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Task: 4.4 Embedding user innovation in technology design

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Authors:

Marinka Vangenck

Jo Pierson

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Intermediate version of report on socio-technological 3D navigation design





IBBT vzw, Interdisciplinair Instituut voor Breedbandtechnologie
Gaston Crommenlaan 8 (bus 102), 9050 Gent, België • E info@ibbt.be • T +32 9 331 48 00 • F +32 9 331 48 05 • w

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2 Introduction

Our role within the URBAN project is twofold. On the one hand we conduct an explorative in-depth user research in two iterations on the way people would interact and engage with 3D navigation in a city environment. On the other hand we try to connect these findings concerning current and future user practices on navigation in a 3D environment to the actual technology development process in the URBAN project. In other words, we need to integrate the user research in the technological activities. This report deals with the second component of our research in the context of URBAN and in particular the first iteration of Task 4.4.

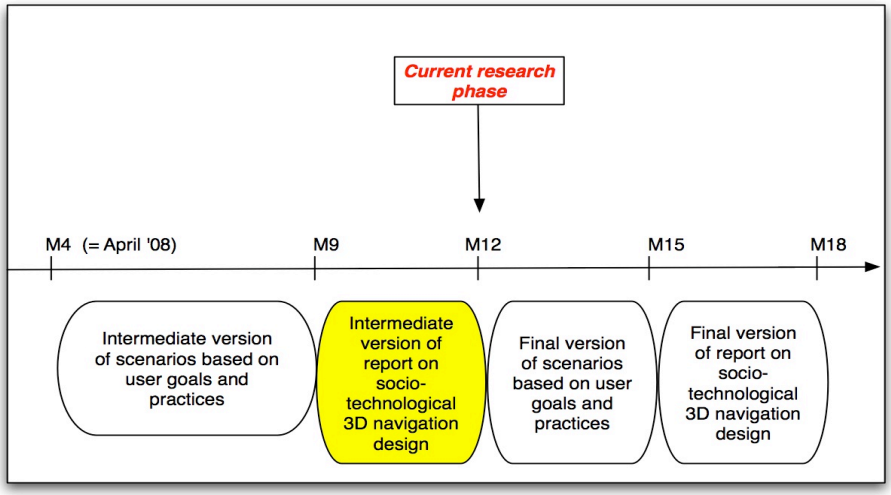


Figure 1: Current research phase within URBAN

The objective of Task 4.4, 'Embedding user innovation in technology design', is to integrate the user research outcome, and thus the Task 4.3 user scenarios, in the technology development process. This is done on the experimental level, by participative design techniques bringing together potential users, technology researchers, developers and user experts. This will deliver a user-centred input for the further development of 3D city environments. It is only through embedding user input in the design and development process of new products and services that innovation as a chance to succeed. This fits in the current trend of user-driven innovation. (Wise & Høgenhaven, 2008)

It is important to realise that the embedded user scenarios are under constant development throughout the whole research project. At the beginning of the project,

we first did a desk research to get a horizontal state-of-the-art overview of possible innovative domains regarding the use of 3D city environments. These insights led to the creation of preliminary user scenarios that formed the foundation for the further empirical user research. These draft user scenarios were then discussed in depth and revised with the (technologically oriented) project partners from research and industry (EDM and Androme). In a next step we investigated archetypal users of the two domains that seemed to have the most potential in relation to 3D city service innovation, namely tourism and real estate, by means of a combination of qualitative and ethnographic research methods. The explorative desk research together with the empirical study has generated more user-grounded scenarios for city trips and real estate that define the possibilities and constraints of a 3D digital city environment. It are these Task 4.3 user scenarios that need to be embedded in the technology development process in the context of Task 4.4.

Integrating the user research in the technological activities implies that we first identify which technological elements and activities of the URBAN project are susceptible to change based on the former user findings. Consequently we interviewed the different technological project partners to trace the 'hooks' where user input could guide the development. In other words, we try to identify the research and development activities where user input can have a genuine added value and hence where we can 'hang up' our user conclusions. We conducted the first interview on the 5th of November 2008 and ended the interview round on the 27th of November 2008. With exception of Procedural and SPC, we consulted all the project partners.[1]

In a next phase we involved the related partners in an interactive workshop on the 15th of December 2008 with the objective to bring together all the relevant stakeholders in the design process. On the one hand this enabled us to assess to what extent user innovations and ideas from Task 4.3 are technologically feasible. On the other hand the elements from the scenarios are built into the technological design decisions. This refers to issues like customised mapping based on user profiles or transforming the 3D 'reality' in line with specific preferences of user types (e.g. scaling up or scaling down specific buildings of interest). The output of this exercise is a report on the process and the outcome of socio-technological development activities.

[1] As Procedural is located in Switzerland, we were not able to get an answer on one of our several requests for an interview. A separate interview with SPC seemed to be redundant, as a former SPC employee - who now works for GeoAutomation - was also present during the GeoAutomation interview. In addition GeoAutomation and SPC closely work together on a daily basis in the same office.

Before elaborating on the actual outcome of our attempt to embed user innovation in the technology development process, the report will contextualise the applied research perspective, namely people-centred design and user-driven innovation. In addition we will go into detail on the way in which we tried to realize user-driven innovation in practice in the context of the URBAN project, more specifically by organising an interview round and an interactive workshop with most of the project partners. Furthermore we will discuss the findings of the previous and second research phase. Within the part of the findings, we first present the actual output of the interviews with the project partners and the interactive workshop, being illustrated by means of quotations from the interviews and workshop. Secondly we take the opportunity to reflect on the user-driven innovation process that we tried to establish and thus discuss the meta level of the research results. All relevant research material can be found in the annex.

3 Conceptualisation: User-Driven Innovation

Within Task 4.4 we try to implement user-driven innovation in a 3D city environment from a people-centred development perspective. In order to contextualise this research perspective, the following part will elaborate on the importance of involving the user in the innovation process, the evolutions within the field of user-centred design and on how to grasp user-driven innovation.

3.1 Why users in innovation?

The importance of innovation for the future of companies cannot be underestimated. We live in a world where change is the only constant and thus innovation is essential for companies of every size in every industry (Chesbrough, 2003). Yet together with the increase of the amount of new ICT-products, we also notice an increased amount of failed innovations, in the sense that the new products did not meet the expectations of the management. (De Marez, 2006) Chesbrough (2003) puts it quite vigorous: "*Most innovations fail. And companies that don't innovate die*." According to Von Hippel (2005) only 25% of the innovations are successful. Similarly Frissen (2004) concludes that 75% of all the innovation projects in the Netherlands partially of completely fail. De Marez (2006) points at the lack of insight in the user and the related inefficient marketing as the most important causes for innovation failure. There is a lack of insight in the needs and expectations of the user, in how the user perceives the new products and in what makes a product attractive, which often leads to a bad market positioning of a product. The lack of user insight can be caused by insufficient or bad market and user research, a lack of research methods or by the mentality of the company itself that attaches no or too little importance to user insights and market research. Consequently it is obvious that paying attention to the user in the innovation process is essential to avoid investments in products and services that do not fit in with consumer behaviours, experiences and expectations. (Wakeford, 2004) Without a good understanding of the (potential) users, a new product is often doomed to fail.

The role of the user in the innovation process has changed considerably over the past decades. (Von Hippel, 2005) In the 80's and 90's, the supply of new research and technology were seen as the key driver for innovation. The objective of most companies was the development of the most technologically advanced products and

processes. However, in recent years the notion of demand-led innovation, innovation driven by user needs and requirements, has stepped to the forefront. From an 'Open Innovation' perspective, companies should use external ideas as well as internal ideas in their search for technology advancement. From our perspective, external user input can be of significant value. The 'Open Innovation' paradigm breaks with the old paradigm 'Closed Innovation' within which companies were strongly self-reliant and generated their own ideas and developed them. Although this paradigm worked well for most of the twentieth century several factors, such as the growing mobility of highly experienced and skilled people and the increasingly fast time to market for many products and services, undermined 'Closed Innovation'. No company can still afford to innovate in a vacuum. (Chesbrough, 2003) In the context of increased global competition, companies can no longer rely solely on 'traditional' drivers like price and quality in order to maintain their competitive advantage. Today companies must also find alternative sources of competitive advantage in order to deliver more valuable products and services to the market. These new innovation strategies frequently entail more open business models, more attention for understanding latent consumer needs and more direct involvement of users in various stages of the innovation process. (Wise & Høgenhaven, 2008)
The emergence of web 2.0 services for instance is a case in point: users are increasingly in the drivers' seat and determine to a high extent the content and the business model of new products and services. In innovation contexts, the influence of the user is increasing and has shifted from a role in the final phase of the product development process to becoming an integral part of the value chain. In this way, new products will fit the users' everyday practices, which is an important condition for consumer satisfaction and thus product success.

Obviously the involvement of users from the beginning of the creation and design process of new innovative products and services is necessary to mitigate the risk in developing new technologies. (Wakeford, 2004) Yet what does user-driven innovation actually imply and how can it be established? The following part addresses these questions.

3.2 User-Driven Innovation: what & how?

3.2.1 From user-centred design to user-driven innovation

Since technological innovations are often perceived as too complex or irrelevant by users, the notion of 'user-centred design' (UCD) has gained importance. The awareness is growing that involving users in the product development process increases the chance that new products and services will actually link in with the expectations, characteristics and practices of future (end)users. UCD has originally been formalized in the field of Human-Computer Interaction in the eighties. (Veryzer & Boria de Mozota, 2005; ISO, 1999) "*User-centred design emphasizes that the purpose of a system is to serve the user, not to use a specific technology, not to be an elegant piece of programming*". (Norman, 1986:61)

UCD is a quite general term that is often defined differently by different authors. It is an umbrella term for development processes and practices within which the user has a central position. Different authors use various terms, such as user-oriented design (Veryzer & Borja de Mozota, 2005), human-centred design (ISO, 1999), customer-centric design or people-centred design (Wakeford, 2004). Unfortunately UCD is frequently considered to be solely about 'usability' or the 'ease of use' of things. UCD often becomes only 'user testing' and is brought in at the end of the product development cycle. (Wakeford, 2004)

In 1999 ISO (the International Organization for Standardization) established an international standard for 'human-centred design'.[2] The standard aims to help designers to identify and plan effective and timely human-centred design activities and thus makes the existing knowledge about human-centred design processes also available to non-specialists. According to ISO 13407, the incorporation of a human-centred approach is characterized by:

- The active involvement of users and a clear understanding of user and task requirements
- An appropriate allocation of function between users and technology
- The iteration of design solutions
- Multi-disciplinary design (ISO, 1999:3)

Similarly our research approach goes out from the conviction that involving users as early as possible in the new product/technology development process is necessary to increase the chance that new products and services will actually respond to the

[2] ISO provides multiple international standards for HCI and usability, e.g. ISO 9241-11 'Guidance on Usability', ISO 14915 'Software ergonomics for multimedia user interfaces', .ISO WD 20282 'Usability of everyday products', etc. Yet while most standards are aimed at making interfaces and products more user friendly, ISO 13407 named 'Human-centred design processes for interactive systems' is more in line with people-centred design and hence the closest related to our research perspective.

needs and practices of users. Moreover the empirical field research, Task 4.3, consists of two iterations. In the first research phase we investigated current user practices in the domains of city trips and real estate in order to identify potential 3D city services that could have an added value from a user perspective. Project partners EDM/ANDROME[3] have integrated this user input in a first version of the demonstrator. In the third research phase in which we go back to the users we will investigate the potential of the formulated 3D city services in-depth by means of the proxy of EDM/ANDROME. In addition the user scenarios also have an iterative nature since they are constantly fed by the results of our research activities. In other words, the development process is a nonlinear, iterative process that is guided by feedback from end users. Finally URBAN is a multi-disciplinary research project that involves research groups and institutions with diverse backgrounds and expertise. As such the URBAN technology is characterized by a multi-disciplinary design.

Within UCD the user input that is integrated into the design process is often more focused on individual experiences, while media technologies are domesticated in the everyday social life world of people. Therefore we prefer to talk about 'people-centred design', within which the social context and possibly the domestication perspective are included to obtain user insights. PCD proposes a heuristic approach and combines anthropology, sociology and design to identify opportunities and shape organisations, products and services to best exploit those opportunities. (Wakeford, 2004) In other words, PCD extends the UCD scope by considering the user within his/her social context rather than task-centric users as a fundamental source of innovation. This is in line with the identification of 'social requirements', complementary to user and context requirements, as defined by IBBT-SMIT (Lievens et al., 2008).

Yet the domain of UCD is under constant evolvement. Currently in the Nordic Region one even goes a step further with the notion of User-Driven Innovation (UDI), which we try to implement within URBAN. UDI can be defined *as "the process of tapping **users' knowledge** in order to **develop new products, services and concepts**. A user-driven innovation process is based on an understanding of **true user needs** and a more **systematic involvement** of users."* (Wise & Høgenhaven, 2008: 7) So the two key components within UDI are the understanding of users for finding new opportunities to create value and a systematic involvement of users in the innovation process. In order to achieve this goal, the innovation process needs to be undertaken

[3] Research group EDM and institution ANDROME are taken together in this report since there is no clear distinction between their research and development tasks in the context of the URBAN project. Both partners closely work together towards the demonstrator that will be presented at the end of the project.

with a systematic/planned involvement of users **and** other stakeholders. Only in this way, companies can define and deliver unique experiences together with users, which is required to survive and to create a competitive advantage. (Wise & Høgenhaven, 2008)

Now that we became acquainted with the concept of user-driven innovation, the key question is how to investigate users from this perspective. The following part will try to grasp the concept of user-driven innovation and frame it within the overall product/technology development process.

3.2.2 How to grasp user-driven innovation?

In the new product/technology development cycle (see figure 2) one can distinguish three main phases: the conceptual phase, the test and experimentation phase and the evaluation phase. However, these phases should not be considered as separate well distinguishable phases. New product development is a cyclic process characterised by a lot of overlap between the different phases. For instance during the testing of a prototype a researcher is at the same time already evaluating the technology and during the evaluation of a prototype new ideas can arise that then will be conceptualised.

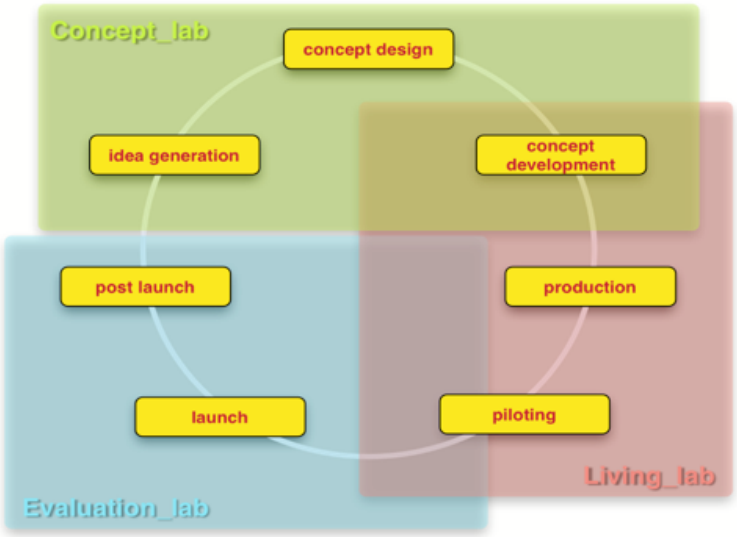


Figure 2: New product/technology development cycle

The conceptual phase starts with idea generation and the design and development of a concept. In this phase assumptions that are often implicitly taken for granted are empirically founded. Therefore our first research phase within URBAN that focused

on identifying services that could offer a genuine added value for users in a 3D city environment can be situated within the conceptual phase of the new technology development cycle.

Within the test and experimentation phase (potential) users are confronted with (prototypes or demonstrators of) technology. In our third research phase in which we go back to the users, people will be able to test a first version of EDM/ANDROME's demonstrator that has been developed by means of the Task 4.3 user scenarios. ICT user behaviour is unpredictable since users can adopt ICT in creative and sometimes unanticipated ways that deviate from the initial expectations of the engineers or product developers. That is why users are more and more investigated in direct contact with the technological prototype or service that is being developed. The user is brought in contact with the technology during its development process and the user experiences are integrated as feedback in the different technological design and development phases. This requires test and experimentation platforms (TEPs) with an active involvement of (potential) users. Yet it is not always clear what type of facility is best suited to achieve the required results. Therefore Ballon et. al. (2007) created a typology of test and experimentation platforms (TEPs) that are defined as "*all facilities and environments for joint innovation including testing, prototyping, and confronting technology with usage situations*". (Ballon, Pierson & Delaere, 2007:139)

The researchers identify three major rationales for establishing TEPs:

1. Involving users in the innovation process
2. Increasing policy awareness of the importance of innovation activities for competitiveness
3. Overcoming failures in innovation

Our research approach and thus the fact that we want to test a preliminary demonstrator are essentially based on the first rationale, the involvement of users in an early stage of the development process of the URBAN technology.

The different TEPs are arranged on two axes. (see figure 3) The horizontal axis represents the technological readiness thus the maturity of the technology or application. The vertical scale goes from a focus on testing technology to a focus on the design aspects. In other words, do we look more at the proper working of the technology in technical terms or do we focus more on how the technology should look like and what it should be capable of doing? Thirdly the typology differentiates between the degree of openness, going from in-house activities to open platforms. (Ballon, Pierson & Delaere, 2007)

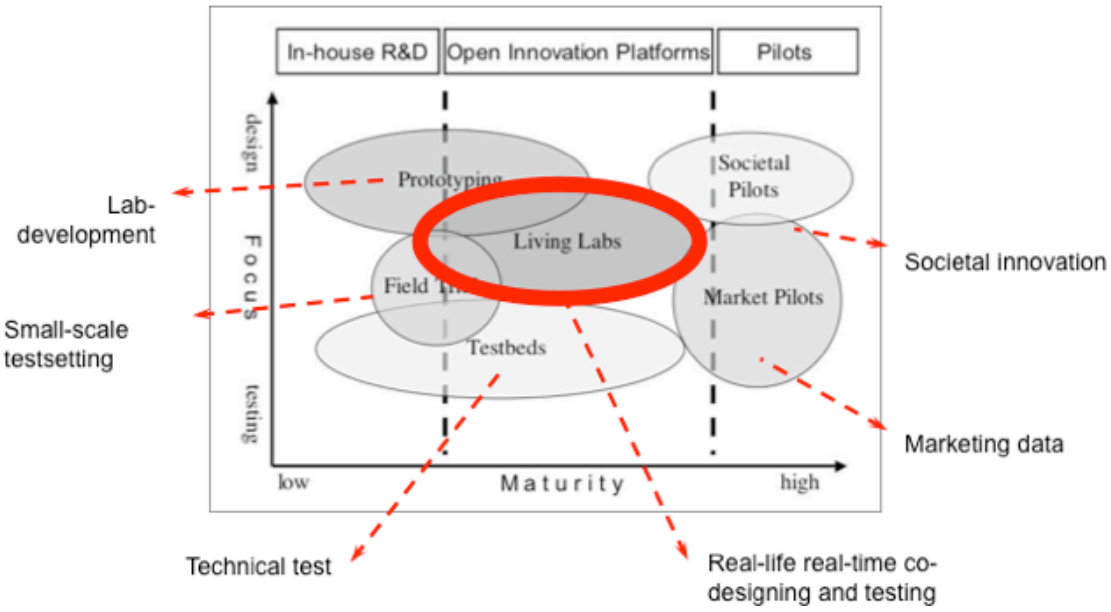


Figure 3: Conceptual framework of test and experimentation platforms

Following the typology, the demonstrator of EDM/ANDROME that will be tested by users in our next and third research phase can be considered as a prototype. Prototyping platforms can be defined as "*design and development facility used prior to mass production and resulting in the first proof-of-concept of a new technology, product, or service*". (Ballon, Pierson & Delaere, 2007:151) When we go back to the user, the focus will be more on the design aspects rather than on technology testing. In particular, the research question that has been formulated in the first research phase will now be investigated in-depth by means of a 3D city model prototype: "*Which services could offer a genuine added value for users in a 3D city environment?*". Furthermore the URBAN technology that will be tested by means of a proxy is more immature and thus far from (almost) market ready, another characteristic of prototyping. The final demonstrator will definitely not be a fully working end application. This leaves EDM/ANDROME enough room for technological changes based on our user input. Finally a prototyping platform is situated between in-house activities and open platforms, just like the test setting we foresee for the users in the second part of the empirical field research. We cannot talk about a 'real-life setting' in which users can be considered as co-producers and can use a technology during a considerable period like within a Living Lab context. We will have to install EDM/ANDROME's prototype on a desktop computer and ask users to navigate through the 3D city environment.

Finally the third phase of the new product development cycle is the evaluation phase. This phase aims at developing and applying user-centred evaluation criteria. The

final URBAN demonstrators will be developed by the end of the project in month 24. We are involved within the URBAN project until month 18 and therefore cannot conduct a user-centred evaluation of the final demonstrators. However we will be able to use a first version of the EDM/ANDROME demonstrator as a proxy for the URBAN technology during the second iteration of our empirical field research. This means we will be able to conduct a first evaluation of the prototype whose results can be integrated by EDM/ANDROME in the development of the final demonstrator.

Now how did we aim at user-driven innovation within the URBAN project so far? The following part will address this question in detail.

4 The praxis of user-driven innovation

4.1 Overview

In the previous research phase we have conducted a scanning of user innovation opportunities. On the basis of a thorough desk research and expert meetings with the project partners EDM & ANDROME, we first identified four areas within which a 3D city model and its related services could have a clear added value from a user perspective: tourism, real estate, urban planning and public transport. We then investigated archetypal users of two of the four domains, namely the ones that seem to have the most potential in relation to 3D city service innovation: tourism and real estate. **Tourism** was selected because the market of (mobile) city applications is gaining momentum in the tourist sector. With the 4.3 research track we aim to analyze to what extent such existing services can be complemented with 3D city model applications. **Real estate** was assessed as relevant by the experts from the perspective that 3D visualization of cities could offer significant added value for people looking for and assessing a house or apartment. In addition, based on our desk research, this seems to be a domain that has received very little attention in the current literature on service innovation in 3D environments.

	Tourism (city trips)	**Real estate**
Professional users	Travel agents	Real estate agents
Private users	City trippers	Prospective home-buyers/renters

Figure 4: Overview of archetypal domains and users investigated within task 4.3

The empirical field research led to a first assessment of innovation opportunities and validated the two selected domains of tourism and real estate as domains that could have a lot of potential in relation to 3D city service innovation. The previous findings also enabled us to identify and draft two user grounded scenarios. They define the possibilities and constraints of a 3D digital city environment and point out the technological requirements and challenges from a user point of view. These scenarios served as guidelines for user-driven innovation of the URBAN technologies. They were a starting point for iteration and further development in the project.

In order to find out how the findings of the user research could be implemented in the research and development process of the URBAN project, we first interviewed all the project partners. The objective of these interviews was to trace the 'hooks' where user input could guide the development. Secondly, we organised a participatory workshop with the different project partners. During this workshop, we tried to assess to what extent we can find a match in the user scenarios between a user perspective and technological feasibility.

We will now discuss the preparation and actual implementation of the interviews and workshop in detail.

4.2 Interviewing the project partners: in practice

4.2.1 From preparing to conducting interviews

Integrating the user research in the technological activities requires the identification of the technological elements and activities of the URBAN project that are susceptible to change based on the former user findings. Consequently we interviewed the different technological project partners to trace the 'hooks' where user input could guide the development. In other words, where can we provide which partners with what kind of user input so that the user will have a central position within the development process? The interviews with the involved groups also enabled us to assess to what extent user innovations and ideas from Task 4.3 are technologically feasible in the URBAN project. The list with the names, research group or institution and function of all the interviewees can be found in annex 1.

Before staring with the interview round, we prepared a concise profile sketch of each research group and institution that is involved in the URBAN project. (see annex 3)

The profile sketch is based on information found in the proposal and on the internet and consists of four parts:

1. The first part shortly describes the partner's role within the URBAN project.
2. 'What?' defines the core business of the partner in question
3. 'Towards the users/consumers' indicates the message/profile the group or institution sends to the outside world, for example a company's commercial advantages.
4. Some background information on the research group/institution forms the fourth and thus last part of the profile sketch.

During the actual interview, each project partner had the chance to read his own profile sketch and make adaptations in case of inadequacies or incompleteness. The profile sketch served as a preparation for the interviews in order to get a better insight in the different interviewees. Though at the same time closely examining the proposal and browsing the internet to identify each partner's background, expertise, profile and role within URBAN was already an essential part of the user-driven innovation process. The preparatory process gave us a first indication of with which project partners it would be rather easy to trace user hooks in their development and research process and with which partners cooperating would not be that self-evident. The actual findings that came out of this process will be discussed in detail later.

As a preparation for the interview, we asked each interviewee to go through the two user-grounded scenarios of task 4.3 and already think about the (technological) feasibility, requirements and challenges of each component of the scenarios from their own perspective. We communicated that their input on the scenarios would be discussed during the interview.

The interview questions were clustered around three main topics in a topic list (see annex 4):

1. The interview started with the topic 'project implementation' that deals with what kind of research the partner conducts within the project, which goal they pursue within the project, how they conduct the research and to what extent they work together with other project partners.
2. The second topic 'profiling/positioning' delivers insight in the direction the research group/institution wants to go to with the URBAN technology, the context(s) within which the technology could be used. Within this part we also wanted to trace possible user types that the partner could have in mind during his research activities.
3. The third part of the interview began with discussing the two scenarios that each partner had read as a preparation. Thus we asked the project partners

to give input on the different components of the scenarios. On the one hand we used the user scenarios as a tool to cooperate with developers. On the other hand the scenarios also enabled us to keep the focus on a common goal and to come to a consensus.

Throughout our research trajectory in URBAN, the user-grounded scenarios are under constant development. Consequently the scenarios are adjusted based on the collected input of all the interviewed project partners. Only by reaching a consensus concerning the two scenarios, the scenarios can be embedded successfully within the technology development process. After gathering the input on the scenarios during the interview, we asked the interviewees to evaluate our working method, to describe how they see our role within URBAN and their possible former experiences with other user research groups. The gathered input of the project partners on the scenarios as well as the adjusted version of both user scenarios can be consulted in the annex (annex 5-8). The components of the Task 4.3 scenarios that have been adjusted based on the interviewee's input are marked in bold in the adjusted version. The latter documents in the annex also indicates which input led to which adjustments. It is this adjusted version that was taken along to the next research step, namely the workshop.

Before continuing with the way we prepared and organised the participatory workshop will all the URBAN partners, we will further discuss some findings of the process of developing profile sketches of the involved project partners.

4.2.2 Profile sketch of the project partners

The profile sketch of the different project partners shows that the consecution of the different work packages in URBAN more or less coincides with the positioning towards the user. More specifically, the project partners who are primarily involved in the first work packages (in particular WP1), which deal with fine-tuning and experimenting with the basis technology, come the least in contact with user issues in their research and development activities. Firstly the role of the leader of work package 1 'Digital Surveying', IMEC, lies far from our role on user research. The main goal of this work package is to make GeoAutomation's 3D data capture as well as the processing more efficient. IMEC's know-how on speeding-up algorithms and systems are applied to the existing GeoAutomation pipeline. So the technological research group works on optimizing the first processing steps in the URBAN workflow and is very close to the data acquisition phase. It not evident to embed user

research in a research phase that is mainly focused on fine-tuning the basis of a technology and on finding solutions for processing issues. IMEC will benefit the most from a close collaboration with GeoAutomation and the engineering office SPC, their partners in WP1. Nevertheless we did conduct an interview with IMEC and other partners that we already thought would probably not see any usefulness in user input in relation to their own research.

Secondly the URBAN research activities of the industrial image processing group VISICS/ VISICS, leader of WP2 'Object Recognition' and WP3 '3D City Modelling for Visualisation', initially also seemed to be far away from user-driven innovation activities. Nevertheless while preparing the profile sketch, we did identify some user issues that could be of importance for VISICS. For example VISICS uses the data GeoAutomation records with their van to detect in first instance traffic signs but also other object categories like pedestrians, cars, trees, benches, etc. A relevant user issue could be whether the detected trees and/or benches should be removed from the 3D city model or are they important urban elements that need to be part of the 3D reconstruction of an urban environment?

Thirdly, being all part of WP4 'Visualisation of and interaction with 3D City Models', EDM and ANDROME are clearly the two partners that benefit the most obviously from user input. Consequently we regularly meet with the two technical partners as from the beginning of the project to think about and investigate potential 3D city services, also in relation to demonstrator 2 called 'Location-based city services'.

Finally for ICRI, leader of WP5 'Legal Aspects', user input is not relevant since the legal activities are in fact at the involved industrial partners' service. ICRI's role within URBAN is to make a legal framework concerning the protection of privacy and of personal data and intellectual property rights in the context of the processing of the data for the surveying application and for the creation of the 3D city models. The legal group will provide the industrial partners an overview of legal restrictions that they should keep in mind in their development activities. The figure below represents the position of the involved URBAN research groups towards the user as perceived and indicated by the different project partners. IBBT-SMIT is positioned right next to the user and ICRI the most remote from the user. However the real distance to or relevance of user input for the partners concerned can be very different in reality.

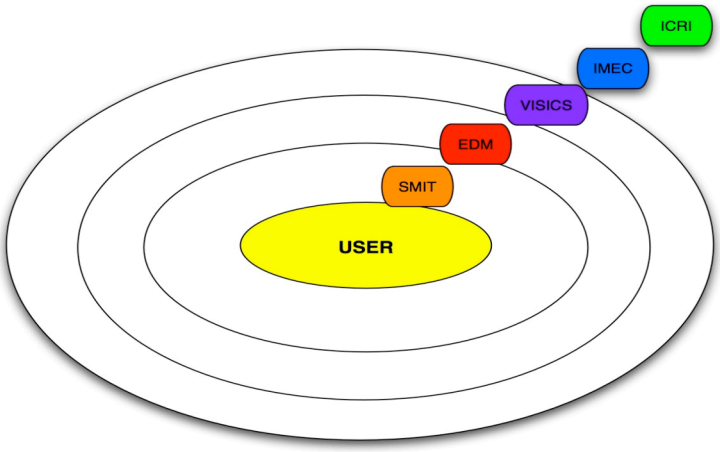


Figure 5: Self-perceived position of URBAN research groups towards the user

Once we had conducted all the interviews with the different project partners, we set up an interactive workshop that took place on December 15th 2008 at the IBBT offices in Ghent (Belgium).

4.3 Participatory workshop: In practice

The 2 user scenarios, that were fine-tuned and adjusted on the basis of the outcome of the interviews with the project partners, served as guidelines during the workshop. They were visualized by means of the storyboarding technique, which will now be described.

4.3.2 Storyboarding

We have chosen to visualise the user scenarios by means of the storyboarding technique to facilitate the communication during the workshop. The storyboards illustrate a particular user practice, namely 'planning a city trip' and 'searching for a house', using representative images to illustrate the scenarios. The scenarios describe how a particular persona, in our case the city tripper or the person who is looking for a house, enacts the practice or behaves in a given situation. In other words, the scenarios bring the user to life since it is more difficult to feel connected to an abstract description of something. They enable you to see if the technology that is being developed meets the user needs. They provide a setting, has actors, objectives or goals, a sequence of events and end with a result. The fictional personas, created to describe the typical city tripper and real estate purchaser, represent a group of end users during design discussions and keep everyone

focused on the same target. (Courage & Baxter, 2005)

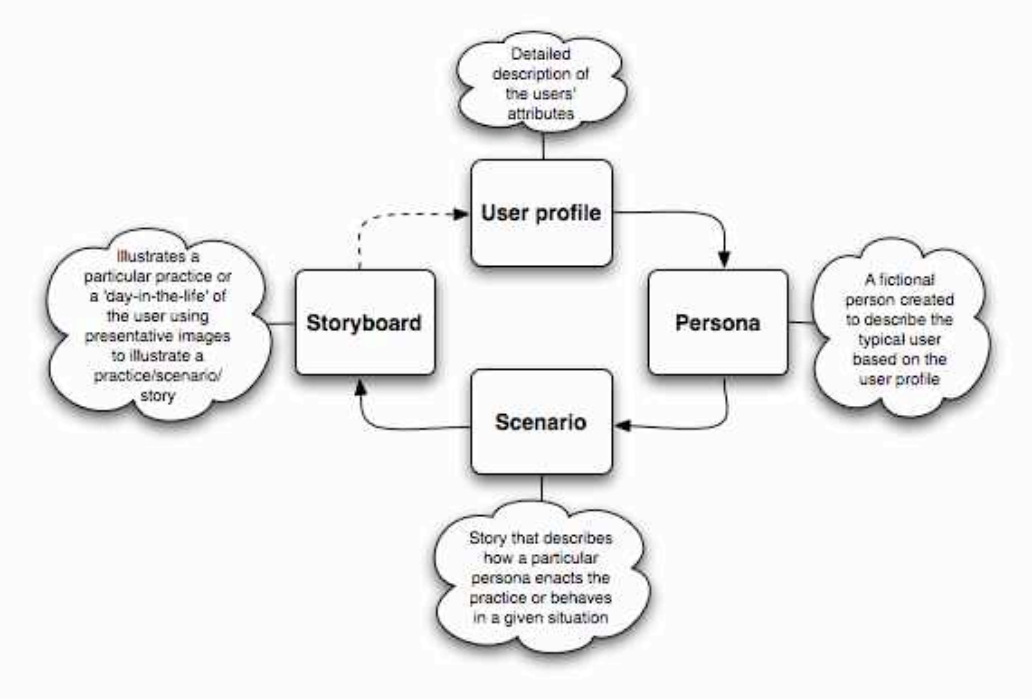


Figure 6: From creating user profiles to scenarios and storyboards

We brought together project partners with very different backgrounds and in such settings storyboards offer a common visual language to communicate on aspects of design. The product design storyboard supports developers in understanding the product-user interaction in context and over time. (Van der Lelie, 2006) "*Stories are useful with multidisciplinary or cross-organizational teams because they tend to serve as a 'common language' that spans differences in background and organizational status and focuses attention on the people who will use the system (a constituency often absent from many design discussions)*." (Gruen, 2000: 1) Each component of the two scenarios was visualised by means of an image (screenshots, pictures, drawings, etc.) that represents what a user would see on his computer screen on the one hand and a drawing of a user sitting in front of his computer and his reflections at that moment on the other hand (see figure below). We added the same drawing of the user in front of his computer with a reflection box on every slide since according to Truong et.al. (2006) the inclusion of people and emotions/reflections is an important attribute of storyboards.

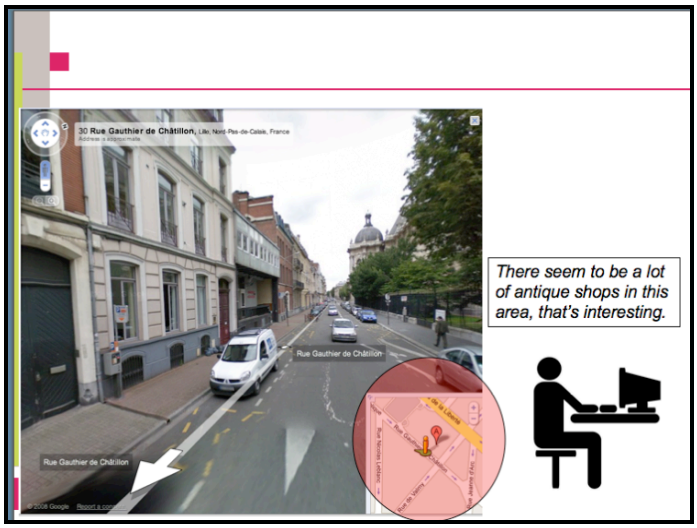


Figure 7: Example of one scenario component visualised by means of storyboarding

The consecution of these slides forms a coherent story about the possible use of future urban 3D services. "*A storyboard is a short graphical depiction of a narrative. (...) In designing new technologies, storyboards often illustrate an envisioned scenario of how an application feature works*." (Truong, et. al, 2006: 12)

The style of storyboards can vary from very open and sketchy to very detailed. A sketchy storyboard will evoke more comments and suggestions, while a detailed storyboard will sooner be perceived as final, as to be accepted the way it is visualised. So it is important to apply the right visualisation style in the product development phase in question. (Van der Lelie, 2006) We have chosen to mainly work with screenshots of applications that resemble the 3D urban technology that is under development the most, more specifically Google Earth, Virtual Earth and Google Maps, in order to make the abstract text-based scenarios more concrete. The use of existing 3D applications was also useful since URBAN's objective is to integrate existing and innovative technological possibilities. It is important to constantly keep in mind what is already possible in the field of 3D urban visualisation and where and how the URBAN technology can create a genuine added value within this field.

4.3.1 Organising the interactive workshop

By organising a two-hour workshop, we physically brought together all the (relevant) stakeholders in the development process. The list with the names, research group or institution and function of all the participants together with the invitation e-mail can be found in annex 2. The workshop aimed at generating insights and identifying opportunities and bottlenecks with regard to the different components in each of the

two user scenarios for user-driven innovation, from the perspective of each URBAN partner.



Figure 8: Set-up participatory workshop

The user scenarios are mainly focused on demonstrator 2, called 'Location-based city services', that will be developed by EDM and Androme by the end of the project. The challenge this demonstrator faces and that the workshop wanted to address is the integration of existing and innovative technological possibilities. There already exist a lot of (3D) urban services, especially in the domain of tourism, yet the challenge is to integrate these on an innovative manner and create a genuine added value for users. From a mutual shaping perspective, the workshop tried to find a match between users on the one hand and the technological, research and industrial partners on the other hand. What are the users' practices, goals attitudes, expectations and social context and to what extent can these fit the goals, planning and expectations of the project partners? In addition an interactive workshop is an ideal setting to set priorities. The storyboards of the scenarios visualize in which direction the URBAN technology can/could/should go. Yet it is important to find out what should be the priorities in the next phase of field research. What should be our focus when we go back to the users in the context of task 4.3 'Exploring user innovation in 3D city navigation', taking into account the views of all URBAN partners? Furthermore the storyboarding technique helps to assess which decisions will have which consequences, for example concerning the interface. So visualised scenarios can provoke more reactions and input than written scenarios and are therefore an excellent tool to use in a workshop setting. Finally the workshop was the moment on which each of the different scenario components could be evaluated in

group. Which components are not feasible within the URBAN project and could these be relevant for other another projects and which components are feasible within the project and will thus be integrated within the final demonstrator? Components that do fall within the scope of the project according to the project partners will then be the subject of our next research phase, the in-depth user research. In that way the findings of this third research phase can be built into the technological design decisions. This refers to issues like customised mapping based on user profiles or transforming the 3D 'reality' in line with specific preferences of user types (e.g. scaling up or scaling down specific buildings or other points of interest).

Since we have discussed the way in which we tried to establish a user-driven innovation research process in practice, we will proceed to the actual output of this research set-up.

5 User-driven innovation findings

The guiding question for the URBAN user research in this phase are: To what extent can user research be embedded in the technological development process in URBAN and what are the lessons learned? What kind of obstacles for integrating user research with technological development can one encounter and how can one anticipate on these barriers?

This section on the research results is subdivided in three main parts. The first part deals with the actual output of the interviews with the project partners and the interactive workshop for URBAN. The second part discusses the implications of UDI for the project approach, based on the analysis of URBAN research. Here three central issues were identified: 'project direction', 'cooperation' and 'involving the user (research)'. These findings will be illustrated by means of quotations from the interviews and workshop. The third part reflects on the user-driven innovation process and methods that we applied and thus discusses the methodological implications.

5.1 UDI in URBAN

It is still somewhat too early in the project to exactly assess the outcome of the user-driven innovation approach in URBAN. In the first phase (Task 4.3) we developed the first version of the user scenarios, in co-operation with the relevant project partners and preliminary validated by user research. This scenario text forms a 'living' document because it will be continuously adjusted and refined with input during the project. In the current phase (Task 4.4) we translated the user scenarios in story boards to assess more in detail what would be desirable and feasible in the URBAN project.

In this way we found that it will be less than evident for the user-driven innovation research to have already now (in this project) a substantial impact on the technological development path of 3D city modelling. The different (technological) partners perceive URBAN foremost as an opportunity to do basic research on technologies like 3D moddelling for visualisation, compression, object recognition, omni-directional video and legal aspects. The high end research done by each partners, possibly in cooperation with one or two other partners, will then be brought together in the end in order to be shown via a demonstrator. So the demonstrator is used in the traditional way, namely to demonstrate what has been found on

technological level.[4] Therefore most research partners see little added value to involve user research in their (early) technological research.
The little involvement of the user perspective also became visible through the fact that no prior use case scenarios were defined in the project. These are now being developed on route, not so much to steer technological choices but to configure one of the two final demonstrators. In this way the user scenarios (and the related storyboard) are dependant of the technological choices already made, instead of the other way around. The technological research will determine how the user scenario (and story board) will look like, instead that the latter is used to make decisions on technological options. The defensive reflex to add new technological functionalities that originate from the user research is an important observation in this regard.

This means that for the moment it seems that the outcome of Task 4.3 (preliminary user scenarios) will have created some awareness among the other (technological) partners about the potential translation of the technological research towards added value for the user. However the identification of these user aspects has not (yet) led to major technological implementation of other elements than those foreseen from the beginning of the technological research plans. Only on the level of the demonstrator a number of elements will be taken up, especially those that were already planned. This relates to the finding that most project partners perceive that user perspectives are part of the final development and translation to the market, and have little or nothing to do with the basic technology or architecture.

However this perspective differs from the UDI approach in which the user is an integral part of the full technological trajectory. Apparently there is a chasm between the functional requirements of the technological partners on the one hand and the user practices on the other hand. These practices relate to the kind of services and applications that are to be linked with the interaction framework (Task 4.2). Although each functional requirement could be coupled with some kind of user input, this does not seem to be obvious for the technological partners at the moment.
A solution to cross this chasm is to discuss what kind of technological research steps would be needed to (hypothetically) fulfill the identified user requirements, based on their practices and expectations. The question would be if and how the functional problem created by a specific user requirement could be solved technologically in

[4] In UDI the demonstrator can also be used as a tool for interacting with user perspectives in earlier phases and to find these user findings back to the technological research. This will be investigated in the next research phase (second iteration of Task 4.3).

this project or in future projects. This will be investigated further in the second iteration of Task 4.4.

For the moment we already identified a number of user requirements that conflict with the functional requirements identified by the URBAN project partners. These issues will be central in the next phase of our field research when we go back to the users (second iteration of Task 4.3).

- We see that for Tele Atlas the **location based and public transport services** are outside the scope of URBAN since these are already part of other, separate projects on themselves. This already indicates that the different components of a technology or service to be developed are split up according to the projects they belong to. Therefore only if the services already exist and can easily be integrated into the demonstrator, they can be part of the demonstrator.
- We also found that user input concerning the way **important buildings or locations should be indicated** (e.g. colouring, enlarging, framing, etc.) conflicts with the technological possibilities in the current 3D model being developed by EDM/ANDROME. A much more technological feasible option for the latter partners seemed to be the functionality of important buildings that 'glow' in the demonstrator.
- We also found that the project partners rank the relevance of the different functionalities (whether or not important for users) according to their **own** technological challenges in the project. In this way the **'search functionality'** has little priority within this project. Within one scene of the storyboard on city trips, the user entered a top curiosity in Brussels, namely 'Marollen', in the 3D city application and did not get any useful result. From a user perspective 3D tourist applications should certainly give results on top curiosities. Yet because only Google Maps will be integrated in the demonstrator the application can only give the search results that are available through Google (and 'Marollen' is not available via this way). Several research partners declared that finding a solution for such search problems was out of the scope of the project.

In contrast to the issues where the user practices conflict with the functional requirements of the technological partners, there are also subjects where both views converge. In this way we identified certain items where user input could guide the development and research process of the other project partners.

- The technological partners especially struggle with **visualisation issues**, such as the added value of 3D versus 2D and the required level of details and thus realism. This means that user input concerning these issues would definitely match with the needs of the technological and industrial partners. More in particular this refers to whether users will actually prefer 3D visualisation to 2D images. A 2D representation might provide the user with a better overview of (parts of) a city than a 3D city model.
- For one of the research partners (AGIV) defining the a**dded value of 3D city visualisation** would also be of great importance for internal discussion on future strategies. If the added value of GRB (Flemish Large Scale Reference Database) in 3D can be scientifically proven, the investments in GRB could be increased since the current objective is creating GRB on a flat 2D map.

"The images that we have are recorded in all directions. So you can perfectly say now I want to see it like this, I want to see that over there, that is all possible. Okay in that case you are stuck to those images, you do not have them in 3D. The question is if that is a big problem." (GeoAutomation, interview, 18th of November)

- The degree in which the 3D model should be realistic is another important issue. The 3D city model is developed by EDM/ANDROME based on the Tele Atlas 3D data. It generates a generalised 3D representation of the urban environments. While navigating through this 3D city environment, the users will not be able to look at **realistic façades of shops or restaurants**. Observing realistic façades would only be possible by means of omni-directional video, which is also foreseen in the project. Several project partners assume that a detailed front view of buildings is not important for users.

"You don't need to model your complete 3D model photo realistic only for the few restaurants and other things that you really want to see photo realistic." (Tele Atlas, workshop, 15th of December)

- EDM/ANDROME argues that users are mainly interested in the location of certain shops or restaurants and not in their appearance in reality, which makes realistic façades in the 3D model less relevant. Nevertheless, further research will have to show to what extent that the outside appearance of a

restaurant for instance is an important first criterion in the selection of possibly interesting places to eat, when going on a city trip. This will be further investigated in the next research phase. As an alternative, EDM suggested that the generalised **3D model could be combined with annotated data like Google** already applies, namely showing pictures of a point of interest when clicking of its location.

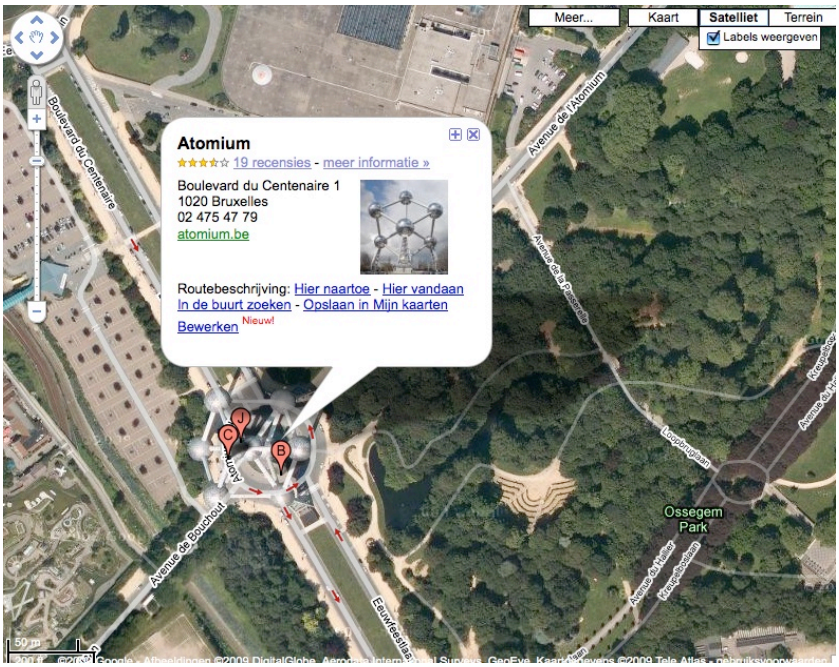


Figure 9: The addition of pictures to a location in Google Maps

In any case we see how assumptions on user perspective seem to be a possible strong determinant in technological development processes. Besides the research aspects that the other project partners see as a priority (like visualisation details), we also need to involve contextual aspects (such as search issues) in order to enable sufficient immersive experience and creating a kind of proxy technology (Torben Nielsen et al., 2008) that can deliver insight of how users would 'domesticate' the 3D city model in the everyday life practice of a city trip or looking for a house. So providing the research tools that emulates the everyday user practices in the best way are also required in the user-driven innovation process.

5.2 UDI project approach

The output can be classified under three main topics: direction, cooperation and user (research) involvement. In the context of URBAN, user-driven innovation can only be

achieved by pursuing the same objective and finding a consensus concerning the direction in which the URBAN technologies should go to and thus concerning possible application domains/contexts. Therefore the first topic deals with the separate objectives of the project partners. Yet user-driven innovation also required a close cooperation and a systematic involvement of users and all relevant stakeholders. Thus it is important to get an idea of the degree in which the different project partners currently work together and their perception of a close collaboration with all the partners within the project. Though it is important to realize that cooperation should never be a goal as such, it needs to be a means to achieve a shared vision on possibly relevant application domains for a particular technology. Consequently the cooperation between the different project partners is the second topic that will be adressed in this part. The third and final topic within this part will elaborate on the involved partners' perceptions on how user reseach (by IBBT-SMIT) can or cannot be integrated into the development process.

In order to establish a close collaboration and involvement of all project partners in the context of user-driven innovation, it is important to get a good understanding of the direction in which the different partners want to go with the URBAN project. What do they want to achieve at the end of the project, what are their priorities and to what extend do these match with user research objectives? During the individual interviews with all the partners involved, each research group/institution communicated its own goal(s) that they pursue within URBAN. Yet during the workshop it was interesting to confront these separate goals with each other. By doing so, it became clear that not all the project partners share the same idea of what should by achieved at the end of the project and what should be the project's priorities. The following topic addresses these findings.

5.2.1 Project direction

During the interviews and the workshop, it became clear that there is foremost a technologically oriented vision among the project partners on what should be achieved at the end of the URBAN project. Currently (in the middle of the project, i.e. December 2008) all partners are mainly focussing on the basis technology and research and less on the deployment. As a result it is not yet clear in which context(s) and for which applications the technology could be used in the future. According to the project partners, a clear vision on where the URBAN technology should go to, does not yet have to be formulated at the beginning of the project. For them, the project serves as an opportunity to experiment with and fine-tune the

technology. By doing so it will be more clear at the end of the project what the actual outcome will be.

"I rather work like I first want to see what I can do technologically and then I will take a look at the user. Of course if you are doing this kind of research you actually do not know what will be the outcome so first I want to see what is possible." (GeoAutomation, interview, 18th of November)

During the workshop EDM/ANDROME emphasised that URBAN is still a research project and the demonstrator that they will develop will not be a fully working end application where the user will be satisfied with all its functionalities. Obviously at the moment the URBAN research activities are still situated in an early phase of development and given the brevity of the project developing a fully working end application is impossible.

"That is what these projects are for, to do research on which direction we should go to because we look more at long-term planning." (Androme, interview, 14th of November)

Most of the project partners foresee that the direction of the URBAN technology will be determined by the technological experiments and research. However EDM/ANDROME attribute an important role to the user research within this process. as they are responsible for the development of the second demonstrator, This demonstrator focusses on the display of 3D geometry and location-based city services. During the first research phase the two partners worked together on the base technology, i.e. creating a 3D city through which one can navigate. In the current phase, after fine-tuning this technology, they are looking for user input (based on user needs and expectations) in order to guide the development of the demonstrator/end application. EDM/ANDROME would like us to provide them with pointers for 3D city services/functionalities in the interaction framework, based on user needs and expectations, in order to be able to develop a successful application that possible can be marketed.

"What is especially important I think is insight in what the users would like to have at this moment or in the future so that we can make a planning of where we could go to with our products (…)" (Androme, interview, 14th of November)

The following and second topic that determines the socio-technological development process in URBAN deals with the identified cooperation forms among the involved partners.

5.2.2 Cooperation between project partners

In the URBAN project a research group/institution typically works together with only one or maximum two other partners, in most cases the partners that are involved in the same work package and/or a data provider. While some partners regret the limited multilateral collaboration and communication within the project, others prefer to focus on their own specific tasks and expertise domain. The different groups that cooperate together often perceive that there is a gap between their work and the work of others. They state that everybody is working on different aspects of the project with different objectives and backgrounds. In this way collaboration is seen as difficult and/or redundant. Obviously within the context of user-driven innovation it is important that all the involved parties are at least informed about each other's activities since these are regularly interwoven. The activities and decisions of one project partner can have implications for those of other partners, including the user. As an illustration: in the context of object recognition VISICS is currently focussing on the recognition of traffic signs, which are quite standardised objects. The recognition of statues for example is much more complex. If VISICS decides to integrate statue recognition into the URBAN technologies this could have implications in relation to the compression and it would most likely have an effect on the user's experience and wayfinding in the 3D city. Within a development process, the activities of the involved partners are often more linked to each other than one might think at first sight.

"As programmer, as real researcher it seems to me that we do not very often come in contact with the other partners because as I mentioned before we are usually the ones who actually implement it and the others deliver more theoretical things on paper, which does not have a direct influence on our application or research." (EDM, interview, 14th of November)

One company even talks about being a 'fraction' within the project. On the one hand you have the research groups/insitutions that are mainly working on technical aspects and the optimalisation of technological processes and on the other hand you have the partners that are more working towards the end application and demonstrators. Building a bridge between these two groups of project partners is often perceived as impossible and even maybe irrelevant from their perspective.

"You work closely together with EDM and ANDROME to get those user scenarios ready and yes that is like okay that will result in something nice, but actually there is in fact a fraction within the project." (GeoAutomation, interview, 18th of November)

For some non-technical research groups within the project, like e.g. the legal research group ICRI, collaboration is not really a priority as each project partner is still fine-tuning its own technology and experimenting. AGIV also shares this feeling. According to them all project partners are, in the current research phase still focussing on their own developments and are not yet thinking about the demonstrator for the Flemish Large Scale Reference Database that will have to be developed by the end of the project (December 2009).

"Look in this case it does not really matter, cooperating proactive is not really necessary since there still is a lot of testing going on, there still is a lot in an experimental phase and we are lawyers, we are no engineers. We do not have to say you should make it like this." (ICRI, interview, 21st of November)

According to several project partners, cooperation with other partners is mainly useful in case of a win-win situation, when both partners can profit of the collaboration. Consequently the existing cooperation forms that we identified within URBAN principally concern such collaboration. In concrete there is a close collaboration between a data provider and a research group/institution that conducts joint research on the provided data. For example VISICS performs detection recognition of objects (in the first place traffic signs) on the ground root data that they receive from GeoAutomation and EDM/ANDROME use the 3D data of Tele Atlas to construct a 3D city model and at the same time help to optimise Tele Atlas' 3D production and compression processes.

"We are actually the first serious users especially of their 3D data. So for them it is very interesting how we handle it, how we process the data and so on and yes of course we also need Tele Atlas because they have the data, you cannot simply obtain those. (…) So we help each other a little bit with that." (EDM, interview, 14th of November)

An interesting finding is the suggestion that if cooperation within an IBBT project is desirable and/or necessary, this should be well defined in the proposal. If working together with the other project partners is not prescribed in the proposal, it is possible that each partner will focus on its own specific prescribed tasks and goals. Trying to build bridges between the different project partners, exceeding different backgrounds and pursuing a close cooperation is not always perceived as self-evident. Though this will not be a guarantee for UDI as closely working together from a user perspective also needs to be perceived as an opportunity. As we have already discussed, a systematic involvement of all the project partners aimed at a particular user driven outcome is an important condition for UDI. Some partners hardly come in contact with user issues, especially when doing more basic research in the very early stages of research and development. Obviously trying to find a match between research activities that are mainly concerned with fine-tuning and experimenting with the basis technology on the one hand and current and future user practices on the other hand is not always evident. Yet it is important that during the development process the door is kept open for the integration of functionalities that in the future can appear to be necessary from a user perspective.

"I would like the collaboration only if it's suitable for all partners, if it's a win-win collaboration, but it's very difficult since we have all different goals, all different expertises. So it's really at the proposal writing stage that it has to be clearly defined." (IMEC, interview, 5th of November)

Through the interviews and the participatory workshop, we gained an insight in the perceptions of the different project partners on working with user scenarios and storyboarding and on how and when we can guide the development process. These findings are of great importance in the context of our attempt to set up a UDI process.

5.2.3 Involving the user: must have or nice to have?

At the start of the project two user-grounded scenarios were introduced, defining the possibilities and constraints of a 3D digital city environment. These scenarios served as guidelines throughout the different research phases. They were the starting point for iteration and are fine-tuned constantly based on our research results. The city trip and real estate scenarios were perceived overall positively. As mentioned in the discussion of the first topic, 'project direction', there is no concrete idea yet among the project partners about the service or application in which the URBAN technology

should be implemented. Although most of the partners have little interest to know what will be the actual outcome of the project on the user side, the user scenarios are very appreciated for providing some guidance and making the technology - that is still under develoment - more concrete.

"All those details are not always that relevant, but it enables you to imagine how it will look like, what we will be able to do with it and that makes it easy because then you go from an abstract concept to a concrete concept." (ICRI, interview, 21st of November)

Since our user-grounded scenarios are primarily created with a view to demonstrator 2 that will be developed by EDM & Androme, one party suggested that it might be useful to do the same for demonstrator 1 that will demonstrate the accelerated GeoAutomation pipeline on the basis of a real AGIV project for the GRB (Large Scale Reference Database).

"I think it is useful. I think it makes it more concrete and maybe it should also be developed for our GRB demonstrator[5] to say what one actually wants." (AGIV, interview, 19th of November)

The need for this kind of user input varies among the different partners, often depending on their relationship towards the demonstrator. The project partners who are primarily involved in the first work packages, which are fully dedicated to research on the optimisation of the basis technology, feel much less the need for user input. According to GeoAutomation this kind of technological research is even something from which the user should be protected.

"In the first part it is all rather technological and really under the hoods, something we even want to protect the user from as much as possible. He does not need to know how it works technologically and actually I do not even want him to know how it technologically all fits together." (GeoAutomation, interview, 18th of November)

The perception that user input is only useful in relation to the demonstrators (and thus more towards the end of the project) is closely linked to GeoAutomation's mentioning about being a "*fraction within the project*", in the context of the second

[5] Our user scenarios, which can be found in the annex, focus on Demonstrator 2 called 'Location-based city services'. In this citation AGIV refers to Demonstrator 1 'RGB-2-GRB' that will demonstrate the accelerated GeoAutomation pipeline on the basis of a real FGIA project for the GRB.

topic on cooperation. The first phase of URBAN deals with basic research on different technologies. According to the engineers it is only when the URBAN technology is fine-tuned, that partners need to decide on the concrete user-oriented direction of the technology. It is only then that user input can become relevant, which entails that user research only needs to be embedded in the final development phase.

"It seems to be relevant, but for my case, it is not really useful. We understand that our main task is to design an algorithm for object detection. User-friendly application is not actually our task. On the other hand, I believe that the proposed scenarios might be useful for demonstrators." (VISICS, interview, 18th of November)

"I would say the user sometimes is a nice to have more than a must have in this first part of URBAN, but it's quite possible if we want a real demo that is convincing for Immoweb people or others then of course we have to make something that it can be used by people and we cannot guess it ourselves so." (IMEC, interview, 5th of November)

During the interviews as well as the workshop, we noticed that users and their ability to provide developers with valuable input concerning future products, applications or services are sometimes underestimated.

"Eventually the thing is then you are still riding with horse and coach. When the mobile phone was invented nobody needed it, how will it be useful. If you let your research be guided by what people think they need at this moment, then you do not come forward." (GeoAutomation, interview, 18th of November)

This demonstrates the relevance of a mutual shaping approach where users and technological research feed in to each other. Users should be triggered by new (technological) concepts or a provisional prototype.

"The problem is users only know that when they are confronted with it. So we have to confront the user with an application that they can use and only after that they can say us if it was added value or not." (EDM, workshop, 15th of December)

At the same time these technological choices need to be in line with potential user settings, especially not excluding possible favourable user trajectories. However the perception among many project partners is that users should only be confronted with an application when entering the final development stage, so when the technology is becoming 'mature'. This substantially limits the leeway for technological changes, leaving only room for minor adaptations like typical usability assessments (e.g. enlarging certain buttons, adding FAQ section). However the user-driven innovation perspective starts from the idea that successful technological development depends on the involvement of users during the whole product development process, including the early stages. Only in that we can increase the chance that new products and services will actually link in with the expectations, characteristics, practices and experiences of future users.

"The thing is what do you think you can do with the results of the URBAN project that have an added value towards the users?" (URBAN project manager, workshop, 15th of December)

The technological object of fundamental research by engineers is indeed too 'immature' to be 'understandable' for future users. Consequently user input can only have a genuine added value in a technological environment if prospective users are confronted with 'semi-mature' technology that is 'mature enough' or with 'proxy technologies' that can emulate the affordances of the technology being developed (Lievens, Torben Nielsen & Pierson, 2008). Semi-mature technologies are adequate to serve as a boundary object or "*objet frontière*" (Flichy, 1995), in order to enable all involved stakeholders to discuss the meaning and further development of the artefact. (Ballon, Pierson & Delaere, 2007) We argue that the use of a proxy of the URBAN technology, in our case a first version of EDM/ANDROME's demonstrator, will make the 3D city technology to be developed more 'understandable' for users and will enable us to provide the project partners with relevant feedback from the users.

The following part will discuss how we assess the user research involvement in the URBAN technological development process. These are the meta reflections on the research process and the main lessons learned.

5.3 Methodological reflections

5.3.1 Enabling measures for interviews and workshop

Based on our research activities we identified some important elements in applying the user driven innovation proces in the Urban project. These are the following:

1. A user-driven innovation process primary requires the involvement of all main project partners in order to achieve a common vision on possible outcomes and application domains for the technology under development. A first step in this process involved the identification of the technological elements and activities in the URBAN project that are susceptible to change based on the user findings. Through the consultation of the different project partners we traced the 'hooks' where user input could guide the development process. More specifically, we tried to find a match between the Task 4.3 user-grounded scenarios and the user perspective in general on the one hand and the technological objectives and expectations on the other hand.
2. A challenge in this process is the active involvement of the project partners in the user research, taking into account their willingness to make time for an interview and a workshop. A user-driven innovation research is (possibly) experienced as (too) time consuming by the project partners. In order to anticipate on this perception, one needs to adopt a very **flexible research attitude** and lower the threshold for participating in the user research as much as possible, especially for those partner that see this kind of activity as less valuable from their perspective.[6]
3. In the context of socio-technological interaction between different parties, it is very useful to make **profile assessments** of the actors involved, in particular concerning their relation to the user. The identification of each partner's background, expertise, profile and role within the project is an essential step in the establishment of a user-driven innovation process. Yet it also allows you to anticipate on possible reservations of some partners whose daily research and/or development activities are far away from the user. For instance by preparing a profile sketch of each party, we realised in advance that it would not be self-evident to trace user hooks in the development process of IMEC, whose work is primarily devoted to optimizing data acquisition. Through this preparatory work we could also identify easily that EDM and ANDROME are the two partners that will benefit the most of user input.

[6] In the URBAN case this meant that we conducted the interviews on location at the offices of the project partner and that we organised the interactive workshop in Ghent, close to the most time-constrained partners: Tele Atlas and AGIV.

4. The cooperation with other project partners is perceived as most useful in case of a **win-win situation**, so if all partners benefit from working together. In order to optimize cooperation between technological research and user research, the former need to be convinced about the added value of involving the user perspective in their own research trajectory: 'What's in it for us?'. This could be one means for increasing the cooperation within the context of a user-driven innovation development process.

5.3.2 User scenarios

The interviews with the project partners served as an opportunity to gather their input for the user scenarios. The partners communicated what would be technologically difficult to implement, which services of the scenario appeared to be interesting and which additional functionalities could also be interesting. The text-based scenarios were received overall positively and the suggested domains, tourism and real estate, were perceived as high potential in relation to 3D urban environments investigated in URBAN. This exercise learned us the following[7]:

1. The first input on both user scenarios is unfortunately rather general and simply evaluates the potential of the proposed services. Input on the technological steps that need to be undertaken in order to establish the scenarios also needs additional input.
2. There is foremost a technologically oriented vision among the project partners on what should be achieved with the URBAN project. Thinking about and building in 3D city service innovation is not considered as the first priority.

As the user scenarios are 'living' documents, we will take them up again in the fourth and final research phase to finalize them (i.e. Task 4.4 second iteration).

5.3.3 Story boarding

The text-based scenario were received rather positively. By using story boards we triggered useful reactions from the workshop participants. This indicates also the main added value of this research tool. It was the first time that the partners were confronted with visualised suggestions for interfaces and services and thus also with the user and technological requirements. By elaborating on each component of the scenarios and discussing what users should be able to do and how this could be realised within URBAN, the project partners got an idea of what they need to

[7] The detailled input of each project partner on the two scenarios can be found in annex 5 & 6.

investigate and develop in order to meet up to the user scenarios. In the following we sum the main results:

1. The story board visualisation of the same scenarios, added with the partners' feedback and discussed at the interactive workshop, evoked more resistance. This seems to be related with the fact that the story boards visualise the consequences of certain decisions and translate abstract ideas in concrete technological choices. In this way the project partners were able to assess from their perspective which components of the scenarios would be (un)usable, too time-consuming to implement or too extended. For example in one scene of the story board on city trips, a tourist virtually looks at the façade of a restaurant to help him select a cozy dining place. Yet the generalised 3D city model that will be developed by means of Tele Atlas' data will not provide the users with detailed façade images. Implementing photo realistic façade images of restaurants, shops and hotels in the generalised 3D model, for example by means of GeoAutomation's data, is perceived as irrelevant and too complex. In this context the omni-directional video of EDM & Androme, which is also forseen in the project, is proposed as a possible solution.
2. The main reason for declining certain technological functionalities in the story board, such as location-based services and a public transport tool, was that they were not congruence with the scope and the proposal text of the project.
3. Certain services in the 3D city model would require the involvement of external partners: the public transport sector for providing public transport information to city trippers, cultural organisations for integrating up-to-date events information, etc. However this led some partner to conclude that some services would be too time consuming or too complex to integrate in the demonstrator. For example a public transport feature in a 3D urban environment was at first perceived as an interesting tool, but the integration is too complex. Only if an existing service, like 'Google Transit' would incorporat Belgian public transport information, it would become feasible. However from the user perspective in the city trip scenario it is an indispensable functionality in the 3D city model to be developed.

Now that we have elaborated on the output of the interviews and the interactive workshop and identified some meta findings concerning the research process, we end this report with some general conclusions.

6 Conclusion

As the URBAN project aims at the more effective and efficient handling of 3D data for urban environments, it is important to have a clear insight in the process and outcome of the socio-technological development activities. This follows the user-driven innovation vision that embedding user input in the research and development process will bring new products and services more in line with the expectations, characteristics, practices and experiences of future (end)users.

Integrating the user insights in the technological research activities requires the identification of those technological elements and activities of the project that are susceptible to change. Therefore we first interviewed the involved project partners to trace the hooks where the user input could guide the development. Secondly we involved the relevant project partners in an interactive workshop. The developed user scenarios served as guideline throughout the whole process, which enabled us to keep the focus on the common goal. Based on the gathered input of the interviewees the scenarios were constantly adjusted. In the end the adjusted scenarios were then visualised by means of the storyboarding technique and discussed during the workshop.

First our findings show how the socio-technological development process in URBAN is determined by the following three topics: 'project direction', 'cooperation' and 'involving the user (research)'.

1. Project direction: There is foremost a technologically oriented vision among the project partners on what should be achieved at the end of the project. For the moment there is not yet a shared vision on possible future application domains/contexts for the URBAN technologies among the involved parties. The project is considered as an opportunity to experiment with and fine-tune the 3D city technology. Therefore the focus is on the technology as such and not on possible services that can be enabled. Subsequently the 3D city service innovation is not perceived as a priority. Only user input on visualisation issues, such as the added value of 3D versus 2D and the required level of details and realism from a user perspective, would match the need of the technological, research and industrial partners.
2. Cooperation: we found that there is mainly bilateral collaboration and less overall cooperation among the project partners. This refers in the first place to collaboration between partners that are involved in the same work package(s). A

close cooperation between all the involved parties appears to be less self-evident in the current research phase, while each research group is still fine-tuning and experimenting.

3. Involving user research: user research is mainly perceived by the project partners as an activity typically taking place in the final technology development phase. In the first phase of the URBAN project the basis technology is being developed. Once the URBAN technology is fine-tuned, user input becomes more relevant to help the technological partners decide in what way the 3D city technologies can be made useful. In this regard it is understandable and even desirable that the feedback of (potential) users guides the development of the demonstrator. Involving user input earlier in the new product/service development process is perceived as little to not desirable.

Our socio-technological activities enabled us to assess the implementation of the Task 4.3 user findings and hence the user-grounded scenarios in the development process. Some preliminary findings can already be highlighted:

1. Services that deal with search issues, for instance adding 'Marollen' as search query or implementing various kinds of listings (e.g. 'Top 10 Belgian restaurants of Brussels', 'Top 10 B&B's of Brussels, etc.) are seen as less opportune as these are perceived as not in congruence with the scope and the proposal text of the project.
2. Secondly services that require the involvement of external partners, such as cultural organisations for integrating up-to-date events information or restaurant owners to up-date their suggestions, are not implemented based on the perception of being too time consuming or too complex to integrate.
3. User-generated content (UGC) services, like the ability to enter and read reviews of restaurants in the 3D city model, evoke some resistance as it bares close resemblance to the scope of previous research projects. In the IBBT research project A4MC[3] (Architectures for Mobile Community Content Creation) for example EDM and Androme already investigated 'tagging', i.e. linking comments and pictures to particular locations. Therefore both project partners prefer to leave UGC out of the URBAN project.
4. Navigation and orientation functionalities however, such as a route description tool for vehicles and pedestrians and bird's eye view city images as starting point for users' searches, will be incorporated as they meet the expectations and objectives of some project partners, especially of digital maps provider Tele Atlas.

Obviously the actual implementation of the user findings in the URBAN trajectory can only be fully evaluated at the end of the project. Yet we can already determine that the implementations are primarily situated on the level of services in the context of the demonstrators and not on the level of the basic architecture. This is linked to the fact that user input is mainly allocated a place in the final technology development and implementation phase, which is contradictory to the UDI vision that users should be involved in an early stage of research and development. We see that in the context of the URBAN project the involved partners are less convinced of the true user-driven innovation approach than IBBT-SMIT.

The main methodological issues we have identified in doing user-driven innovation (UDI) research are the following:

1. The text-based user scenarios were perceived as positive. However visualising scenarios by means of storyboards seem to trigger people even more. Storyboards visualise the consequences of certain decisions and suggestions for interfaces and services and thus provoke a discussion among the involved parties. Therefore we can conclude that storyboards are definitely a helpful tool to integrate user findings in technological development.
2. A first step required in a UDI process is to make an assessment of all relevant partners (concerning their expertise, background, role within the project, link to user research etc.). By doing so it is possible to assess where user input could have a genuine added value in the research and development process and to anticipate the roles and attitudes of the different partners.
3. Finally as UDI is not self-evident and sometimes a rather time-consuming and demanding process, it is important for a user research group to lower the threshold as much as possible for the involvement of (technological) project partners, especially when user research is perceived as less valuable by some parties, which was the case within URBAN.

Our research has helped us to better understand and assess the kind of obstacles for integrating user research in the technological R&D process. There is certainly no easy match between the user scenarios visualized in the storyboards and the technological objectives and expectations. Therefore we will take up the user scenarios and storyboards again in the second iteration of Task 4.4 in order to create a more extended overview of the technological challenges of and possible technological solutions for the different scenario components.

In the next research phase, the second iteration of Task 4.3, we will go back to the users and confront them with the first URBAN prototype. For this we use the first version of EDM/ANDROME's demonstrator, which has been developed in line with the user scenarios. This kind of Proxy Technology of the main demonstrator (to be ready at the end of the project) allows the users to have an (immersive) experience of 3D urban navigation. (Torben Nielsen et al., 2008) Moreover, by bringing users in contact with the technology during its development process, the user experiences can be integrated as feedback in the following design and development activities. By means of the 3D city model prototype, we will investigate:

1. The research question formulated in the first iteration of Task 4.3: "*Which services could offer a genuine added value for users in a 3D city environment?*".
2. The visualisation issues that have been identified as hooks where user input could guide the development process according to the technological partners, e.g. the possible added value of 3D over 2D.
3. The users' perception of the 3D city environment and its functionalities.
4. The extent that the proposed semi-realism (e.g. linking pictures to a 3D location) responds to the users' expectations and needs. This entails that the user will compare photo-realistic high detail city images of GeoAutomation with the generalised 3D city model using the 3D of Tele Atlas combined with some annotated data.

However, besides the research aspects that the other project partners have indicated as a priority, e.g. visualisation issues, we will also involve contextual issues, like search issues, in order to have a clear insight in how users would 'domesticate' the 3D city model in the everyday life practice of a city trip or in the search for a real estate property. This will result in a final version of the user scenarios based on user goals and practices and an overview of the findings about user navigation in a 3D city environment.

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8 Annex

Annex 1: List of interviewed project partners

Annex 2: List of participants of interactive workshop

Annex 3: Profile sketch of URBAN project partners

Annex 4: Topic list for interviews with project partners

Annex 5: Input of project partners on user scenario tourism

Annex 6: Input of project partners on user scenario real estate

Annex 7: User scenario tourism adjusted based on input gathered during the interviews with project partners

Annex 8: User scenario real estate adjusted based on input gathered during the interviews with project partners

Annex 9: Storyboard tourist scenario presented at interactive workshop

Annex 10: Storyboard real estate scenario presented at interactive workshop

Annex 1: List of interviewed project partners

- **Overview of interview round from the 5th to the 27th of November 2008:**

Date of interview	Research group/ insitution	Function	Name interviewee
05/11/08	IMEC	Research developer	Patrice Rondao Alface
14/11/08	ANDROME	Research developer	Tom Jehaes
14/11/08	EDM	Researcher	Jeroen Dierckx
18/11/08	VISICS	Researcher	Karel Zimmermann
18/11/08	GeoAutomation	Post-Doctoral Researcher Researcher	Maarten Vergauwen Marc Olijslagers
19/11/08	AGIV	Acount Manager Line Research & Development GIS-expert Line Research & development	Jo Van Valckenborgh Nele De Wolf
21/11/08	ICRI	Legal Researcher	Christophe Geuens
27/11/08	Tele Atlas	Project Manager Strategic Research	Linde Vande Velde

- **Invitation e-mail sent to all project partners on the 30th of October 2008:**

Dear URBAN partner,

Within task 4.4 'Embedding user innovation in technology design' SMIT plans to interview the different partners in the project. During these interviews we will try to trace the 'hooks' where user input could guide the development.

Could you send this email to the person within your research group/company who is the most suitable to answer questions concerning your role within the project, your vision/positioning towards the user, etc.

The interviews will be conducted between the 5th and 21st of November and will take up approximately 1,5 to 2 hours. Could you please fill in the Doodle to let me know which moments suit you? I will conduct the interviews at your offices so you do not need to come to Brussels.

The Doodle link is:
http://www.doodle.com/w43kqd8wazct68ik

Kind regards,

Marinka Vangenck
Researcher
IBBT - SMIT, Studies on Media, Information & Telecommunication
Vrije Universiteit Brussel
Offices: Pleinlaan 9, 2nd floor
B - 1050 Brussels
Tel: +32 2 629 1625
Mobile: +32 479 81 76 53
E-mail: marinka.vangenck@vub.ac.be

Annex 2: List of participants of interactive workshop

- **Date of workshop: the 15th of December 2008 at IBBT Ghent 2 p.m.–4 p.m.**

Research group/ insitution	Function	Name participant
AGIV	GIS-expert Line Research & development	Nele De Wolf
ANDROME	Research developer	Tom Jehaes
EDM	Deputy Managing Director	Prof. Dr. Frank Van Reeth
EDM	Researcher	Jeroen Dierckx
GeoAutomation	Researcher	Marc Olijslagers
IBBT	Program Manager	Nico Verplancke
IBBT-SMIT	Senior researcher	Prof. Dr. Jo Pierson
IBBT-SMIT	Researcher	Marinka Vangenck
ICRI	Legal Researcher	Christophe Geuens
IMEC	Research developer	Patrice Rondao Alface
Tele Atlas	Project Manager Strategic Research	Linde Vande Velde
VISICS	PhD student	Radu Timofte

- **Invitation e-mail sent to all project partners on the 28th of November 2008:**

Dear URBAN partner,

During the past 2 weeks I have interviewed most of the project partners. In a next research phase, SMIT will organize a workshop on Monday the **15th of December** at **2 p.m** at **IBBT Gent**. During this workshop SMIT will try to bring together all the project partners to discuss the user scenario's that we have developed in relation to the URBAN technology. The user scenario's will be visualised by means of story boards and will be subjected to an interactive discussion.

Could you please let me know whether you can be present at this workshop?

Kind regards,

Marinka Vangenck
Researcher
IBBT - SMIT, Studies on Media, Information & Telecommunication
Vrije Universiteit Brussel
Offices: Pleinlaan 9, 2nd floor
B - 1050 Brussels
Tel: +32 2 629 1625
Mobile: +32 479 81 76 53
E-mail: marinka.vangenck@vub.ac.be

Annex 3: Profile sketch of URBAN project partners

1. Enterprises/institutions

1.1 AGIV/FGIA: Agentschap voor Geografische Informatie Vlaanderen
www.agiv.be

Role within URBAN

Just like Tele Atlas, AGIV is a user group within the URBAN project. AGIV is interested in both the 3D city model that will be developed within the project as well as in the mobile mapping technology, for instance in the framework of GRB. Research projects like URBAN can help AGIV to determine a strategy for the future.

What?

AGIV is responsible for the data production of reference files and for their management, distribution and accessibility. AGIV has become an important expert in the field of GIS-technique and implementation routes. Other related disciplines such as photogrammetry, GPS-positioning, topography and satellite teledetection are also closely followed.
In addition, AGIV has developed know-how in the domain of geo-informatics, which is necessary for the development of internet tools, the setting-up of extensive operational databases and for the implementation of processes concerning quality control.

Towards the users/consumers

- The FGIA's mission is "*Ensuring the optimal use of geographic information in Flanders*".
- The FGIA has focused its activities on:
  - Geographical data dissemination
  - Providing advice and services on the use of geographic information
  - The execution of extensive pilot projects to initiate the development of a regional SDI (RSDI).
- In 2003, the agency shifted from a project to a program oriented way of working. This change in operations aims to ensure a sound client oriented development of the RSDI through an extensive participatory structural collaboration among the partners of GIS-Flanders.

Background?

The FGIA is the executing agency in charge of implementing the objectives of GIS-Flanders described in the decree. In 1995 the Flemish Government established a framework and partnership, referred to as GIS-Flanders, with the aim to facilitate the exchange of geographical information among all governmental (regional and local) and public service agencies. This framework was further institutionalized by a decree in 2000. The Flemish Geographical Information Agency (FGIA) originally started as a division of the Flemish Land Agency, named 'Support Centre of GIS-Flanders' (SC GIS-Flanders). A second decree (April 2004) outlines the implementation of a Large Scale Reference Database (GRB) for which the SC GIS-Flanders is the coordinating and implementing agency.

In april 2006 the Support Centre GIS-Vlaanderen became an external independent agency, called FGIA (dutch AGIV).

1.2 Tele Atlas

www.teleatlas.com

Role within URBAN

Within URBAN, Tele Atlas is the digital map provider. By means of research projects like URBAN, Tele Atlas want to see what the research field has to offer in order to make the company's products more efficient and cheaper. In addition Tele Atlas wants to make its own 3D production process and the compression of data more efficient.

What?

Tele Atlas provides digital maps for GIS-applications, navigation systems and location based services. The databases cover the road network of Europe, the US, Canada and parts of South-America and Asia in detail. Tele Atlas' digital maps include millions of POI's, 2D maps, 3D maps, 3D landmarks and traffic alerts.

Tele Atlas was the first map provider to add 3D imagery to digital maps and has a growing number of 3D maps of major cities around the world. The company believes that 3D city maps will enable consumers to orient themselves more quickly and easily in new environments through realistic map displays. Tele Atlas' 3D landmarks comprise buildings and statues that are well-known among residents and tourists.

Towards the users/consumers

Tele Atlas draws the consumers' attention to the fact that they do not develop navigation-related devices. They provide the digital map data and related dynamic content that their partners incorporate into these devices and applications.

According to Tele Atlas, the main advantages for the consumers are their worldwide coverage, their points of interest and their freshness and accurancy.

Background?

Tele Atlas has been set up in 1984 in The Netherlands and extended rapidly worldwide. Tele Atlas' most important competitor is the American NAVTEQ, which is bought up by Nokia. In 2008 navigation system developer TomTom took over the digital map producer Tele Atlas.

1.3 Procedural

www.procedural.com

Role within URBAN

Procedural has developed the 'next-generation' CityEngine software to model buildings. One module of this software converts images into models, but only for large buildings with sufficient returning elements. URBAN wants to extend this kind of efficient modelling to smaller houses in urban centra. So URBAN will follow the Procedural modelling approach.

What?

Procedural Inc. is specialized in software for the efficient creation of 3D buildings and cities. With its flagship product, the city modelling software CityEngine, urban environments can be created 10 times faster than with existing (manual) solutions. The software can be used for game creation, modelling of stand-in models for film & tv and content services for virtual worlds.

Towards the users/consumers

Procedural draws potential buyers' attention to the fact that working with the CityEngine will result in lower production costs. The manual modelling of urban environments with existing solutions is a time-consuming and expensive process. With the CityEngine, this content creation process can be accelerated by magnitudes, eliminating the need for multiple software solutions and manpower. Another advantage of using the CityEngine is that the procedurally generated 3D buildings can be exported in various file formats, allowing for a flexible and simple integration into existing production pipelines.

Background?

The company procedural is a spin-off of ETH Zurich, a Swiss technical university where the underlying unique procedural modelling technology has been invented and developed.

1.4 GeoAutomation

http://www.geoautomation.com

Role within URBAN

GeoAutomation is mainly involved in WP1 'Digital Surveying' within which they closely work together with IMEC on compression issues on the one hand and on the process of the 3D reconstruction on the other hand. Furthermore GeoAutomation is also involved in WP2 'Object Recognition' within which they work together with VISICS on automatically recognizing objects in the data that are recorded with the van.

What?

GeoAutomation has developed a mobile-mapping system that allows efficient and accurate measurements to be performed that can be imported into GIS systems. To this end GeoAutomation disposes of a recording system, mounted on a van.

GeoAutomation provides geo-referenced images of the surveyed area, as well as surveying tools that work with these images.

GeoAutomation's mobile mapping system is being used intensively for the creation and update of surveying projects for the Flemish large-scale reference database (GRB). GeoAutomation's technology has been used successfully for several GRB projects, in both rural and urban environments.

Towards the users/consumers

After the recording, using a mobile mapping van, GeoAutomation can offer a range of possible products, like geo-referenced images, data management (at the location of the costumer or at the server of GeoAutomation) and accurate surveying of all objects that matter to the customer: road markings, traffic signs, signposts, etc. The mobile mapping data is also a good source for 3D reconstruction and visualization.

Background?

GeoAutomation is a spin-off of the University of Leuven and SPC, the Engineering Office Patrick Casier, both located in Leuven. The company, founded in February 2007, combines the technological and operational know-how of both partners. The result of this mix is a hi-tech and efficient solution to many surveying and measuring needs. GeoAutomation's technology focuses on high accuracy and is able to deliver this even in the most difficult urban environments. The company continuously invests

in improving accuracy and efficiency, and it broadens the user benefits of the resulting data.

1.5 SPC: Studiebureau Patrick Casier

Role within URBAN

SPC is strongly linked to GeoAutomation, another URBAN partner with whom SPC closely works together. The research part is conducted by GeoAutomation, while the actual measurements are done by SPC.

What?

- Studiebureau Patrick Casier (SPC) is a company specialized in geo information. It is active in three domains: above-ground survey, under-ground and water measurements and digital data processing. For many applications these three domains overlap.
- Digital topography, GPS survey and 3D Cartography are part of the above ground measurements.
- In the water division, SPC is specialized in 3D inventory taking of sewerage infrastructure, flow survey in rivers and sewer systems and water quality measurements and sampling.
- In the data processing domain SPC has an extensive expertise in scanning and vectorisation, GIS- conversions and the software development for these applications.
- Currently, SPC is working on further adaptations in order to make optimal use of the GeoAutomation 3D acquisition pipeline.

Towards the users/consumers

SPC mostly works for public and utility services. As a creator of large data sets (cartography, 3D topography, inventory databases) SPC has a high expertise in data management and efficient data manipulation and conversion. This is a large added value for the customer who needs this knowledge during the further lifespan of the created geographical data.

As an important user of the GeoAutomation technology, SPC helps to improve the system from a user point of view.

Background?

SPC started in 1989 as a company specialised in topography. The focus was always towards larger customers who want to augment the use and value of their geographical information. Because of this, SPC naturally expanded its field of operation to GIS applications in general. It now employs more than 20 people.

SPC has always been fast in adapting new technologies. It was one of the first Belgian companies to work with GPS. In the flow survey SPC has the largest number of flow monitors in Flanders, and developed its own data management software for the survey data. In the same tradition, SPC noticed the possibilities of the K.U.Leuven computer vision technology in large scale mapping, which resulted in the founding of GeoAutomation. Since mid 2007 SPC conducts the large-scale cartography of the public domain and the immediately adjacent area by means of mobile mapping.

1.6 ANDROME

www.androme.com

Role within URBAN

Androme is involved in work package 3 ('3D city modelling for visualisation'), 4 ('Visualisation of and interaction with 3D city models') and 6 ('Demonstrators'). Androme has the most man months within WP3. In WP3 the focus lies on visualisation and thus visual realism. One will also investigate how a portable omni-directional video capture set-up can be devised that allows to capture imagery of places where it is difficult or impossible to deploy the current car-based camera set-ups of Tele Atlas and GeoAutomation.

What?

Androme focuses on three domains of expertise:

- Telecommunication: Audio/Video communication applications.
- E-Business: Advanced E-commerce applications and tools.
- Interactive Multimedia: High-end interactive applications focused on user experience.

Within these three domains, Androme offers companies different possibilities:

- Products: Customizable off-the-shelf products to allow a fast and easy integration into a business.
- Subcontracting
- R&D

During the last years, Androme's focus lies on technologically advanced projects, products, and services in the domain of telecommunications, with a clear link to solutions for community building and virtual interactive communities (VIC). Androme also wants to become an important player in technology development for computer graphics en computer animation.

Towards the users/consumers

The lion share of Androme's activities is providing services to other companies, related to high-end software. Androme positions itself as "*your partner in innovative ICT*". "*ANDROME brings you innovative software in the fastest and most flexible way possible*."

Androme emphasizes to build the perfect tools that suit companies' business needs and attaches great importance to taking the specificity of each customer into account.

Background?

Androme is the leading company of the ANDROME Group, a European group of dynamic ICT companies in Belgium and Spain. Androme, which has been set up in 1990, is the oldest spin-off of the university of Hasselt.

2. Research groups IBBT

2.1 EDM: Expertise centre for Digital Media

http://www.edm.uhasselt.be/about/the_institute

Role within URBAN

EDM is involved in work package 3 ('3D city modelling for visualisation'), 4 ('Visualisation of and interaction with 3D city models') and 6 ('Demonstrators'). EDM has the most man months within WP4. The latter investigates among others efficient data transmission and visualisation of large-scale city datasets and flexible methods for interaction specification.

What?

EDM performs fundamental, basic and applied research as well as contract research and development. EDM focuses its research activities on three competence areas: multimedia and communication technology, computer graphics and human-computer interaction:

- Multimedia and internet technology, concentrated on networked virtual environments and interaction and communication between users.
- Computer graphics, computer animation and virtual reality, with special attention to modelling and rendering. The Virtual Reality group sometimes also conducts user tests.
- Human-computer interaction, research on innovative graphical or multimedia user interfaces for stand-alone and networked environments, multimodal user interfaces.

Towards the users/consumers

No online information available concerning the vision/positioning towards users.

EDM wants to involve users and perceives user input as very important.

Background?

The research institute EDM has been active in Information & Communication Technology since 1987. EDM is related to 5 spin-off companies: Androme, Zeus Software Engineering, Animante Baleares, QuESD and Opikanoba.

2.2 IMEC

Role within URBAN

IMEC is mainly involved in WP1: 'Digital Surveying'. The main goal of this WP is to make the 3D data capture as well as the processing more efficient. IMEC's know-how on speeding-up algorithms and systems are applied to the existing GeoAutomation pipeline. IMEC works on optimizing the first processing steps in the URBAN workflow and is very close to the data acquisition phase: for example improving the performance of the video compression tools in the recording van of GeoAutomation or in their 3D reconstruction tool-chain.

What?

IMEC is a world-leading independent research center in nanoelectronics and nanotechnology. IMEC performs R&D, ahead of industrial needs by 3 to 10 years, in nanoelectronics, nanotechnology, design methods and technologies for ICT systems. IMEC combines:

- MORE MOORE research: fundamental research into scaling the basic building blocks of chips.
- MORE THAN MOORE research: research into combining heterogeneous functionality on chips.

Only the Multi Media Group of IMEC is involved in the URBAN project. The Multi Media Group is part of the NES department, Nomadic Embedded Systems. Within NES you have 2 main groups, namely Design Technology and Wireless. The Multi Media Group is one of the 7 to 8 groups within Design Technology.

Towards the users/consumers

IMEC profiles its research as bridging the gap between fundamental research at universities and technological development in industry. Its unique processing and system know-how, intellectual property portfolio, state-of-the-art infrastructure and its strong and worldwide network position IMEC as a key partner for shaping the technology for future systems. In short IMEC claims to collaborate, innovate, educate and inform.

Background?

IMEC was founded in 1984 as a non-profit organization for advanced research in microelectronics. Nowadays, IMEC collaborates with more than 1000 partners

worldwide. IMEC has created more than 20 spin-offs and is supported by the Flemish government.

2.3 VISICS: Vision for Industry Communications and Services

http://www.esat.kuleuven.ac.be/psi/visics/

Role within URBAN

VISICS uses the recorded data of GeoAutomation to detect in first instance traffic signs but also other object categories like pedestrians, cars, trees, benches, etc. As a result these objects could be removed in case they are in front of the façades of buildings, which then can be completed.

What?

The research group is part of the Centre for Processing Speech and Images (PSI) within the K.U.Leuven. With a staff of more than 20 people it is one of the biggest groups worldwide working in the field of computer vision. The range of topics on which research is done is extensive and includes: 3D modelling, database retrieval, augmented reality, inspection, remote sensing, navigation, detection recognition, …
Research in the industrial image processing group (VISICS) is structured in several research teams. These teams specialise on certain topics within the realm of computer vision. At the moment, the research teams are focussing on the following subjects: 'reconstruction and recognition of shapes', 'multimedia end image communication, surveillance', 'remote-sensing', 'visual inspection', 'image processing hardware' and finally 'content-based retrieval and image understanding'.

Towards the users/consumers

As a research unit, possible users/consumers are industry companies (like GeoAutomation or Procedural). VISICS offers collaboration in developing new algorithms for computer vision applications (like surveillance or 3D modelling).

Background?

The group has also been the starting point of the spin-off companies ICOS, Eyetronics and GeoAutomation, the latter is also an URBAN partner.

2.4 ICRI: Interdisciplinair Centrum voor Recht & ICT

http://law.kuleuven.be/icri/

Role within URBAN

ICRI is involved in WP5: 'Legal Aspects'. The main issue that ICRI investigates in this work package is the protection of privacy and of personal data during the processing of the data for the surveying application and for the creation of the 3D city models. Another important issue that is being investigated are intellectual property rights. The plans and constructions of buildings are works that are protected by intellectual property rights and the rights holder will be protected as an exclusive right holder, who will have to give permission for the adaptation or reproduction of his work. He also has the moral rights on the work, including the right of integrity and divulgation. This has consequences for the creation and dissemination of 3D city models.

What?

ICRI comprises three different research teams that deal with the following areas:

- Information Technology Law: legal aspects of the Internet, legal aspects of information security, personal data protection, IT contracts, law enforcement in cyberspace, electronic fund transfer, legal aspects of EDI in the public sector.
- Electronic Communications Law: international telecommunications law, European competition law in the telecommunications market, legal framework for the broadcasting sector, legal consequences of the convergence between the audio-visual and the telecommunications sectors.
- Legal Informatics and Information Retrieval: legal knowledge representation, legal information retrieval, automatic indexing and abstracting.

In each of these three fields, ICRI carries out research, provides consultancy services and is active in education. ICRI offers expert opinions and consultancy services to private and public-sector clients.

Towards the users/consumers

ICRI profiles itself as the leading Belgian research centre in the field of law and information technology. Today, they also offer their expertise in a large number of areas to private firms. Private companies can avail of ICRI's varied consultancy services.

Background?

ICRI acquired an international reputation through its research concerning legal information retrieval. The research centre has played an important role in the development of Belgian and Flemish legislation, among others concerning electronic trade, digital signatures, protection of personal data, etc.

Annex 4: Topiclijst interviews URBAN projectpartners

Voorbereiding: user scenario's lezen

Projectuitvoering

- Wat is jullie hoofddoel/core business in het algemeen binnen de organisatie/onderzoeksgroep?
- Hoe omschrijft u uw rol binnen het project?
- Wat wilt u op het einde van het project bereiken? Wat zijn jullie concrete doelstellingen, zowel op onderzoeksvlak als mbt uw organisatie?
- Werkt u binnen URBAN (nauw) samen met andere projectpartners?

    Indien ja:

    - Met welke partners? Waarom deze partners?
    - Op welke manier werken jullie samen?
    - Proberen jullie binnen een project altijd aansluiting te vinden met de andere projectpartners?

    Indien nee:

    - Waarom niet?
    - Werken jullie binnen andere projecten gewoonlijk wel samen met andere projectpartners?

Profilering/positionering:

- Werken jullie rond bepaalde use cases binnen het project?
    - Hoe maken jullie die?
    - Kan u mij deze in het kort uitleggen?
- Hoe ziet u het gebruik van uw technologie binnen een concrete context?
- Houdt u in uw dagdagelijkse activiteiten een bepaald beeld van de (eind)gebruikers/consumenten voor ogen?

    Indien ja:

    - Welk soort type gebruiker heeft u voor ogen?
    - Houdt u in uw werk ook rekening met de gebruiker/consument?

    Indien nee:

    - Houdt u in uw werk soms rekening met de behoeftes, noden, verwachtingen van gebruikers/consumenten?

Visie op gebruikersonderzoek

U heeft ter voorbereiding van dit interview, de user scenario's doorgenomen. Wij gebruiken scenario's enerzijds als instrument om te kunnen samenwerken met ontwikkelaars (zij kunnen aangeven wat technologisch haalbaar is en wat niet) en anderzijds om de focus te houden op het gemeenschappelijk doel/target binnen het project en te komen tot een consensus.

- Hoe relevant zijn deze scenario's voor jullie?
- Zou ons soort onderzoek en perspectief een rol kunnen spelen in jullie onderzoekstraject?

  Indien ja:
  - Op welke manier?
  - Waar zou IBBT-SMIT input kunnen leveren?

  Indien nee:
  - Waarom niet?
- Hoe percipieert u IBBT-SMIT's rol binnen het URBAN project?
- Hebben jullie in het verleden reeds samengewerkt met gebruikersonderzoeksgroepen?

  Indien ja:
  - Wat zijn jullie ervaringen hiermee?
  - Vinden jullie gewoonlijk makkelijk of moeilijk aansluiting met hen?

  Indien nee:
  - Waarom niet?
  - Kunnen jullie een relatie zien tussen het eigen werk en gebruikersstudies? Welke relatie?