects are important elements of the constructed mixed reality scenes. Some content, such as for example buildings, has to be 3D so as to maintain the sense of volume and orientation within space. On the other hand, 2D objects are needed for conveying 'telling detail' and creating ambience. They support the construction of narrative on top of an architectural intervention. The 2D content we provided is based on photographic images, sketches, architectural renderings, and paintings. To lend them a spatial dimension these images had to be cut out and 'abstracted' so that they no longer appear as flat canvasses. As we refrain from applying true 3D techniques such as a virtual model of the site, positioning objects in the panorama is supported by occlusion based on a depth image. We found that the 2D images aligned themselves well with the panorama. Interestingly, the real size of both, 2D and 3D objects, something the urban planners had deemed crucial in an urban composition, did not matter so much to non-expert participants. They often made an object bigger to emphasize an intervention, and they arranged the object optically in relation with other objects and the panorama view, without necessarily focusing on the real size.

Moving objects – pedestrians, cyclists, cars, and boats – connected to the different types of paths not only introduce an additional, human scale in the scene and provide depth information, but also animate it. Participants' gaze drifted between the table view, where the flow was represented as moving dots, and the animated mixed reality scene. They examined the spatial arrangements of 2D and 3D objects they had created in relations to these flows, eventually changing the

position of a road and/or of an object that turned out to be too close to it.

Sound proved to be a fascinating but complex medium. Sound adds a dynamic element to a static image. Still, although participants sometimes changed the sound file connected to a visual object, the sound, if not intrusive, mostly stayed in the background. This is partly to do with the fact that they worked a lot with panoramas taken from a distance that provide an overview but also let appear the sound come from far away. Only when actively working with the hearing position participants became more aware of sound as an additional medium for representing and evaluating the site. Changing the hearing position made participants more critical of some their interventions, such as for example the closeness of the road they had introduced to some of the buildings they had planned. They replaced a bus that seemed too noisy by a tram. They also used the 'sound token' to identify an object that emitted an annoying 'casino sound'. We observed how working with sound reactivated the group, motivating it to continue. Exploring the scenario with the hearing position made them enter the scenario in a way that the visual representation in itself cannot achieve. They truly started walking through the scenario and exploring it once more.

We could observe how tools and content together enabled participants to work on the urban issues for the site:

***Connectivity*:** Participants discussed about the different possibilities to set connections through the site and with its environment (the two towns, the river Oise) on the physical map. They defined the types of the connections and used the pair of tokens to add them to the scene. Maps of two scales allowed them first see the grand picture and then focus on the site itself and see how different types of roads affected it.

***Circulations*:** Participants took the flow tokens to set the circulation in each of the transversal streets. Flows, representing circulations, animated not only the scene but also gave a clear understanding of the dynamics of the infrastructure. Content placed close to it added an additional level of animation. For example, the image of the bus stop stimulated thinking about what kind of traffic to invite onto the site; so did the image of the bridge across a cascade, which was also connoted with the noisy stream of cars on the highway (Figure 14). The sound connected with flows heightened participants' sensitivity towards the difficulties of protecting green spaces, living spaces, children and their activities, when opening the *Caserne Bossut* and making it more accessible.

Figure 14: Bus stop; Bridge across the highway

Activities: Participants expressed their ideas about activities to invite onto the site mainly by using 2D images. They used the triangular tokens and positioned them according to the previously defined connections and surroundings. They also positioned buildings connected with specific activities, such as cultural centre or congress centre, creating a collage of activities next to the 3D building blocks they had placed (Figure 15).

Figure 15: Collage of activities and buildings

***Housing types*:** Different housing types were on the one hand represented by highly abstract 3D objects, which once inserted took on the character of massive interventions, eventually blocking the view onto already existing objects, such as the university. Participants discussed the housing types to be placed on the site and used the pair of square tokens to define areas for individual and intermediate housing. They then placed 2D images to denote specific uses on the site, such as social housing, the façade of a movie theatre or a kiosk (Figure 16).

Figure 16: Scene with 3D buildings seen from above (top) and 2D images visualizing use and detail

***Centrality*:** This issue was discussed in terms of paths that frame and/or transverse the central space, in relation to the commercial space and housing units. Specific interventions and uses, such as fountain, playground, green space, as well as paved areas were introduced as 2D objects. Here the points of view offered by the different panoramas helped participants develop a notion of centrality.

6. Discussion

How can MR tools and events, such as the workshop we described, help build a COP around an urban project? We here take up some of the principles for cultivating COPs put forward by Wenger et al. [22], reinterpreting them from the point of view of a COP's long-term engagement in an urban project.

***(Different levels of) participation*:** The first aspect concerns the participatory potential of the MR-Tent. One of its main strengths is that it brings people together around a table and provides them

with tools that are easy to learn and handle in an interactive way so that they can quickly develop a good way of working together. The table acts as a mediator insofar as participants do not have to discuss in a confrontational way face-to-face but by means of gesturing, setting interventions, commenting, and modifying. This is an inclusive mode, which does not favor the expert. It leaves space for everybody.

The MR-Tent provides a space for 'mixing realities' that can be viewed and evaluated together. The diversity of perspectives as well as the presence on the site enlarge this interaction space, hence also the means of expressing and experiencing. People point to the panorama view, they cluster in front of the see-through, they look for content, they zoom into the video-augmentation, they may even step out of the tent to look around.

Our focus on participation had strongly influenced our design decisions, namely to build a tangible user interface in combination with color tracking, to create a 2.5D interaction space, and to support 'immediacy' - the ad-hoc creation of mixed reality scenes as an integral part of participants' expressing and experiencing ideas – rather than perfect renderings. Erickson [6] stresses the 'roughness' of design representations that leave openings for discussion. However, the MR-Tent is not a tool for 'ad-hoc' participation. Participants need to prepare for the workshop so that they arrive with a vision and issues to address (see our 'cultural probes interviews'). They want to bring their own content or find content that helps them express their ideas. Preparing content (3D, 2D, sound) requires special expertise, including artistic skills. The main challenge here is to select and edit content that allows represent urban issues in ways professionals but also lay people can relate to.

***Open a dialogue between inside and outside perspectives*:** The non-expert participants that were invited clearly represent perspectives that are traditionally kept 'outside' or at best at the margins of an urban project. The 'cultural probes interviews', as well as the round table were our main instruments for helping them enter into a dialogue with those 'inside'. Crucial to this was the fact that the technologies we provide are relatively open. We did not implement any 'rules' or 'constraints' beyond the technical limitations of the tools, and with this made an explicit step away from simulation tools. This moved decisions away from the technology into the responsibility of the participants. The floor was theirs with regard to the actions they wanted to set and the level of complexity they wanted to address. We had in a previous workshop [1] experimented with a set of urban rules concerning the urban density, such as the spacing of volumes of different sizes and heights or the reachability of central places. We observed how this quite simple set of rules turned the MR-Tent into a teaching tool (with the specific benefit of letting participants better understand the implications of some interventions) rather than a tool for an open dialogue.

***Focus on value*:** From an urban planning point of view, the MR-Tent lends itself more to developing a general strategy for a site, discussing main interventions and ambiences. The results of such sessions can be taken back to the design office for specialists to detail the design, eventually returning to the Tent for presenting, discussing, and taking up additional comments.

A particular value of the MR-Tent lies in the fact that urban planners have the chance to find themselves on 'equal footing' with non-experts. This implies that they need to give up control over how to represent urban issues. Essential for urban planners is, for example, to correctly visualize the volume, scale, and position of objects. The video view onto the scene offers no depth information; and in the panorama view an approximation is created by occlusion based on a depth image. We observed that participants partially compensated for these imperfections on the one hand; that they sized and arranged objects 'optically' in the panorama in relation to other objects on the other hand. 2D objects may not work so well spatially but they have a strong expressional value. The composed scenes (including the screenshots we printed out for participants to further discuss) are rather different from the material architects are used to work with, in terms of perspective, as well as mixture of real elements with 3D objects and 2D images. Also working with sound as a predominantly expressive medium requires learning on the side of urban planners. We contend that the value of the MR-Tent is precisely that it opens up for novel forms of representation beyond widely accepted representational techniques, such as sketching, 3D modeling, and simulation. These novel forms play a crucial role in the intended dialogue between inside and outside.

***Combine familiarity and excitement*:** Many aspects of the MR-Tent are based on familiarity: the meeting place of a tent, the experience of a round table, physical maps, the simple objects made from well-known material we provide, as well as interaction modes participants know from everyday life. Participants could even recognize a part of the content as 'theirs'. At the same time, we use these elements in a somewhat unusual way. Participants are invited to not just talk about their vision but to enact it; in fact the action temporarily moves to the foreground and the talking to the background. They engage in a mixing of realities, which is new to them: composing a scene on the physical map with physical objects while feedback in the form of footprints is projected on the table; seeing the same scene presented in different perspectives – panoramas taken from different viewpoints, real video stream, or see-through; being exposed to a soundscape that changes with each object they place and with the hearing position. We may even look at performing *in situ* as an unusual experience.

Feedback: 12 participants filled in a questionnaire, which asked for personal comments in free text. Their answers have to be read in connection with the dynamics of the workshop. They provide some interesting and complementary insights. Participants participants stressed the evolution of ideas in the group. The immediateness of interventions was seen as making the work more lively ('it is a pleasure to experience the process') and opening up possibilities. The urban specialists appreciated the fuzziness of representations ('they allow to focus on the conceptual level') more than the lay participants who look for more realism. They appreciated the reality elements that flows add to a scene ('a real city is always in movement'). Some thought of the connection between image and sound as interesting and occasionally 'surprising'; in general sound ('an often forgotten dimension') was seen as an important element in creating ambience.

The urban planners and representatives from the city, who had been rather skeptical at the beginning, came to the conclusion that the workshop had opened up the already existing 'masterplan' for the site and created valuable input for further panning sessions. We actually were invited to organize a participatory workshop in

connection with another project in the area were planning is still at the very beginning.

7. Conclusions

The MR-Tent as a mobile in situ laboratory has been designed to shelter a community gathered around a common project. As a shelter, the Tent contains all archetypes of a place where the members of a community bounded to a common activity can meet, get to know each other, exchange, and decide in an equal feeling of wellbeing. Its envelope reminds the original nomad dwelling, giving participants the pleasant and enjoyable impression of an exceptional meeting. The round table in the middle of the Tent is typically the place where a community meets and exchanges ideas, values and perhaps friendship. Because, as Antoine de Saint-Exupéry says (Terre des hommes, 1938), «Aimer, ce n'est pas se regarder l'un l'autre, c'est regarder ensemble dans la même direction» (Love is not looking at each other, it is looking in the same direction [our translation]). The window opening to the neighboring landscape metaphorically describes the research collective's view onto the world and the ambition to understand it. Like a city or a house, the Tent is a place that stimulates the desire to be together and invites a common decision; a place where people can meet, discover and appropriate a world; in other words live together inside a complex and sometime contradictory community.

8. Acknowledgements

The authors would like to all members of the IPCity project (EU Grant FP-2004-IST-4-27571), in particular Andrea Börner, Michal Idziorek, Stephan Gamohn, Burcu Ozdirlik and Sevasti Vardouli, as well as all workshop participants.

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