Project: URBAN ('Uitmeten, Reconstrueren, Bekijken, Animeren en Navigeren van stedelijke omgevingen')

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Task: 4.3 Exploring user innovation in 3D city navigation

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'*Exploring user innovation in 3D city navigation*'



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1 Table of content

1 Table of content **2**
2 Introduction **3**
3 User tests **6**
3.1 Description of the URBAN prototype **6**
3.1.1 A preliminary 3D city model: A prototype? 6
3.1.2 The URBAN prototype: Affordances 8
3.2 Description of the user tests **14**
3.3 Tourism user tests **22**
3.3.1 Selection and description of the respondents 22
3.3.2 Findings of the user tests 24
3.4 Real estate user tests **44**
3.4.1 Selection and description of the respondents 44
3.4.2 Findings of the user tests 46
4 Conclusion **70**
5 References **74**
6 Annex **77**
6.1 Draaiboek gebruikerstesten city trips **78**
6.2 Draaiboek gebruikerstesten vastgoed **81**
6.3 Scenario-based tasks for city trip respondents **84**
6.4 Scenario-based tasks for real estate respondents **89**
6.5 Vragenlijst na gebruikerstest city trips **92**
6.6 Vragenlijst na gebruikerstest vastgoed **95**
6.7 Detailed description of the city trip respondents **98**
6.8 Detailed description of the real estate respondents **103**

2 Introduction

Within task 4.3, 'Exploring user innovation in 3D city navigation', we investigate how people would interact and engage with 3D navigation in a city environment. This report deals with the second iteration of the explorative in-depth user research we have conducted in the context of task 4.3. The empirical field research is steered by the following research question: "*Which services could offer a genuine added value for users in a 3D city environment based on their city-related needs and practices?*". To answer this question we first conducted a desk research in order to get a horizontal state-of-the-art overview of possible innovative domains regarding the use of 3D city environments during the first iteration of the user research. Based on this desk research in combination with several expert meetings with the project partners EDM & Androme, we identified four vertical areas within which a 3D city model and its related services could offer opportunities and added value for users, namely tourism, real estate, urban planning and public transport. In a next phase we focused on the two areas that, based on internal meetings with user experts and researchers, seem to have the most potential in relation to 3D city service innovation, more specifically tourism and real estate. Both areas were the core topics of a first round of multi-method ethnographic research in order to assess the opportunities for innovation and to identify sensitizing concepts for a user-driven development of 3D city services. This research phase enabled us to identify and draft user grounded scenarios that define the possibilities and constraints of a 3D digital city environment. Hence the first iteration of the empirical field research provided us with an insight in the practice of planning a city trip on the one hand and the practice of searching for a house on the other hand and the possible innovative opportunities of a virtual city model. Nevertheless, these possible innovative opportunities needed to be investigated in depth by means of a second phase of multi-method empirical field research.

During the previous research phase, the second iteration of the empirical field research and thus the subject of this report, we confronted people with the first URBAN prototype, more specifically the first version of the demonstrator that has been developed by project partners EDM & ANDROME in line with the user scenarios. The prototype comprises a downsized set of affordances that are present in the 4.3.1 user-grounded scenarios given the time constraints and technical possibilities at this phase of the URBAN project. We will elaborate on the functionalities and possibilities of the prototype later. By providing users with this kind

of Proxy Technology of the main demonstrator (to be ready at the end of the project in December 2009), we allowed them to have a rather (immersive) truthful 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 (ideally) be integrated as feedback in the following design and development activities, which we aim to do within task 4.4 'Embedding user innovation in technology design'. ICT user behaviour is unpredictable as 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 it is vital to investigate users in direct contact with the technological prototype or service that is being developed. However, immature technology that is still linked to fundamental research of engineers and technology developers, which is the case for the URBAN project, is not yet fully 'understandable' for future users. Therefore user input will only have a genuine added value in a 'semi-mature' technological environment. Semi-mature technologies are adequate to serve as an "*objet frontière*" (Flichy, 1995) and allow all involved stakeholders to discuss the meaning and further development of the artefact (Ballon et. al., 2007). Consequently, the URBAN prototype and thus the first version of the URBAN demonstrator served as the "*objet frontière*" for the 3D city modelling technology during the second iteration of the empirical field research. In this report the respondent interviews during which users were confronted with the URBAN demonstrator will be refered to as 'user tests'. It needs to be emphasized however that this is not linked to traditional usability testing where the testing of the technology in itself is the actual goal of the user tests. Within our research setting, bringing users in contact with a preliminary model of the URBAN technology served as a means to make the 3D city modelling technology understandable for users and also served as a technological probe to trigger users to reflect on the future usage of similar virtual city models, which is the actual goal of the URBAN user tests. By providing users with a proxy of the URBAN technology, we have tried to avoid the idea generation process being too "*functionally fixed*", which means that the ideas of users are fixed to their current use context. In other words, the provisional demonstrator and hence the 3D urban navigation experience enabled users to generate new ideas (Lettl, 2007). This approach fits in the mutual shaping perspective that users and technological research need to feed in to each other and where users are triggered by new (technological) concepts of a provisional prototype.

The outcome of this exercise is a report on the expectations and perceptions of experienced city trippers and real estate purchasers with regard to 3D city models

and services. In others words, the findings of the user tests identify the innovative opportunities for the 3D city modelling technology within the investigated domains of tourism (in particular city trips) and real estate.

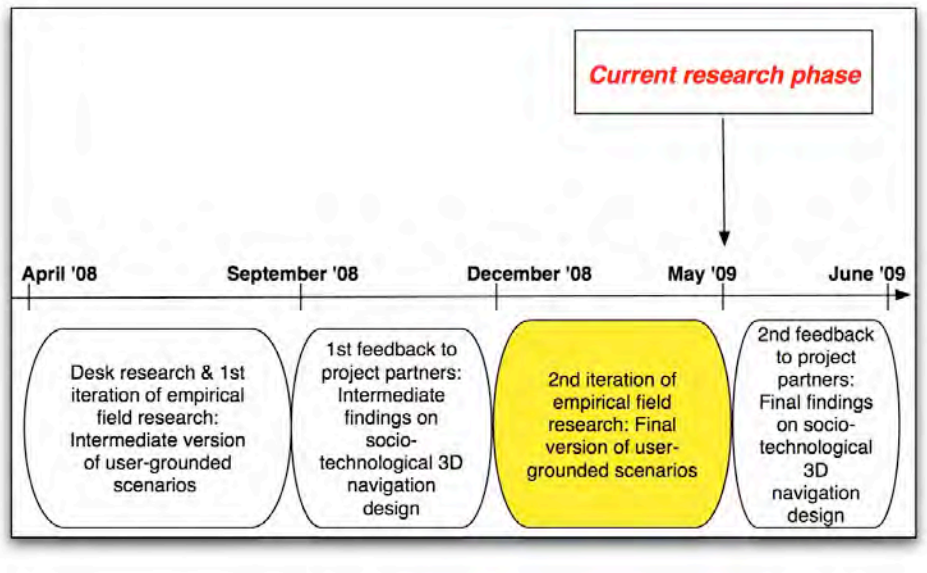

Figure 1: Current research phase within the URBAN project

In order to guide you through this report, we give a brief overview of the content. The first part will describe the URBAN prototype on the level of its positioning within the field of test and experimentation platforms, but secondly also on the level of its affordances and the implemented functionalities of the Task 4.3.1 user scenario's. Then we will describe the set-up of the user tests, including the guidelines we predefined prior to the actual implementation of the user tests. Further a detailed overview of the recruitement of the respondents will precede the actual findings of the user research. A final conclusion will reflect on the outcome of the empirical field research and its implications and meaning for future 3D city modelling applications.

3 User tests

3.1 Description of the URBAN prototype

This part will first address the question whether the URBAN proxy can indeed be referred to as prototype within the domain of test and experimentation platforms before narrowing down to the actual affordances of the URBAN demonstrator that was used by the respondents.

The user tests with a preliminary model of the URBAN demonstrator can be framed within our overall research objective in the URBAN project, that is establishing a user-driven design of a 3D city model. From a user-driven innovation (UDI) perspective, we try to have a thorough understanding of users for finding new opportunities to create value and a systematic involvement of users as early as possible in and throughout the whole innovation process (Wise & Hogenhaven, 2008). UDI goes further than the traditional user-centred design (UCD), a notion that has originally been formalized in the field of Human-Computer Interaction in the eighties, that is regularly used to refer to pure 'usability testing' and is only brought in at the end of the product development cycle (Veryzer & Boria de Mozota, 2005; ISO, 1999). We argue that implementing test and experimentation platforms in an early phase of R&D activities is vital to create a UDI development process.

3.1.1 A preliminary 3D city model: A prototype?

The unpredictability of ICT user behaviour explains why users are more and more investigated in direct contact with the technological prototype or service that is being developed. The conducted user tests with the first version of the URBAN demonstrator brought (potential) users in contact with the 3D city modelling technology during the develoment process and hence allows to integrate user experiences as feedback in the technological design and development phases. It is not always clear what type of test and experimentation platform (TEP) is best suited to achieve the required results. For that reason 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 user testing of the preliminary URBAN demonstrator is 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 2). The horizontal axis represents the technological readiness hence 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).

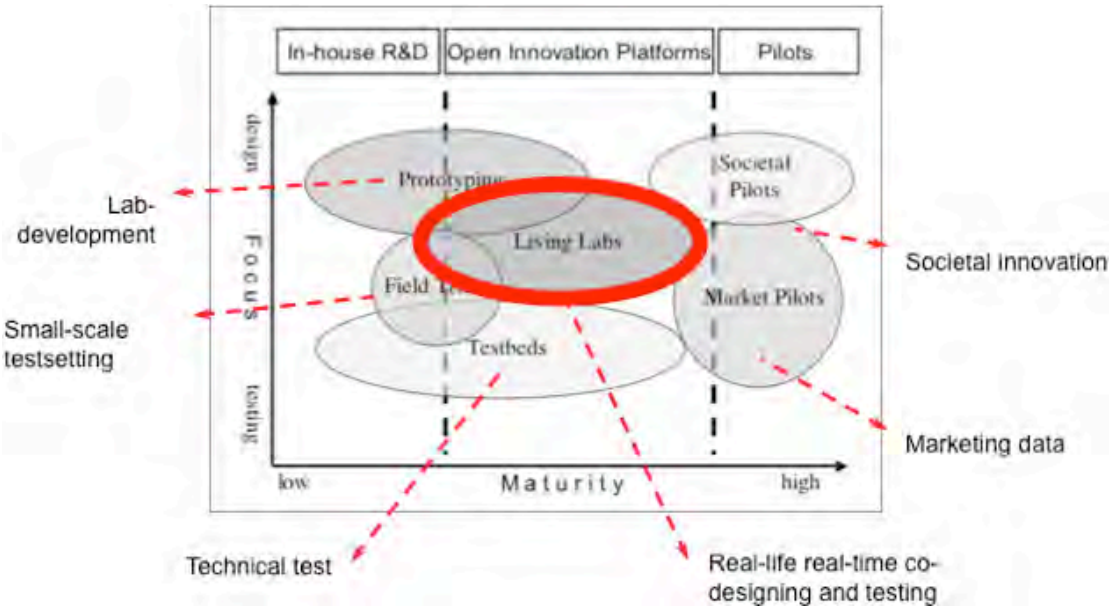

Figure 2: Conceptual framework of test and experimentation platforms

Following the typology the first version of the URBAN demonstrator, which we have tested in the context of the second iteration of the user research, can indeed 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). The URBAN demonstrator definitely meets the characteristics of a prototype:

1) During the user tests, we mainly focused on the design aspects, namely how a 3D city model should look like and what it should be capable of doing, rather than on the proper working of the 3D city modeling technology.
2) The URBAN technology that is tested by means of a proxy is more immature and thus far from (almost) market ready.
3) The final demonstrator will definitely not be a fully working end application. This leaves the technical project partners enough room for technological changes based on our user input.
4) A prototyping platform is situated between in-house activities and open platforms, just like the URBAN test setting.

3.1.2 The URBAN prototype: Affordances

In this report we use the concept 'affordances' to refer to the abilities that lie in the URBAN prototype and hence the functionalities of the Task 4.3.1 user scenarios that are incorporated by the developers within the project. Norman defines the term affordance as "*a combination of perceived and actual properties of the thing – primarily those fundamental properties that determine just how that thing could possible be used.*" (1988:95)[1]. For instance a mobile phone has become a full mobile multifunctional multimedia device. Yet the primary affordance is still making phone calls and sending text messages, even though the device can also be used for a lot of other services.

The affordances of the URBAN prototype are discussed by means of three topics, namely the different views or perspectives that the user can select, the predefined points of interest and the implemented additional functionaltities.

From Top View to Street View

[1] See also Gibson, 1977; Newman, 2001; Pierson et al., 2006.

Starting with the highest view that is implemented in the URBAN proxy, '**Top View**' (see figure below), once can notice that this is actually the satellite view of Google Maps. 'Top View' allowed the respondents to zoom in on satellite pictures of Brussels that indicate street names and important curiosities of a city such as churches, statues, squares, etc. 'Top View' is the only view that offers a **photorealistic** two-dimensional visualisation of Brussels. Both other views offer a three-dimensional representation.

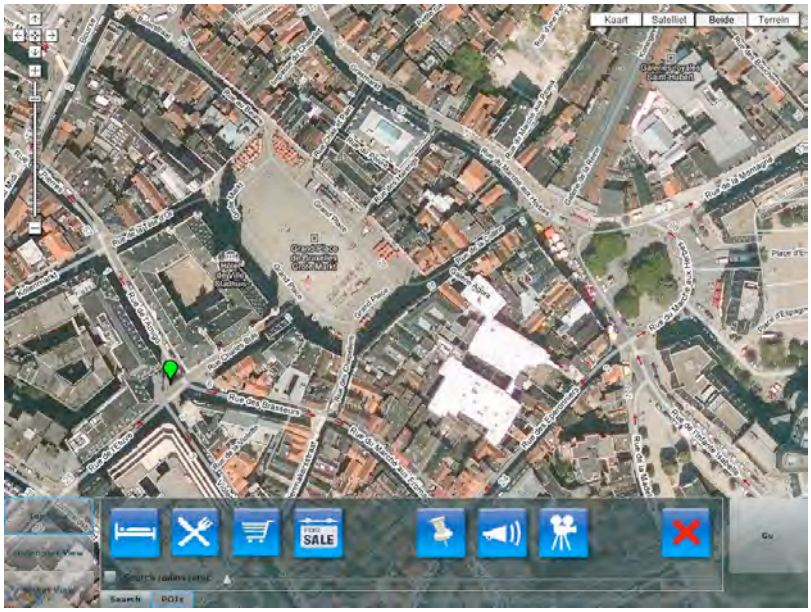

Figure 3: Screenshot of 'Top View' within the URBAN prototype

While 'Top View' gives the most general overview of urban environments from a top-down perspective, '**Helicopter View**' (see figure below), in which the user flies over the roofs of buildings, also provides the user with an overview of particular parts of the city, but not of the city as a whole. Yet the **three-dimensional** aspect of 'Helicopter View' offers an insight in the building structures and hence is more than solely a top-down perspective. Since there are no street names projected on the ground like in 'Top View', the developers have implemented an **orientation circle/map** that is situated in the right top corner. The green angle within this circle indicates the view direction of the user within the 3D model and the cross at the beginning of the angle indicates the user's current position.



Figure 4: Screenshot of 'Helicopter View' within the URBAN prototype

The lowest level, '**Street View**', allows the user to virtually walk around through the city model on street level. Again the orientation circle is implemented for the user to be able to orient himself in the virtual city.

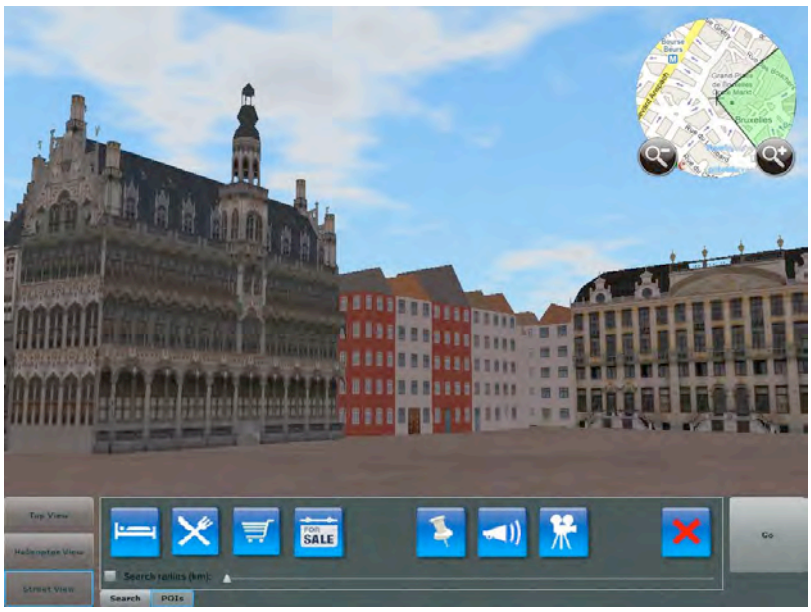

Figure 5: Screenshot of 'Street View' within the URBAN prototype

Points Of Interest

In order to search for a particular location, sight or facility the user has two options: he can enter the address or name in 'Search' (see figure 6) or he can choose for one or more Points Of Interest (see figure 4 & 5), being predefined 'useful' locations.

From the left to the right, the first POI stands for **accommodations**, the second for **restaurants**, the third for **shops** and the fourth POI is implemented specifically for real estate purchasers and indicates the available properties. The following buttons are not really POIs and require some further information. The drawing-pin highlights the **3D landmarks**, the loudspeaker shows the **events** that will take place on certain locations and the camera stands for **omni-directional video**. By means of the button with the red cross, the user can erase his previous search actions.

The 3D landmarks, provided by Tele Atlas, can be defined as: "*remarkable buildings and statues that are well-known to residents and tourists. Each landmark has a realistic texture and can be zoomed-in and rotated, giving users a better understanding of their spatial environment.*"[2]. Thus when the user clicks on the drawing-pin button the important curiosities of a city, which are much more detailed than the other buildings in the 3D model, will be provided with tags (see figure 6) that can serve as orientation support.



Figure 6: Screenshot of 3D landmarks within URBAN prototype

[2] http://www.teleatlas.com/OurProducts/MapEnhancementProducts/CityMaps/index.htm

Omni-directional video (ODV) (see figure 7) is in fact a constant moving interactive video fragment recorded by a portable ODV camera set-up within which the user can see in all directions. ODV is comparable to the 360° panoramic pictures that is achieved by stitching normal, perspective, photographs taken from a fixed location by a camera. When the user clicks on the camera button in the POI search bar several locations in the 3D model where ODV fragments were recorded are highlighted. After a double click on these specific locations the matching ODV fragment starts to play.



Figure 7: Screenshot of ODV fragment of Dansaert street in Brussels

Additional functionalities

Finally we will discuss two additional functionalities that are implemented in the URBAN prototype, more specifically the '**Search Radius**' and the '**Route Calculator**'.

The incorporated POIs are spread all over the city centre of Brussels, which is quite a large area. The 'Search Radius' functionality (see figure 8) enables the user to limit his search to a self-selected area. The green pin on the 'Top View' map indicates the user's current position. After selecting the 'Search Radius', which can be found under the row of POIs, it is possible to draw a green circle over the area in which one wants to search for particular POIs, for instance the present restaurants within a search radius as figure 8 illustrates.

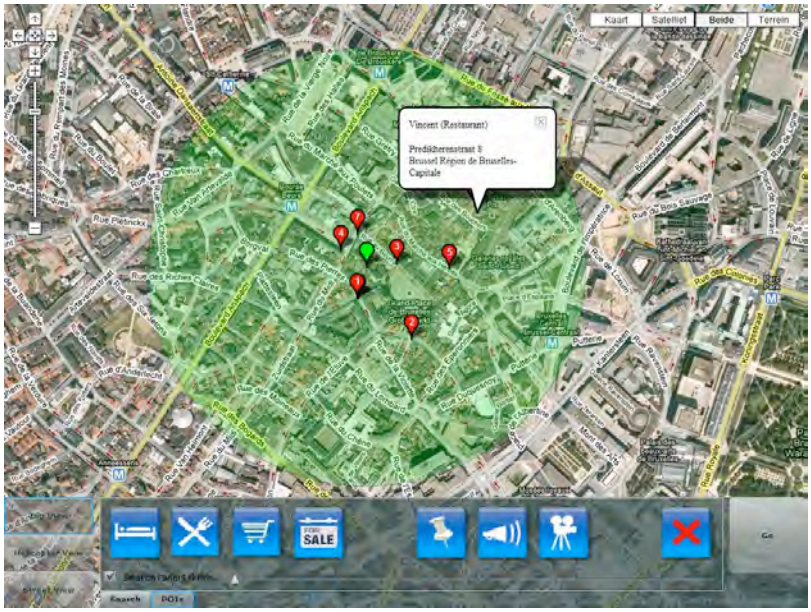

Figure 8: Screenshot of 'Search Radius' functionality within the URBAN prototype

The ‘Route Calculator’ functionality allows the user to receive a route description from point A to point B by selecting these two points on the ‘Top View’ map. The route is marked by a blue line, which is also projected on the ground in ‘Helicopter View’ (see figure 10) as well as ‘Street View’. It is important to add however that the route summary, including the travel distance, travel time, the straight-line distance and the actual route description, is only fitted to vehicles and hence not to pedestrians.

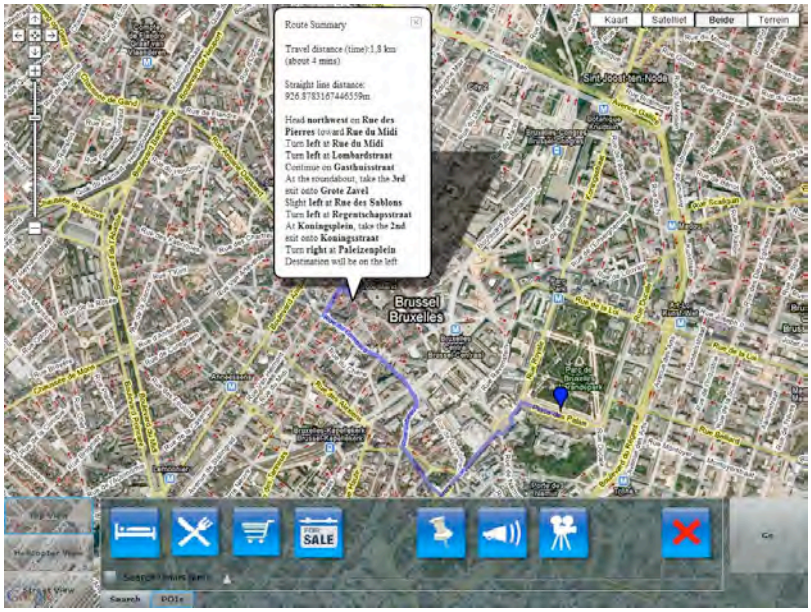

Figure 9: Screenshot of 'Route Calculator' functionality within the URBAN prototype



Figure 10: Screenshot of 'Route Calculator' functionality in 'Helicopter View'

3.2 Description of the user tests

The user tests, hence referring to the interviews with respondents during which they had the chance to experience 3D city navigation by means of the URBAN proxy, were composed of several parts. It was not the objective to simply test the preliminary version of the URBAN demonstrator, but to gain an insight in the

innovative opportunities of a 3D city model for people who plan a city trip on the one hand and people who are looking for a new home on the other hand. That is why we also interviewed the respondents with regard to their current city trip or real estate practices, why we let the respondents conduct on online search to see to what extent they currently use online information in their city trip or real estate practices, why the respondents were given scenario-based tasks to conduct in the URBAN proxy, etc. In order to create consistency between the differend user tests, we created a **step-by-step plan** (that can be found in the annex) that served as a guideline for the researcher. The step-by-step plan indicates what needs to be done in which order, which means are needed to realise this and who has which tasks. The step-by-step plan illustrates that the user tests actually composed of ten parts. The ten steps are partly based on the eight guidelines indentified by Tim Fidgeon (Head of Usability at Webcredible[3]) for usability testing[4], but are adjusted to our research set-up and objective. First we will shortly describe the eight guidelines for user testing to continue with the ten steps we identified in the context of the URBAN user tests.

It is important to clarify that even though the ten steps of the user tests are partly inspired by Fidgeon's usability testing guidelines, we have framed the guidelines in a broader perspective. As we have emphasized before, the URBAN user tests cannot be considered as usability testing as traditionally conducted within the human-computer interaction (HCI) domain. Nevertheless we need to point out the way the HCI domain is currently evolving and broadening by pursuing a constant feedback and dialogue between users, designers and engineers. We notice a shift towards the development of technical systems based on user experiences and needs rather than starting from a completed system and basing user experience around it (Wise & Hogenhaven, 2008). In addition Bannon (1991) argues that in the HCI domain it is more appropriate to talk about 'human actors' instead of 'human factors'. Bannon uses the term 'human actors' to place emphasis on "*the person as an autonomous agent that has the capacity to regulate and coordinate his or her behaviour, rather than simply being a passive element in a human-machine system*" (Bannon, 1991:26). Hence Bannon wants to step away from a passive, fragmented and de-personalised connotation of the user and go towards a more active, controlling connotation. Consequently our usage of Fidgeon's testing guidelins within a much

[3] Webcredible offers a range of usability, accessibility and design services for websites, intranets, mobile devices and applications. http://www.webcredible.co.uk/

[4] The eight guidelines can be found on: http://www.w3reports.com/index.php?itemid=1156

broader perspective actually fits within the way the HCI domain is currently broadening itself.

8 guidelines by Fidgeon (2005):

1. *Choosing your subjects*:

   The results of tests depends on the people you test. Fidgeon argues that it is best to not test people from your own social network and to outsource the selection.

   → Link to URBAN: How we have recruited our respondents for the URBAN user tests will later be discussed in detail in part 3.3.1 'Selection and description of the respondents'.

2. *Before the testing*:

   Each participant must be put at ease as the testing environment is often a very artificial environment. In addition the participants should be provided with clear instructions on what they can expect from the test.

   → Link to URBAN: In order to put the URBAN respondents at ease, we have consciously chosen to install the prototype on a portable computer to enable the users to test the 3D city model in the safe and **'natural' environment** of their own home. Conducting the user tests at the university might impose an 'intellectual' framework, within which users may feel that they can only give 'intellectual' answers, and hence cause some reservation among possible respondents. By going to the home setting, we intented to create a comfortable atmosphere in which users could possibly have an **immersive** experience of 3D urban navigation (Torben Nielsen et al., 2008). However, we are well aware that bringing an unknown laptop with a new application into the home environment of people cannot be considered as genuine ethnographic research in the home.

3. *Beginning the testing*:

   Before conducting the actual tasks, participants need to get familiar with the environment, for instance by letting them take a first look at the website they will be testing and gauging their first impressions.

   → Link to URBAN: Will become clear in the description of the ten steps of the URBAN user tests.

4. *Choosing tasks*:

The tasks that the participants need to conduct need to be essential for the new application's success. One can also ask the user to suggest tasks that can indicate new functionalities or priorities.

→ Link to URBAN: Throughout the whole user tests the respondents were encouraged to think freely about possible additional useful functionalities and services of 3D city models from their own perspective.

5. *How to word tasks*:

   People tend to perform more naturally if you provide them with scenarios and goals rather than instructions.

   → Link to URBAN: Will become clear in the description of the ten steps of the URBAN user tests.

6. *Presenting tasks*:

   Only give participants one task at a time. More than this may intimidate them, or alter their approach to the test.

   → Link to URBAN: The respondents were provided with very accessible scenario-based tasks on which we will elaborate later.

7. *How to behave during the testing*:

   The researcher must stay neutral, quiet and out of sight during the test to avoid that one alters the test results by providing clues, suggesting directions or by reacting to things the participants say or do.

   → Link to URBAN: We did not want to give the respondents the feeling that they were simply testing an application by themselves and wanted the respondents to be able to imagine themselves in a particular situation/scenario, more specifically in the situation of planning a city trip or searching for a property by means of a 3D city model. Therefore we chose to let the researcher read each scène of the scenario together with the respondent to ensure that the latter took the time to reflect on the content of the scenario. The researcher also regularly intervened to help the respondents with some technical problems that occurred during the user tests as we aimed at providing users with a smooth experience of 3D city navigation. Hence the researcher did not take-up the passive and quiet role as the usability testing guideline prescribes. Yet since we are transparent concerning the way the researcher guided the user tests, this guidance does not form any problem.

8. *After the testing*:

   After all the tasks have been completed, the researcher should gather as much information as possible. Asking for overall impressions of the application will allow the researcher to judge whether expectations have been met, and whether the participant's view of the application has changed during the process.

   → Link to URBAN: During their first acquaintance with the URBAN prototype, we probed into the respondent's first impressions of the prototype. Once the respondent had finished all the scenario-based tasks and before elaborating on the different functionalities of the prototype, we sounded to the respondents' overall impressions. By doing so it became apparent that the respondents' first impression did not change during the process of scenario-based task performance.

It is clear that Fidgeon's eight guidelines for testing are situated in the user-centred design (UCD) tradition, within which the user input that is integrated into the design process is often more focused on individual experiences. Though we argue that 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 (see figure 11) by considering the user within his/her social context rather than task-centric users as a fundamental source of innovation.

User-centred design	People-centred design
Needs	Practices
Tasks	Goals
Individuals	Social context & Communities
Explicit knowledge	Tacit knowledge

Figure 11: Characteristics of UCD versus PCD

The ten steps of the URBAN user tests are actually a combination of the 'need-based' lens of UCD as well as the practice-based lens of PCD (Van Lier, et. al., In press). The user tests sounded to the respondents' needs as well as practices, we gave them tasks as well as goals, we focussed on the individual level as well as contextual aspects (e.g. Have the respondents already been on city trip? Are the respondents inhabitants or non-inhabitants of Brussels?), we probed into the respondents' explicit knowledge as well as tacit knowledge (e.g. by bringing the respondents into contact with a 3D city prototype we were able to obtain knowledge that would not have been possible by means of solely interviews).

10 steps of the URBAN user tests:

1. '*Description of the objective and set-up of the user test*':

   Taking the second guideline of Fidgeon into account, which is putting the respondents at ease, we started the user test by clearly informing the respondents on what they could expect from the user test, on its set-up and on its objective. We emphasised that the scenario-based tasks would not be difficult and that the respondents were definitely not the ones being tested. We communicated that the tasks and interviews only aimed at generating their feedback on and mapping their experiences with the URBAN technology.

2. '*Establishing a profile sketch*':

   In view of making a profile sketch of each respondent, we probed into their relevant city trip or real estate experiences, their average internet usage and other profile data.

3. '*Conducting an online search*':

   In order to gain a better insight in the practice of planning a city trip and searching for a property and the role the internet has within these practices, we asked the respondents to conduct an online search and show us how they would look for tourist or real estate information and what kind of information they would look for. The choice to give the respondents an online search assignments is based on the hypothesis that the take-up of a 3D digital city model in the process of planning a city trip or searching for a new home is partly linked to the current user practices and the role that other existing digital applications, e.g. websites such as 'Tripadvisor' for city trippers and 'Immoweb' for real estate purchasers, plays

in these planning practices. For example, a tourist who always plans a city trip by means of a traditional paper travel guide and does not consult any additional (digital) information sources, will probably have more reservations towards using a 3D city model in his planning practices than a city tripper who exclusively plans a city trip by means of online tourist information and online maps.

4. '*Interview on current domesticated practices*':

   After the online search, an interview further probed into the respondents' domesticated practices. The first iteration of the user research already provided us with a first insight in the practice of planning a city trip and searching for a property. Nevertheless we again sounded to the respondents' current practices to possibly validate the Task 4.3.1 findings on the one hand and to frame the user test respondents on the other hand.

5. '*Presenting the URBAN prototype*':

   In order to give the respondents the opportunity to have a first 3D city navigation experience, we briefly explained how to navigate through the 3D environment and the different functionalities and buttons that are implemented in the proxy.

6. '*The respondent's first acquaintance with the URBAN prototype*':

   In relation to the third guideline of Fidgeon, i.e. letting the respondents familiarize with the application, the respondents had the chance to navigate freely through the 3D city model for approximately ten minutes. Hence before continuing to the predefined scenario-based tasks, the user had the chance to familiarize with 3D city navigation. During this first acquaintance with the URBAN prototype, we used the 'think aloud' method (Van Someren et. al., 1994) to gain insight in the respondents' first impressions. Thus the respondents were encouraged to say out loud what came to their mind while exploring the 3D city model.

7. '*Gauging the respondent's first impression of the URBAN prototype*':

   The think aloud method used during the previous step of the user test already gave an insight in the respondents' first impression of the URBAN prototype. Nevertheless after the respondents' first acquaintance with 3D city navigation, we explicitly probed into their first impression, thus what they noticed and what they liked and disliked.

8. '*Installing the URBAN prototype for the scenario-based task performance*':

Before continuing to the actual scenario-based task performance, we erased the search actions the respondent conducted during his first acquaintance with the URBAN prototype and installed the prototype in accordance with the first scene of the scenario.

9. '*Scenario-based task performance*':

   With regard to the fifth guideline for user testing, the fact that people tend to perform more naturally when they are provided with scenarios rather than with instructions, we worded the tasks in the form of a story (that can be found in the annex), more specifically a downsized version of the 4.3.1 user scenarios that fits the technical possibilities of the prototype. An important question that should be addressed in this context is why we have assigned tasks to the respondents instead of solely letting them navigate freely through the URBAN prototype. First the tasks enabled the respondents to explore all the possibilities and functionalities of the application. Secondly as the users' experience of 3D city navigation had a central role during the user tests, the guiding tasks preserved the user from pure usability issues. In other words, in order to enable the user to possibly have an immersive experience, the interaction between the user and the prototype cannot be disturbed by technical shortcomings. Furthermore the scenario-based tasks also avoided the user tests being too task-oriented in the sense of being purely a user task analysis dominantly used to assess the usability of a new application.

10. '*Evaluative interview on the URBAN prototype*':

    In line with the eight guideline for user testing, the evaluative interview (the questionnaire can be found in the annex) that took place right after the scenario-based task performance began with sounding to the respondent's overall impression of the prototype before elaborating on his thoughts on the different functionalities of the prototype.

Now that the set-up of the user tests is clear, we can continue to the actual findings of the respondents' user tests. The findings will be preceded by a detailed description of the selection of the respondents.

3.3 Tourism user tests

3.3.1 Selection and description of the respondents

The respondents were selected via purposeful sampling. For this we used the snowball method. By means of different selection criteria we aimed at creating a good variation among the respondents in order to be able to compare different types of users. We have mobilised people we know to look for people in their social networks who match the predefined selection criteria.

The basic criteria to which each respondent had to respond:

- The respondent is not an inhabitant of Brussels since exploring the 3D model of Brussels from a tourist perspective is not relevant for inhabitants.
- The respondent has to be interested in a possible future visit to Brussels in order to emulate the everyday life practice of planning a city trip as best as possible.
- The respondent must already have been on at least 2 city trips in the past in order to insure that he/she is familiar with the everyday life practice of a city trip.
- The respondent needs to be familiar with conducting online searches and basic computer tasks as the flow of the user tests should not be disturbed by the lack of computer skills, which would prevent the respondent of having an immersive experience.
- The respondent should already have searched for tourist information on the internet to allow him/her to imagine him-/herself using an (internet) application in the process of planning a city trip.

Next to these basic criteria that are shared by all the respondents, we differentiated the respondents by means of two additional criteria, namely **age** and the degree of **initial city trip planning**. We involved the two age categories '< 40 years' and '40 to 60 years' to create more variation among the respondents in comparison to the first iteration of the empirical field research where we investigated a dominantly young group of respondents with high computer skills. The final additional selection criterion we have chosen, namely the degree of initial city trip planning, is guided by former research. The user research conducted during the first iteration of Task 4.3 has shown that all tourists plan, more or less formally, a city trip, whether or not depending on online information sources. However, the carefulness and the level of detail of this initial planning substantially varies among tourists and depends on various circumstances, such as the tourist's previous knowledge of the destination, earlier city trip experiences, the duration of the vacation, etc. (Mollerup, 2005;

Rubben, 2006). People can take up different roles, depending on the aim of the visit and the specific situation. Within the ROMAS project (Research On Mobile Applications and Services), researchers identified seven different roles (illustrated by the figure below and described in detail in D. 4.3.1) that a person can assume when going into town. Each role can lead to specific requirements for future urban services and applications (Pierson et al., 2008).

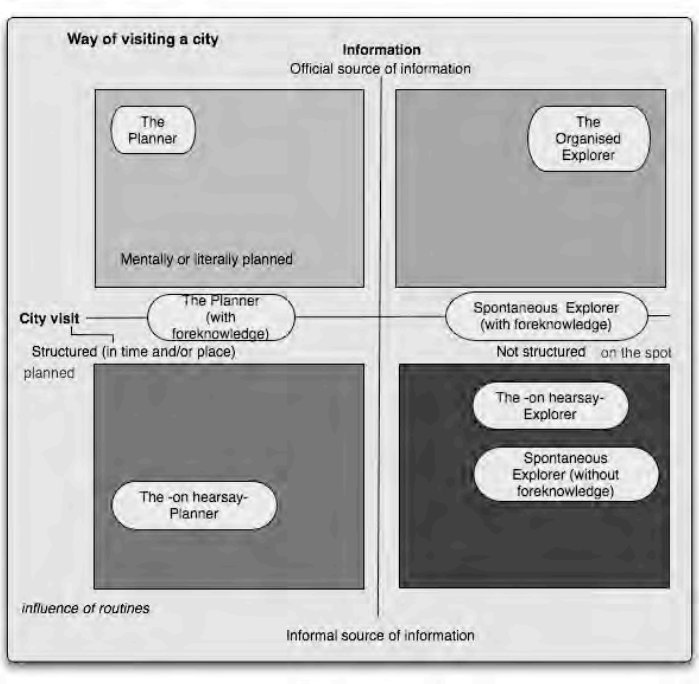

Figure 12: Typology of roles in the practice of 'going into town'

Nevertheless, the ‘Going into town’ model (Figure 12) is still under development as there is not yet a formal identification of each of the seven roles. Therefore the final additional selection criterion based on which we recruited the URBAN respondents, the degree of initial city trip planning, is only based on the basic profiles and thus the horizontal axis, more specifically ‘the planner’ on the one hand and ‘the explorer’ on the other hand. We keep in mind though that there are several gradations within these two basic profiles. While the ‘Going into town’ model differentiates between ‘official sources of information’ versus ‘informal sources of information’ based on which people plan a city visit, we differentiated the URBAN planners between planners who mainly prepare their city trip on the basis of online information (e.g. online travel guides, online travel diaries, user-generated tourist content, etc.) versus planners whose preparation is mainly based on offline information (e.g. travel guides, magazines, brochures, word-of-mouth, etc.). In the context of URBAN the distinction

between online and offline is more useful than a distinction on the level of the character of the sources of information (official versus informal). The question whether one would actually use a 3D digital city model with tourist functionalities to plan a city trip is to a certain extent linked to the current user planning practices and the role that other existing digital tourist applications, for instance online tourist websites as 'Tripadvisor', already plays in these planning practices. Whether users consult official or informal online tourist information is less of importance in the case of URBAN.

The selection criteria have led to the following matrix of respondents[5]:

	< 40 years	40 to 60 years
The (mainly) online planner	*Annelies*	*Rob*
The (mainly) offline planner	*Thomas*	*Els*
The explorer	*Evelien*	*Noëlla*

Now that we have elaborated on the selection and description of the respondents that were subjected to a second round of multi-method ethnographic research, we will detail the actual findings of the user research.

3.3.2 Findings of the user tests

Whether a 3-dimensional city model and its related services could offer opportunities and added value for city trippers depends on the everyday life practice of planning a city trip. Do the existing tourist information sources and tools have certain shortcomings and if yes, could future 3D digital city applications serve as an answer to these shortcomings? The city trip practice was the scope of the first iteration of the empirical field research. Yet the second iteration of the user research again investigated the practices of the recruited city trip respondents in order to frame the respondents on the one hand and to possibly validate the findings on the practice of planning a city trip, hence the first iteration of the user research, on the other hand.

[5] A detailed description of the respondents with regard to the predefined selection criteria can be found in the annex.

Therefore the **first topic** will address the findings on the **dominant tourist information tools**.

Next to the possible shortcomings of the domesticated tourist information tools, the innovative opportunities of a 3D city model are also linked to its affordances, hence the different functionalities and services that is offers. We will see that **wayfinding** together with **localization** is perceived as the **primary affordance** of the URBAN prototype.

The fact that a virtual three-dimensional model is primarily perceived as a practical navigation and localization tool, which is especially useful when one is on the spot in an unfamiliar surrounding, identifies the possible added value of mobile 3D city applications. As a result the perceptions of and expectations towards **mobile 3D urban applications** will be addressed as a **third topic**.

Though the perceived usefulness and added value of a 3D city model also depends on the latter's ability to create an immersive urban experience. **Immersion** is linked to the degree to which the virtual reality is perceived as 'real'. Therefore we will discuss the perceived **realism** of both the **three-dimensional model** and the **omni-directional video**.

Finally the innovative opportunities of a 3D city model are also situated in the field of the offered Points of Interest. POIs can only have added value in case they fit the personal interests of the user. In the context of POIs we see that two important elements need to be taken into account, more specifically **personalisation/categorisation** and **synopsis**.

All these findings have implications for the **willingness-to-pay** of the respondents and will be discussed as a **final topic**.

The practice of planning and going on a city trip: The dominant tourist information tools

- The main advantage of a travel guide is its **mobility** and thus its ability to provide some (navigation) guidance on the spot.
- The tourist information that is offered by a **travel guide** is perceived as more **synoptic** and **well organised** in comparison to the **diffuse online** tourist information.

- Tourists prefer to decide which restaurants, bars and shops they will visit on the spot in order to keep the city trip more or less **spontaneous**. Future mobile tourist applications should be able to respond to this need to not plan everything in advance.
- City trippers are interested in **up-to-date information** such as opening hours, events, exhibitions and the schedules of public transport. Three-dimensional city models should therefore play a part in this particular need of tourists that a traditional guidebook cannot fulfil.

The first round of multi-method ethnographic research, of which the results can be found in D4.3.1, has already indicated the dominant position of the traditional travel guide. The practical paper guide can serve as a tool to plan a trip beforehand, offers support on the spot to look up some extra information about certain sights, contains several maps of different parts of the city, gives an overview and description of restaurants, bars, shops, etc. The URBAN proxy, as it was tested by the respondents, is not a digital travel guide in itself, but it has the following functionalities of a traditional paper travel guide:

1. The static 3D city model can also be used to plan more or less a city trip in advance from the home setting.
2. The 3D landmark functionality can give the user an idea of the most important sights of a particular city. Though it does not provide any additional information about these sights like a travel guide does and it is not consultative on the spot since the 3D city model is not mobile.
3. The 3D city model also visualizes all the different parts of the city like the street maps and pictures in a travel guide do.
4. The 3D city model gives an overview of (a selection of) the available restaurants, hotels and shops as well, but it does not provide a description or ranking of these facilities.

First we noticed that the travel guide clearly responds to the needs of **various types of city trippers** as even the two respondents we recruited in the context of the user tests as the archetypal ‘online planner’, thus mainly planning a city trip on the basis of online information, admitted to always take along a paper travel guide on a city visit. The online planners make use of the city maps in the guide to orient themselves in unfamiliar urban environments and read the background information of certain

curiosities. Our empirical research, hence both iterations, has already highlighted the great significance of city maps for city trippers. Later we will elaborate on the topic of wayfinding/navigation.

> *"You know it is practical the moment that you have planned everything that you take a small atlas or a small guide with you for, as I have said, a street map or to. Els (= his wife) does it often when you are somewhere when you are at that place to read some more details in that guide or facts or to not always have to buy a guide at a museum or something like that."*[6] *(Rob, Online planner, 48 years)*

Yet **next** to its potential to serve as a navigation support and a personal (museum) guide, the travel guide is also frequently applied on the spot to look up particular things that even well prepared planners do not like to look up beforehand, namely restaurants, bars and shops. Obviously the choice of such **facilities** is often based on serendipity and contextual factors.

> *"(…) I can imagine that you are not going to plan everything concerning food and shops beforehand. When you are somewhere in the neighbourhood and you are hungry then it is practical to know where there is a nice restaurants in the neighbourhood." (Annelies, Online planner, 23 years)*

Nevertheless, the users tests have pointed out some **shortcomings** of the traditional paper guide to which the internet can respond to and that can create opportunities for virtual city applications. The **internet** is the medium pre-eminently that lends itself to **up-to-date information**, while a paper guide carries a certain inertia in itself. Consequently the internet is much more suitable to anticipate on temporary activities such as events, exhibitions, concerts, etc. All types of city trippers can benefit from up-to-date tourist information. Consequently the two recruited archetypal 'offline planners', who plan a city trip mainly by means of offline information sources, still consulted the internet to search for some up-to-date information like opening hours or events. Obviously a 3D city model can also be considered as a fast medium that can lend itself to up-to-date information.

[6] All respondent interviews were conducted in Dutch. We have translated the citations as literal as possible from Dutch into English.

> *"Like events, the latest new things, for that I would rather go to the internet. For what has changed, happened or is being organised the last months, years, but for the classics, for example the places, the sights offline information might even be easier and more organised than online." (Thomas, Offline planner, 25 years)*

Yet at the same time, as the previous citation illustrates, Thomas as an offline planner indicates his preference for the **well organised** and **synoptic** structure of the paper **travel guide** in comparison to the more **widespread and diffuse online** tourist information. The first iteration of the user research has already identified the perceived abundance of online tourist information, which makes it sometimes very difficult and time-consuming to gain an overview and to find the required information. As a result well-structured tourist applications that offer a quick overview would be useful.

In addition, similarly to the previous empirical field research, we notice that online tourist information is also appreciated for its **user-generated content** created by other tourists (review, rankings, etc.), its strong **visual feature** and its **ease-of-use** for online bookings (flight tickets and accommodations).

The comparison between the two popular tourist information sources provides a clear insight in the domesticated practices of tourist information retrieval and highlights the needs and expectations of city trippers. These insights are indispensable to be able to identify user innovation in the context of 3D urban navigation.

Wayfinding and localization as primary affordance

- All city trippers regularly struggle with **wayfinding** issues. From this perspective navigation support is perceived as the primary service of 3D city models. Consequently navigation should be a basic function on all urban tourist applications.
- **Three-dimensional visualisation** of urban environments provides a clear insight in a city, a better orientation and allows users to better link particular places to each other.

- Tourist applications should enable users to **localize** traditional tourist facilities, such as hotels, restaurants and tourists centres.

By means of the users tests we addressed the following research sub question: "*Which services could offer a genuine added value for city trippers in a 3D city environments*"? The first iteration of the empirical field research already showed that tourists often struggle with **wayfinding** issues and strongly rely on a city map to navigate through an unfamiliar city. How to get from point A to point B, on foot or by public transport, is actually the main concern of city trippers during their visit to a city (especially their first visit). The interviews with the test users also express and thus confirm this need for navigation support in unfamiliar urban environments. This also explains why the respondents primarily situate the added value of the tested URBAN application in the context of wayfinding and navigation. It is important to add that wayfinding on the one hand, how to get from one place to another, and localization on the other hand, determining where particular things and yourself are localized, are usually linked to each other, but they can also be considered separately. While conducting the scenario-based tasks, the respondents came in contact with all the affordances of the 3D city model. One specific functionality is the ability to calculate a route, which is the primary function of GPS devices. During the evaluation of the model this well-known 'GPS functionality' repeatedly came forward as one of the most interesting functionalities of the 3D city model. For the moment the route descriptions are tailored to vehicles. It is obvious that, in order to be relevant for city trippers, the user should also be provided with routes for pedestrians and ideally even with public transport schedules.

> *"The most practical is probably the route description that you receive automatically when you click on Control (…) that you can actually form your route and then you don't even need your map anymore." (Thomas, Offline planner, 25 years)*

The URBAN prototype also enables tourists to search for hotels, restaurants and shops. **Localising** and **finding your way** to these facilities and to other tourist locations, including tourist centres, is obviously perceived as the **primary affordance** of 3D city models by the respondents. All other functionalities and additional information are perceived as **practical extras**. With regard to wayfinding and localization the three-dimensional aspect of the city model can contribute to a better

spatial insight in the composition of the city and hence can facilitate the navigation practices according to the respondents.

> *"Now it is just practical to have a spatial view and to know where everything is located geographically, but if you receive extra options with that like comments and reviews and additional information, as consumer you go as far as you want with that, but it would be practical if you have that possibility." (Evelien, Explorer, 23 years)*

> *"For me it is just purely a manner of orientation to know where hotels, restaurants, shops are located and possibly to find the way throughout the city." (Annelies, Online planner, 23 years)*

The female respondents frequently mentioned their lack of orientation skills and the difficulties they experience with reading common 2D street maps during city trips. They sometimes even generalised these problems to all women with citations such as "*it is just practical for women who often get lost*" (Evelien, Explorer, 23 years). From this perspective, the three-dimensional representation of urban environments, especially in 'Helicopter View' (in which the user is located just above the roof of buildings), is perceived as interesting to provide users with a clear insight in (parts of) the city and thus to link different locations to each other. Several respondents even indicated that thanks to the 3D representation of Brussels, they could now link several important sights or buildings in Brussels to each other.

> *"I have absolutely no orientation skills and this (i.e. helicopter view) gives me an insight "ah the Dôme is located over there", to say something, or "ah it is positioned in that way". It is difficult for me to visualise that and this gives me some depth view, literally and figuratively." (Noëlla, Explorer, 48 years)*

After navigating through the 3D city model Evelien too mentions that the 3D visualisation, in case of a mobile version, can be a genuine added value to orient herself and to navigate through the city in comparison to an ordinary plan. She compares the three-dimensional visuals with the visual application of a GPS. Again the tested URBAN prototype with all its functionalities is thus mainly perceived as an interesting urban navigation tool.

> *"I think it is a very interesting program, it really is something practical for me. I can also no longer miss it on the GPS in my car. There too I use that visual application of how you are driving and not the plan simply because that is more difficult. (…) It is very practical to know which buildings (= in the 3D city model), you don't loose time with figuring things out or with asking the way a hundred times at locals or other tourists." (Evelien, Explorer, 23 years)*

Currently producers of stand-alone navigation applications are transforming their 2D-maps into 3D-maps with 3D orientation points and internet companies like Google and Yahoo! and software giant Microsoft are investing heavily to introduce the 3D experience in their desktop map services. Based on our user findings we can give some indication that this current trend indeed responds to users' wayfinding issues.

A mobile 3D city model

- A mobile 3D city model would offer a **genuine added value** from a user perspective:
- City trippers, especially explorers, would like to have some (navigation and localization) support on the spot.
- A mobile virtual city application could respond to the shortcomings of the domesticated travel guide and city map.
- Because of the perceived added value, users will be **more willing to pay** for a mobile version of the 3D city model.

The previous findings, namely the mobility (and portability) of a traditional guidebook as the medium's main advantage in combination with the ability of the internet to provide last-minute up-to-date information on the one hand and wayfinding and localization as primary concern of city trippers on the other hand, identify that the innovative opportunities from a user perspective are situated in the field of **mobile 3D urban applications**. During the user tests several respondents spontaneously mentioned that the 3D city model would be more relevant to apply on the spot on a mobile device or, as Noëlla suggested, at specific locations in the city (for example

on kiosks) similar to the current "*you are here*" billboards with a street plan of the city. The fact that the URBAN prototype is a static application is even perceived as problematic as the following citation illustrates.

> *"The problem is this is fantastic to search in advance, but of course it does not help me on the spot when I am walking around. Then I have to memorise it." (Noëlla, Explorer, 48 years)*

Obviously the ability to apply the 3D city model on the spot is also a necessity for the second archetypal 'explorer'. We can argue that tourists who prefer to plan their vacation as little as possible benefit more from mobile support tools to look up tourist facilities and to find their way than the well-prepared planners.

> *"It is also practical for when you are there. When there really is a mobile application, then street view would be very practical because you would immediately find your way, but to me it does not seem practical to use in advance since you cannot picture yourself where you are exactly." (Evelien, Explorer, 23 years)*

The study of the practice of going on a city trip has revealed the strong domestication of the city map and the traditional guidebook. However, a mobile 3D city model seems to have a number of advantages in regard to the current domesticated tourist tools. First of all the respondents perceive the well-established travel guide as a slow medium that does not always provide you with the necessary wayfinding and localization support on the spot, while a mobile 3D city model is considered a fast medium.

> *"I would apply it and it would be more practical than now a Trotter. (…) Then it is just practical, then it is handy, then you can visualise it, then you are helped quickly, then you quickly know where you are and those Trotters are also practical, but it goes slower and you have to go ask more often where everything is located at the local bakery or something like that." (Evelien, Explorer, 23 years)*

Secondly the ability of the URBAN prototype to calculate a route and the time it will take to follow that route, which is calculated by means of Google Maps, allows

tourists to better estimate in what way and in what time one can go from point A to point B in comparison to a regular paper city map. As already described, it also enables you to link particular places to each other and offers a spatial insight in the composition of the city.

> *"The most practical is that it immediately gave you an estimation of how much time it will take you to go from one place to another and that is the most difficult to estimate without such means. Only on the basis of a plan, eventually you have a sense of scale but then it is still difficult and there you receive how long you would have to walk." (Thomas, Offline planner, 25 years)*

The fact that a mobile version of the URBAN prototype can be a genuine added value for city trippers, which should be investigated in future research, is also reflected in the **willingness-to-pay**, a topic that will be addressed in detail further on. Several respondents, explorers as well as planners, are only willing to pay for a similar 3D city model when it is available on a mobile device.

> *"That would be really practical because planning in advance is fine to a certain level, but it would indeed be extremely practical if you can consult it while you are actually walking around in that city. (…) Then you would already have to pay to receive internet on your mobile device, but then it would become more practical and I think I would be more willing to pay for it." (Thomas, Offline planner, 25 years)*

Virtual reality: How real?

- People prefer a generalised 3D model of a city to a hyper photorealistic representation as the latter would leave little room to still get "**overwhelmed"** during the city visit.
- Things that are relevant for tourists, which are generally part of the **public space** (e.g. parks, squares, historical buildings), require a higher level of detail than things that are not of interest to tourists (e.g. private houses).

The URBAN prototype enables users to interact with a simulated three-dimensional model of a real city. Though, the fact that the virtual urban environment is based on real data of Brussels does not necessary imply that users also experience the virtual model of Brussels as real. This topic will elaborate on these issues of immersion and realism.

Virtual reality applications are generally associated with "*its immersive, highly visual, 3D environments*"[7]. We start from the hypothesis that whether the respondents experienced the virtual model of Brussels as **immersive,** depends on their perception of the **realism** of the 3D model.

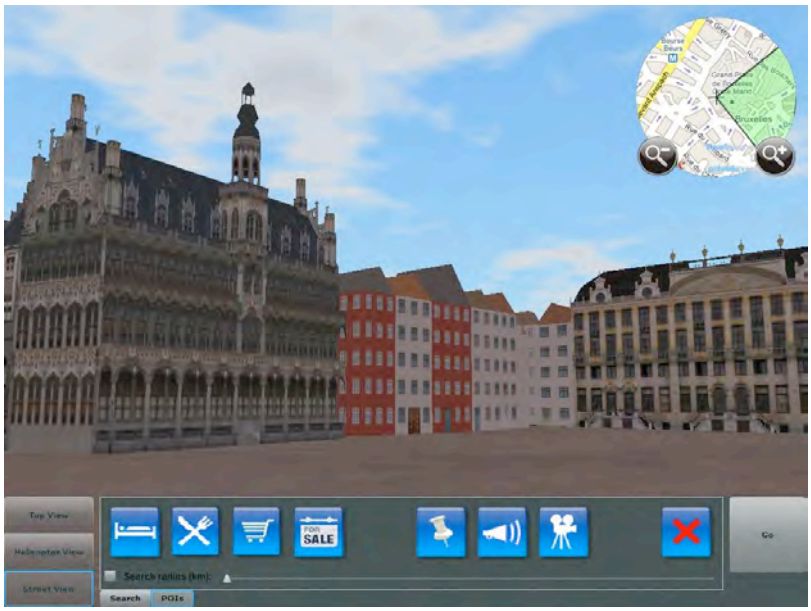

Figure 13: The Grand Place of Brussels from Street View in the URBAN prototype

The overall perception of our respondents (being all non-inhabitants of Brussels) is that Brussels is represented quite realistically and that the degree of detail is sufficient. In addition a more detailed visualisation of a city would even be experienced as a letdown by the city trippers as there would be no surprise left during the actual city visit. In the course of the interviews the respondents were provided with two screenshots of Google Street View (of a street in Lille, France) that served as probes to obtain an insight in the required level of details for tourists.

[7] http://en.wikipedia.org/wiki/Virtual_reality Consulted on: 5th of May, 2009.

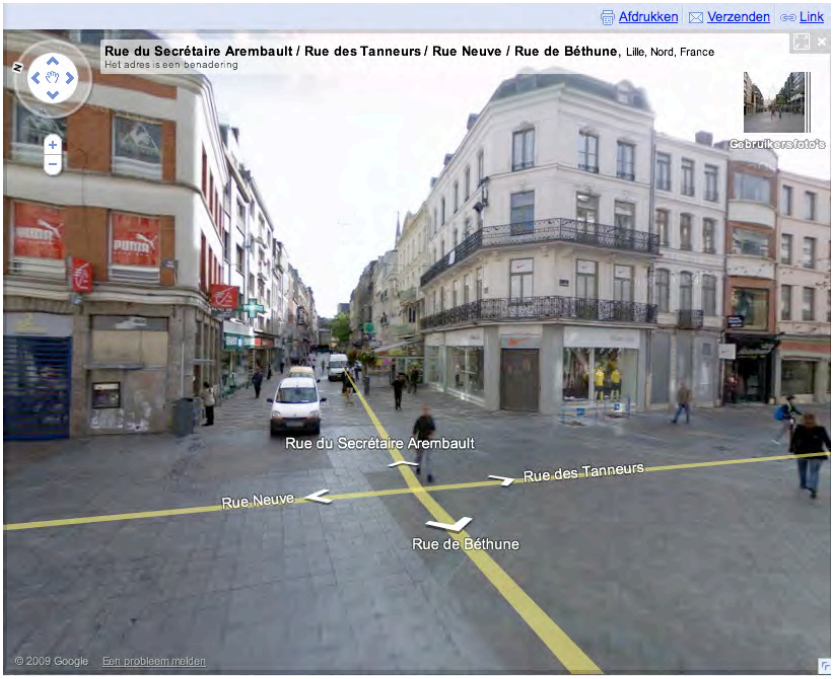

Figure 14: Screenshot of Google Street View in Lille, France

The respondents indicate that they do not need a photorealistic representation of their vacation destination as Google Street View offers. Rob even suggests that if you want to see pictures of a hotel or particular sights, then you can always consult the website in question. From this perspective the generalised virtual model of Brussels is sufficient as long as it provides links to the official website of hotels and curiosities.

> *"Then I prefer this (= URBAN prototype over Google Street View) with the detailed drawings and the links to the websites of hotels or the sights or something like that. (…) Imagine that you go to Brussels and you want to go to the palace of justice and you go to the website, then you have already seen it he." (Rob, Online planner, 48 years)*

Thomas, who had already seen Google Street View in the past, is impressed by the realism of the 360° panoramic street-level view of Google, yet at the same time he asks himself why you would still want to visit a city when you have already seen everything in advance. Several other respondents, planners as well as explorers, made the same argumentation. Thus even the archetypal well-prepared planners do not feel the need to have photorealistic information of a city and are satisfied with a generalised 3D model of a city with detailed landmarks since they also, just as

explorers do, still want to **discover** the city once they are on the spot and do not want to know everything about the city in advance.

> *"(…) I was impressed by how real, okay you could not walk around all the way through, you could go from one cross point to another, but it did give you an image of how it would really be. But then you ask yourself why you would still go on city trip when you have already seen everything. It is a little freaky what is all possible nowadays." (Thomas, Offline planner, 25 years)*

Starting from the perception that a three-dimensional visualisation of urban environments is particularly interesting in the context of wayfinding and localization, a detailed representation, for example of all buildings, is perceived as unnecessary as it creates no added value to finding your way. Both archetypal explorers, who rely the most on tourist and navigation information on the spot as they have planned little to nothing in advance, argue that they do not need more details in order to get a spatial insight in the city. As mentioned before, a general three-dimensional representation does create added value as it provides the user with a spatial insight in an unfamiliar city.

> *"It is practical to just know your street and to spatially see where you are, but you do not need those details to recognise things." (Evelien, Explorer, 23 years)*

> *"Yes definitely realistic, the buildings are all the same so that is not realistic, but you know that. In fact the meaning is, you do not have to look at those details, in fact the meaning is my road network, can I walk through my network? That is the most important and that I think is very realistic yes." (Noëlla, Explorer, 48 years)*

Obviously a higher level of detail in case of ordinary buildings (i.e. not the 3D landmarks) is not required for city trippers. Nevertheless, especially Thomas experienced the lack of trees and thus parks and water as problematic since those are the things that a pedestrian experiences the most during a city visit. As a result we could say that things that are part of the **public space**, such as parks, squares and historical buildings, require a higher level of detail than things that are not that relevant for tourists, for example ordinary houses. Yet it also implicates that other target groups could have other expectations towards the required level of detail and

thus realism. Architects for instance will be interested in a detailed representation of ordinary buildings.

> *"A city trip, the most important is your public space and your buildings are not always equally public thus for example, I have already said that, for me trees should also be incorporated. (…) I do not think those buildings lack details, of those buildings I do not want to see more details than just the façade." (Thomas, Offline planner, 25 years)*

Omni-directional video: As real as it gets?

- The hyper realistic **ODV** is clearly situated on the **border** of getting a prior vague idea of the vacation destination on the one hand and keeping a city trip spontaneous on the other hand.
- Particularly planners like to have a kind of **pre-experience** of a city**,** but there always has to be the opportunity to **discover** (new things of) a city on the spot.
- **Omni-directional video** is mainly a **nice-to-have** functionality to virtually explore the neighbourhood of an accommodation.

The previous findings explain why some respondents did not see sufficient added value in the tested omni-directional video (ODV), which is in fact a **hyper realistic** visualisation method, in the context of planning a city trip. The 360° interactive video fragments are more perceived as a **nice-to-have** rather than a must-have. According to Evelien (Explorer, 23 years) the high level of details in the video are even distractive and is therefore absolutely irrelevant. In the scenario-based tasks the omni-directional video is applied to virtually explore the surroundings of a hotel and thus to see whether the hotel is located well. Yet Rob argues that the three-dimensional view of a hotel in combination with the pictures one can consult on the website of the hotel in question are sufficient to make a well-considered accommodation decision. Clearly Rob does not have a very critical attitude towards the visual information he encounters on the internet.

"When you are going to book then you will first take a look at the website of the hotel, there are pictures and all sorts of things of the rooms shown so that is sufficient I believe." (Rob, Online planner, 48 years)

However, other respondents do have some reservations towards the offered information on and pictures of tourist accommodations. In this case the omni-directional video is perceived as useful to get an idea of the neighbourhood of the accommodation. According to Annelies ODV would also be interesting to see which view one would have while eating in a certain restaurant.

"Because they can always like that time in Barcelona you had in the middle of the centre, near to this, near to that, but eventually you were in such a street really such a slum of a slum and if you could watch it like that (= ODV)." (Annelies, Online planner, 23 years)

Similarly Thomas states that ODV would be practical to see if a hotel is located in a suspicious neighbourhood, but at the same time he asks himself whether the video images are not too detailed to explore in advance.

"(…) maybe then that is a little too much detail to already walk around in advance, although it could be practical. (…) then you can immediately get an image whether it is not located in a suspicious neighbourhood." (Thomas, Offline planner, 25 years)

The previous citation shows the **reservation** people have towards the fact that one can go very far as a city tripper in planning a city trip and looking up information and images of a vacation destination. On the one hand one wants to have a vague idea of how a city will look like, but on the other hand one still wants to be overwhelmed by a city during the actual visit. This is similar to the trailer of a movie. One wants to have an idea of the subject of the movie, but when one has seen too many and too extended trailers of a movie, one is not interested anymore in seeing the entire movie as it is already obvious what the movie is all about. Clearly the hyper realistic omni-directional video is situated on that border and creates a kind of **tension field**.

> *"In principle it would give you the possibility to really see every detail of your city trip, every place you are going to visit in advance and of course you do not want that, but you do want to already have a vague image of how it will look like when you arrive." (Thomas, Offline planner, 25 years)*

In other words, some city trippers and particularly the planners like to have a kind of **pre-experience,** but the degree in which one wants to pre-experience a city trip strongly varies among the respondents. In the course of the first iteration of the empirical field research we have conducted two expert interviews with travel agents. These interviews indicated that the process of visiting a travel agency to take along brochures for careful examination at home afterwards is already part of the city trip experience. Similarly archetypal online planner Rob states that browsing the internet for tourist information already forms half of the actual vacation experience.

> *"I think with this (= online tourist information) you already have an idea. I think that is already half of going on vacation when you are occupied with that. In fact you can find almost everything here." (Rob, Online planner, 48 years)*

The reservation of the respondents towards too many details indicates that the generalised three-dimensional model would probably be sufficient to have this kind of city trip pre-experience. While Noëlla perceives the realistic omni-directional video as partly going on vacation, ODV would go to far for others to pre-experience a city trip.

> *"(…) that you can get an idea whether it is worth a visit or is my hotel located in a nice neighbourhood should that be important. That you get an idea, a visual image. Then you are already partly going on vacation when you see that." (Noëlla, Explorer, 48 years)*

Yet it is doubtful if Noëlla would really use ODV in the city trip planning process since she is an explorer who is very impulsive with regard to planning and going on vacation and generally plans as little as possible.

Points of Interest: Everyone's interest?

- The offer of POIs needs to be extended by means of more **personalisation** and **categorisation** in order to link in with the personal needs and interests of a particular city tripper.
- In the context of the expansion of POIs one should assure that the 3D city model stays **synoptic**, for instance through a layered information structure.

The URBAN prototype enables users to enter queries (addresses, curiosities, restaurants, etc.), but also offers a couple of predefined categories that are relevant for tourists, more specifically hotels, restaurants and shops. These Points of Interest (POIs) are pre-selected by Tele Atlas.[8] The following topic sounds to the perceptions of the respondents concerning the offered POIs.

During the user tests several respondents made remarks concerning the limited offer of restaurants, hotels and shops. They sometimes even asked the interviewer on what basis the facilities were selected: "*That is only a few. Are those the ones that are indicated or that participate?*" (Els, Offline planner, 48 years). Clearly users expect transparent and objective parameters on what basis the selection is done. We were able to identify two elements that have to be taken into account with regard to the expansion of the offer of these POIs, namely **personalisation**/**categorisation** and **synopsis**.

With regard to **personalisation** and **categorisation** the respondents argue that each POI should have different categories that fit the personal needs and interests of a particular city tripper. For instance in relation to restaurants and hotels a tourist wants to know within which price category a certain restaurant or hotel is situated so he knows whether or not they fall within his budget. This basic information, e.g. the amount of stars of a restaurant or hotel, can save a tourist time and effort and thus needs to be noticeable at first glace.

> *"When you are sent to the website then in principle you get there all the information, but maybe it would be practical to immediately receive the opening hours and a sort of price category with it, then you do not have to go to that website, then you save that in effort." (Thomas, Offline planner, 25 years)*

[8] There is no concrete information available with regard to the applied selection criteria.

It is obvious that there is not one kind of city tripper. Future urban city applications should take the profile of the user into account. However, this does not imply that a user should complete a long questionnaire concerning his preferences and interests in advance. Nevertheless a city tripper should be provided with some freedom to indicate his interests.

> *"Yes maybe that you can make several subdivisions like I am a tourist and I want to see everything that relates to churches, I am a tourist and I mainly want to know the history facts or I am a youngster and I want to know where the entertainment district and the trendy things are located." (Annelies, Online planner, 23 years)*

With regard to **synopsis** we notice a certain anxiety about a possible information overload and thus chaos when the respondents talk about the expansion of the POIs and the offered information on the tourist facilities. For instance Noëlla argues that hotels and restaurants should be categorised so that the information that is shown in the 3D city model stays synoptic. "*Just so that it does not turn into a cacophony of things because I think you will already have a hundred (= restaurants) within this radius*." (Noëlla, Explorer, 48 years). In order to enable users to maintain an overview, the provided information about the POIs should be **layered**, thus one needs to be able to dig deeper when one is interested. In other words, the offer of POIs and the information provided about them should be extended, yet at the same time the user needs to be able to decide to what extent he wants to be informed.

> *"Indeed you go as far as you want. It may not be good when you click on it that you also immediately receive the menu card and all the information and the reviews, that would be too much or too chaotic, but if you can select it, and you go as far as you want as consumer, then it would be practical to also receive the menu card or the kitchen." (Evelien, Explorer, 23 years)*

Willingness-to-pay

- People are more willing to pay far a **mobile 3D city model** rather than for a static application as the latter cannot approach the requirements of a traditional guidebook.

- The price people are willing to pay for a (mobile) 3D city model is limited by the price of a paper travel guide on the one hand an by the existing (free) **alternatives**, i.e. tourist brochures, online tourist information, city map, etc., on the other hand.
- In order for a 3D city model to be able to offer a genuine added value from a user perspective, it has to create a **unique city trip experience** that is tailored to the interests of the city tripper in question.

The final question, whether people are willing to pay for a 3D city model and if yes to which conditions the model should comply with, is inextricably linked to the previous findings.

We have already elaborated on the fact that the respondents are more willing to pay for a mobile version of the tested 3D city model rather than for a static application. A non-mobile 3D city model would allow users to virtually explore their vacation destination in advance, but it does not allow any support on the spot, something that all city trippers, planners as well as explorers, ask for. Weighing the requirements of a static virtual city model against the requirements of a practical paper travel guide, the respondents prefer the traditional guidebook. Consequently the price of a travel guide, being between ten and twenty euros, forms the maximum price for a static 3D city model as the former provides guidance in advance as well as on the spot.

> *"It may not cost more than a guide, than a paper guide. And you still have a paper guide afterwards while this yes you can go take a look at it in advance." (Rob, Online planner, 48 years)*

> *"If I could use it in the city then I would be willing to give, I do not know, twenty euros or something like that. (…)* ***Twenty euros*** *or something like that I think, like you would actually give to a Trotter." (Evelien, Explorer, 23 years)*

The fact that the 3D city model is primarily perceived as a practical navigation and localization tool has important repercussions for the willingness-to-pay. The city map that one can find at tourist offices and hotels, the detailed street plans of each district that are incorporated in guidebooks and the online map services all form a (free) alternative for the navigation functionality of the URBAN prototype. In addition the

following citation also illustrates that the necessary extension of the provided information about the POIs is also often repeated in the context of the willingness-to-pay.

> *"I would not pay a lot for it because you do have alternatives. You may have a Trotter, you can search by means of the internet. It (= 3D city model) is very practical, it is user-friendly and it is handy, but I would weigh out costs and profits. (…) I might be willing to pay a small price and then it would be practical if it becomes more extended, that you can see hotels and restaurants more extended." (Evelien, Explorer, 23 years)*

Next to the navigation functionality of the virtual city model of Brussels, the tourist brochures that one can receive at tourist offices and at the hotel counters on the one hand and the online tourist information on the other hand also serve as a free alternative for the 3D landmarks of the URBAN prototype that indicate the most important sights of a particular city. Similarly the existence of these free alternatives is reflected in the limited willingness-to-pay.

> *"I think people will quickly do not do something if they have to pay for it, no matter how small the price is. Just the fact that you have to pay then they think like oh but then we will go to the tourist information office where we can get the brochures for free and we will search a little bit longer and for that one euro or those **two euros** we can drink a wine." (Noëlla, Explorer, 48 years)*

Controversially several respondents admit that they prefer the functionalities of the URBAN prototype and its comprehensiveness, yet if they have to pay for a similar 3D city model they tend to stick to the less comprehensive free alternatives. For instance according to Thomas Google Earth can serve as a free alternative for the virtual city model.

> *"(…) once someone starts to do it for free then it is very difficult to start asking money for it according to me. So when there are free alternatives. The alternatives may not be as comprehensive as this, but I think they are sufficient to manage when you plan a city trip." (Thomas, Offline planner, 25 years)*

Finally the willingness-to-pay is also linked to the topic of personalisation. A city visitor likes to deviate from the typical tourist paves and searches for a unique city trip experience that is tailored to his own interests. Consequently a 3D city model can create added value from a tourist perspective when it goes further than the mainstream tourist information and takes the specific interests and needs of the user into account. Yet whether this means that one will actually be willing to pay for it and if yes, what amount one is willing to pay, is still unclear and needs to be further investigated.

> *"If you can establish your own profile a bit then that is interesting, if it is not too expensive because I would not spend for example fifty euros when you can buy* ***a book for ten euros****. And indeed if you can establish your profile, if that possibility exists like I want that kind of restaurants and that kind of shops (…), not just purely the touristic like the Palace of Justice and the Hallepoort and the Royal Palace." (Annelies, Online planner, 23 years)*

3.4 Real estate user tests

3.4.1 Selection and description of the respondents

Similarly to the respondents who tested the 3D city model from the perspective of tourists, the real estate respondents were recruited via purposeful sampling, more specifically through the snowball method, which led to a good variation among the users.

The basic criteria to which each respondent had to respond:

- The respondent must have a recent (in the course of the last year) experience with the search for a property so that he/she is familiar with the everyday life practice of looking for a home.
- The respondent needs to be familiar with conducting online searches and basic computer tasks as the flow of the user tests should not be disturbed by the lack of computer skills, which would prevent the respondent of having an immersive experience.
- The respondent should already have used a real estate website such as the popular Belgian website Immoweb in order to enable the respondent to imagine him-/herself using an (internet) application in the process of searching for a property.

- Further we differentiated the respondents based on two extra criteria, more specifically **age** and their **relation to the city Brussels**. The subdivision into two age categories aimed at creating more variation among the respondents in comparison to the dominantly young and high computer-skilled respondents that were investigated in the first iteration of the empirical field research. In the context of the respondents' relation to Brussels, we distinguished between non-inhabitants of Brussels, new-inhabitants who already live five to ten years in Brussels and inhabitants who are living for at least ten years in the Belgian capital. This last selection criterion is guided by former research that indicates the greater need for online real estate information of people with less prior familiarity with the destination area. Newcomers to a particular area make use of the internet to familiarise themselves with their new destination. (Palm & Danis, 2002). Zumpano et. al. (2003) similarly argue that out-of-town buyers have higher information costs and thus are more likely to depend upon the internet in the search process than local home buyers. As a result we started from the hypothesis that the possible added value of a virtual city model with real estate services can depend on the user's prior knowledge of that city in question. By involving inhabitants of Brussels we were able to address this hypothesis since the URBAN proxy is based on Brussels.

The selection criteria have led to the matrix of respondents presented below:

	< 40 years	40 to 60 years
Non-inhabitant of Brussels	*Wouter*	*Ludo, Lucia*[9]
New inhabitant of Brussels	*Michèle*	
Inhabitant of Brussels	*Pauline*	*Ronald*

[9] After conducting five user tests, three with inhabitants of Brussels and two with non-inhabitants, it became clear that it would be more interesting to recruit an additional non-inhabitant as final respondent instead of a new-inhabitant in the age group 40-60 years. We noticed that one of the two interviewed non-inhabitants, Ludo, still knew Brussels quite well and hence evaluated the realism of the virtual model in a similar way as the inhabitants, in contrast to the other non-inhabitant, Wouter, who does not know Brussels. Consequently, in line with the notion of theoretical sampling (Strauss & Corbin, 1990), we adjusted the sampling by choosing for an additional non-inhabitant, Lucia, as final respondent for the user tests.

3.4.2 Findings of the user tests

The possible innovative opportunities of the 3D city modelling technology for real estate purchasers are linked to the everyday life practice of searching for a property, which has been investigated during the first iteration of the empirical field research and is described in D4.3.1. Though during the previous and hence second iteration of the user research we again probed the practices of the recruited real estate purchasers in order to be able to frame the respondents and their relevant real estate experience(s) on the one hand and to possibly validate the D4.3.1 findings on the other hand. The question whether real estate purchasers still have some unfulfilled needs and expectations to which a virtual city model can possibly respond to, will be addressed by the first topic.

Secondly we will address the hypothesis that the 3D city model can only create an immersive experience if the model is actually perceived as 'real'. Hence we will elaborate on the respondents' perceptions concerning the realism of the three-dimensional representation and of the omni-directional video.

Then we will discuss the importance of the concepts 'utility' and 'synopsis' in the context of providing real estate purchasers with relevant points of interest.

Finally the possible opportunities of a 3D city model to create added value from a real estate purchaser's perspective is reflected in the part on the willingness-to-pay of the respondents.

The practice of searching for a home: Online real estate information

- Real estate purchasers like to **self-select** potential properties that could be worth a visit in the comfort of the own home setting by means of real estate websites and hence avoid the intermediation of a broker.
- Online property **pictures** are of great importance in this self-selecting process of possibly interesting properties.
- Current **real estate websites** have some **shortcomings** that can hinder an efficient online self-selection of properties and that are situated on the level of the offered information on the neighbourhood, the interior and the street of the property and on the level of the search functionalities.

Task 4.3.1 has already elaborated on the way people combine several search methods (i.e. the internet, word-of-mouth advertising, exploring neighbourhoods, brokers, etc.) to find the perfect property and the dominant position of online real estate websites, particularly Immoweb, in this method mix. The popular real estate website Immoweb again played an important role in the search for a home among both the young and older respondents of the users tests. It has to be added however that basic computer skills together with an earlier experience with a real estate website were two selection criteria based on which the respondents were recruited. Nevertheless it is an interesting finding that all respondents, thus from both iterations, express the willingness to select potentially interesting properties by themselves, which often means avoiding the intermediation of brokers, and hence a clear need for **control**. The investigation of the practice of real estate purchase clearly highlights that real estate websites that provide people with descriptions and pictures of available properties form the **selection tool** pre-eminently.

> *"For me online is purely the selection of several potential houses purely on location, pictures, description and then mostly when I have three or something like that I place them next to each other and I will go do a tour, then I go walk around." (Wouter, Non-inhabitant, 27 years)*

Online property **pictures** are of great importance in this self-selecting process of possibly interesting premises. During the user tests the respondents had the opportunity to conduct an online search on Immoweb and think aloud about what they saw and did. By doing so, it became clear that properties with no or unattractive pictures are immediately excluded from the search. Visiting properties that do not offer online pictures is even perceived as a waste of time and effort. Consequently **photorealistic** data of properties are a vital component in the search for a new home.

> *"Here are no pictures and most of the time when I do not see no pictures then I immediately click away. That may be a wrong reflex. (…) I think it is a waste of effort because then you arrive somewhere, I appears to be absolutely nothing and then you are standing there." (Pauline, Inhabitant, 30 years)*

Online real estate websites seem to be highly appreciated since they allow you to pre-select potential properties from the **comfort of the own home setting**. You no longer need to go out to find houses that are for sale or to let and you do not have to engage owners and brokers. Obviously people are more reserved towards entering a real estate office than towards consulting a real estate website as the latter entails less **engagement**.

> *"Well you know it is easy because you can do it from home, you do not have to move, you can spend a quarter on it or an hour while when you go to a professional it is not like I am coming to take a look. While here you can take your time and say no it does not interest me, but when you enter an office then it is not the same anymore, you are not just going to waste those people's time." (Lucia, Non-inhabitant, 44 years)*

In spite of their popularity, the online search assignment on Immoweb and the following interview has indicated **four** important **shortcomings** of traditional real estate websites with regard to the offered information on neighbourhoods, the search functionalities and the offered information on the interior and on the street of properties.

First of all the case study of the most popular Belgian real estate website Immoweb, which we conducted in the context of Task 4.3.1, indicated that the real estate website does not offer any **information on the neighbourhood** of a property and only indicates the location of a property on a general, abstract map. Yet both iterations of the user research highlight the importance for real estate purchasers to know what a certain neighbourhood has to offer in terms of facilities, traffic, surrounding buildings, etc. The interest in a particular property stands or falls with its location, or in the words of a respondent: "*They say with real estate three things are very important and those are location, location, location*." (Wouter, Non-inhabitant, 27 years).

> *"(…) what I would find interesting and what you cannot have with this kind of tool is for example that you could indicate where are the nearest stops of public transport? Where is a doctor? Is there a school?" (Lucia, Non-inhabitant, 44 years)*

It is important to emphasize however that the fact that all the respondents entered a limited number of postcodes during the search assignment on Immoweb shows that

real estate purchasers usually already know in which neighbourhoods they want to live and why they want to live there. The real estate experts we have interviewed during Task 4.3.1 also confirmed that people who are looking for a home have already decided where they want to go live and know what the neighbourhood(s) has to offer. So usually people do not ask realtors a lot of questions with regard to the neighbourhood of a property because they have already explored it. Consequently the shortcoming of real estate websites, namely the lack of information on the neighbourhood of a property, is not perceived as a shortcoming when people are familiar with the neighbourhood. Though at the same time the respondents add that the provided neighbourhood information on Immoweb would not be sufficient in case they were un- or less familiar with the neighbourhood.

> *"I search in a neighbourhood of which I know where it is, how it looks like, which facilities there are. Yet from the moment it is a new neighbourhood, it may be a little limited." (Ronald, Inhabitant, 41 years)*

Similarly for Ludo it is sufficient that the description of a property on Immoweb in a neighbourhood he knows well mentions '*near the market*' since it immediately allows him to associate the property with all the surrounding facilities.

> *"I do not know the property, I do not know the house, I do not see it in front of me, but I know where the market is and automatically I then associate other things, a bakery, a shop, a bus stop, this or that and I associate it with the house." (Ludo, Non-inhabitant, 43 years)*

A **second** shortcoming, which is linked to the previous one and is highlighted by Wouter, is the inability of a real estate website such as Immoweb to limit the **search** to a particular number of **streets**. Wouter is looking for an apartment that is located in one of the five streets around the train station of Gent and Immoweb only allows him to search for all available properties in Gent. This again indicates that most real estate purchasers have made their minds up about the neighbourhood where they want to find a property and exactly know why they want to live there, in case of Wouter to have a good train connection to his work.

"I notice that it is lacking on sites such as Immoweb. The location is always or almost always mentioned, but you can actually never immediately select on a couple of streets." (Wouter, Non-inhabitant, 27 years)

Thirdly traditional real estate websites do not offer sufficient information on specific features of the **interior** of the properties. It is already obvious that the respondents are only interested in real estate advertisements that entail a sufficient number of pictures as the latter serve as an important selection tool. Yet the offered property pictures are often not enough to estimate whether the interior responds to the personal needs and expectations of potential buyers. As a result an additional phone call to the owner or responsible broker is frequently required to receive necessary additional information to be able to assess the potential of a certain house.

"I do not receive enough information. I want to know if there is a bath in the bathroom, I want to know if there is parquet flooring, I want to know if there are high ceilings because I have a list with things that need to be present." (Pauline, Inhabitant, 30 years)

Finally Pauline states that as an inhabitant of Brussels the general map that locates a property that is provided by Immoweb is sufficient to know where a house is approximately situated in Brussels. Though what she does perceive as a shortcoming is the fact that real estate advertisements cannot offer you a **view of the street** of the property. "*What I would like to have when I click on location is to have more a view of the street*." (Pauline, Inhabitant, 30 years)

These insights on current domesticated practices of real estate purchasers, which build further on and validate the insights on the practices of the typical city tripper and real estate purchaser of Task 4.3.1, are inextricably linked to the innovative opportunities of a three-dimensional digital city model. Can a 3D visualisation application create added value for real estate purchasers and if yes, in which manner? The user tests with a proxy of the 3D city modelling technology conducted by respondents with a recent real estate experience enabled us to gain an insight in this question.

Virtual reality: How real?

- A generalised 3D representation of a city can have **added value** for real estate purchasers who are **unfamiliar** with that particular city in the sense that it provides them with a spatial insight in the city and with an overview of the available facilities.
- A generalised 3D representation of a city does **not** have **added value** for real estate purchasers who are **familiar** with that particular city since they already have a general view of their own town. For these users only an up-to-date **photorealistic** virtual city model with relevant real estate services can be able to create added value.

As we have already discussed in the context of the previous findings of the city trip respondents, we start from the hypothesis that the **immersive** experience of the real estate respondents with regard to the three-dimensional visualisation of Brussels depends on their perception of the **realism** of the 3D model. The city trip respondents, all being non-inhabitants of Brussels and hence unfamiliar with the Belgian capital, perceived the virtual model of Brussels as quite realistic and the degree of detail as sufficient. A hyper-realistic or photorealistic visualisation of a city trip destination would even be a letdown for city trippers, archetypical planners as well as explorers, as it would prevent them to discover new things on the spot. Yet when it comes to the required level of detail for real estate purchasers, it is important to make a **distinction** between **inhabitants** on the one hand and **non-inhabitants** of Brussel on the other hand.

According to the non-inhabitants of Brussels, with Ludo as an exception since he lives in the periphery of Brussels and hence knows the Belgian capital quite well, the URBAN proxy represents Brussels and its buildings quite realistically. Both Wouter and Lucia work in Brussels, but admit to be not that familiar with the Belgian capital. Nevertheless both respondents state that based on their vague mental image of Brussels, the virtual city appears to be realistic and well recognisable.

> *"What surprises me the most is that all buildings are represented realistically." (…) "I really do think that it approximates reality." (Wouter, Non-inhabitant, 27 years)*

"I really think it resembles reality." (…) "It maybe was simplified, but it was still clearly recognizable." (Lucia, Non-inhabitant, 44 years)

Interestingly Wouter even argues that the generalised 3D model shows **more than reality** and allows you to **discover** things that are invisible on traditional city maps as well as on the spot. First the three-dimensional aspect enables you to gain an insight in the **building structures**, e.g. whether a particular property is surrounded by high or low buildings. Secondly the possibility to freely navigate through the virtual city model from different perspectives (i.e. street level, helicopter level and top level) makes **'hidden' spaces** that are surrounded by walls such as squares, parks or playgrounds, which can make one property more attractive than another, visible.

"Here (= helicopter view) it is of course really good that you see the building structures. That is what top view does not have, you do see it in helicopter view and then you immediately see a lot more than if you are just going to take a look on the spot. (…) For example if you would go and take a look on the spot and you are standing in the street then you would not see for example that here is a closed square that actually is not visible from the street. (…) It gives you a much better overview of the city of course." (Wouter, Non-inhabitant, 27 years)

The investigation of the real estate purchase practices described above highlighted the dominant role of real estate website in the self-selecting process of properties from the comfortable home setting. Yet the limited information that is offered by traditional real estate websites with regard to the neighbourhood is perceived as a shortcoming by people who are looking for a home in a neighbourhood that they do not know by heart. Obviously a three-dimensional visualisation can have added value for real estate purchasers who are unfamiliar with the visualised city. Similarly to city trippers who have not yet visited the city, a 3D city model provides them with a spatial insight in the city and gives them an overview of the available facilities. The added value is particularly situated in the fact that the extra neighbourhood information non-inhabitants receive from a 3D city model enables them to even make **a better selection** of potentially interesting properties.

"If this would not exist yet and it does not exist yet and I look at the number of search results, then such a virtual thing might be able to exclude one or two extra." (Wouter, Non-inhabitant, 27 years)

In spite of the non-inhabitants' overall positive perceptions, all the inhabitants among the respondents, the new inhabitants as well as the long-time inhabitants, argue that their hometown is not represented realistically and describe the 3D model of Brussels as "*one big grey block*"[10], "*sketchy*"[11], "*too much looking like a drawing*"[12], etc. In addition several respondents compared the 3D city navigation to navigating in a (computer) game, a domain in which virtual reality technology is frequently applied.

"(…) but in such a model you do not get a realistic view so it is just like you are walking around in a computer game." (Ronald, Inhabitant, 41 years)

"At street level I gives me the impression of the first GPS versions like on Playstation games." (Ludo, Non-inhabitant, 43 years)

The things that make the virtual model of Brussels look unreal for the respondents and thus also define a particular neighbourhood are the fact that **typical urban objects** such as trees/parks, people, cars and traffic signs are not incorporated, the little **diversity** in the style of the ordinary houses (hence excluding the detailed 3D landmarks), the **unrealistic colour** usage and the **sketchiness** of the model. There is no difference between new inhabitants and long-time inhabitants with regard to the negative perceptions concerning the (un)realism of the 3D model of Brussels.

"They do not look like the buildings that are in the Dansaert street. You get the feeling that it is all new building while Dansaert is absolutely no new building, it are all very old buildings. (…) Because there are no buildings with such dark bricks and it is all so very straight and linear. (…) It gives a little a misrepresented view of how the neighbourhood actually looks like." (Pauline, Inhabitant, 30 years)

[10] Pauline, Inhabitant, 30 years.

[11] Ludo, Non-inhabitant, 43 years.

[12] Michèle, New inhabitant, 26 years.

"Okay a house is a house, but they are all the same I think." (Michèle, New inhabitant, 26 years)

As the findings on the domesticated practices of real estate purchasers have already indicated, pictures are of great importance in the self-selecting process of possibly interesting properties as they generally serve as the first selection criterion. The domestication of property pictures in the search for a home can explain why the respondents also expect **photorealism** of a virtual city model. While tourists prefer to leave some room for **surprise** during their planning process, people who are looking for a house do not want to be negatively surprised once they are on the spot to visit a property as the visit would then be a waste of time. Furthermore a general three-dimensional visualisation of a city that people are already familiar with does not create any added value since they already have a general view of and spatial insight in their hometown. A virtual city model of their hometown can only have added value when it offers a photorealistic representation of every street because most inhabitants do not know each street of the city they live in.

"For me when I am searching for an apartment or a building, whether is to rent or to buy, it is important that when there is such an application that what is shown to me also looks like it is in reality. The shops are less important to me. (…) More photorealistic yes, when you offer it, or else it makes no sense I think." (Pauline, Inhabitant, 30 years)

*"I assume that they are still working on it, but if it is really going to be almost a picture of how it looks like in reality then I find it really interesting. (…) if you do something like that I think it really has to be **truthful**." (Michèle, New inhabitant, 26 years)*

Obviously when showing the two screenshots of Google Street View, which also served as probes during the interviews with the city trip respondents, the real estate respondents indicated Google's photorealistic quality as the required level of detail in order to be useful in the search process of properties. While the non-inhabitants, Wouter and Lucia in particular, did see added value in the three-dimensional aspect of the city model among others with regard to the spatial insight in a city, the Google

Street View probes indicated that they would also prefer a more (photo)realistic model if they were provided with the choice.

> *"My preference would go to as truthful as possible." (Lucia, Non-inhabitant, 44 years)*

> *"Here (= Google street view) you see at least what kind of footpath it is and that is something you do not see in this model for example, how broad the footpath is. (Wouter, Non-inhabitant, 27 years)*

Therefore a **combination** of the functionalities of the tested 3D city model of Brussels, including the POIs, the possibility to receive route descriptions, the ability to freely navigate through the model, etc., with Google's Street View quality on the street level of the virtual model is perceived as the ideal real estate application to explore the neighbourhood of potentially interesting properties.

> *"Yes here on Google Street View I do not have any indications of shops and so, well then I would go for the other one (= general 3D city model), but only if it can be equally detailed as the images I receive on Google." (Pauline, Inhabitant, 30 years)*

Interestingly, while arguing for a virtual city model with the hyper realistic quality of Google Street View, some respondents made the reflection that this would more or less come down to the existing application **Google Earth**. Hence a future more realistic virtual city model can only create added value for people who are looking for a property if it offers additional services[13] that are relevant from the real estate purchasers' perspective rather than solely offering a virtual representation of a neighbourhood. In case of the latter, Google Earth is a free alternative that is already more or less domesticated among certain groups op the population.

> *"(…) but if you make it very realistic you end up with a kind of Google Earth where you can actually do the same, also advance and also such an helicopter view and top*

[13] As we will see later, useful additional services can for instance be providing real estate purchasers with omni-directional video (ODV) outdoor (especially in case the location of a property is quite distant), ODV indoor or with utility POIs.

view can actually stay the same because then it automatically switches to Google Maps." (Ronald, Inhabitant, 41 years)

"Now I do not know but Google Earth do they not already have something similar so you can go and take a look in the streets?" (Michèle, New inhabitant, 26 years)

An additional interesting reflection that is made in the context of a hyper realistic city model, is the assumption that a more realistic model will be more difficult to keep **up-to-date** in comparison to a more generalised and hence simplified city model. Obviously, the degree in which the model is up-to-date will be an issue that future users will reflect on when they would consider using a virtual city model in their search for a new home. Linked to this reflection, one assumes that a hyper realistic city model may also be more expensive. We will elaborate on the willingness-to-pay of the respondents later.

"I fear a little that in that case (= Google Street View quality) it will really be much more expensive because it really is reality. According to me with that you will have to need a new version more often than when you use such a simplified model like that (= URBAN proxy) where you can recognise it in, but not as detailed as that (= Google Street View)." (Lucia, Non-inhabitant, 44 years)

Omni-directional video: As real as it gets?

- In comparison to online property pictures, ODV is perceived as more '**real**' and '**authentic**'.
- ODV enables users to see more features (i.e. traffic, parking space, trees, etc.) of the neighbourhood of a property, which is particularly interesting for properties that are **distant from the current place of residence**.
- Referring to the need to receive a better view of the interior of a property, the respondents suggest the added value that **ODV indoor** can have for them.

It is already clear that real estate purchasers expect more realism and thus a higher degree of details from a virtual city model in order to be really useful to virtually

explore neighbourhoods in comparison to many city trippers for whom a too detailed model would be a letdown. Therefore we can assume that the hyper realistic omni-directional video will link in more with the needs and expectations of people who are looking for a new home rather than with tourists. This part will elaborate on the real estate respondents' perceptions in relation to ODV.

Both iterations of the investigation of the real estate purchase practice have indicated the considerable extent to which people rely on the online pictures of properties in their selection of possibly interesting premises that are worth a visit. Yet at the same time they emphasize the fact that they realise that these pictures can be **misleading** and sometimes do not represent the (entire) reality. The same reflection is made in the context of omni-directional video. While the respondents show some reservation towards pictures, ODV is perceived as 'the reality'.

> *"The more real, the better so that you do not get surprised because this (=ODV) shows more than pictures. Pictures can be adapted by Photoshop and whatever, but this (=ODV) is the real situation." (Ludo, Non-inhabitant, 43 years)*

Video is obviously much more associated with **authenticity** and **reality** than pictures. The interactive aspect of ODV, namely the ability to look in all directions in the video fragment, provides the user with a sense of **freedom** and makes him feel more in **control**.

> *It immediately gives me a sense of freedom. I am always suspicious like on the internet on the real estate sites they only put the pictures that can be there. They are not going to take pictures of a whole in the floor or something like that which they try to hide and with that (= ODV) I am like the more freedom you have, the better actually." (Wouter, Non-inhabitant, 27 years)*

The investigation of the real estate purchase practices already indicated that traditional real estate websites do not offer sufficient information on the neighbourhood of a property in terms of available facilities, surrounding buildings, traffic, etc. for people who are not that familiar with a certain neighbourhood. In addition Pauline mentioned that she would like to have a view of the street during the selection of premises that could be worth a visit. ODV seems to be able to **respond to** these **shortcomings** of traditional real estate websites. The interactive video is

very appreciated by the respondents as it enables them to see how **green** a particular neighbourhood is, to assess its **tranquillity** and the **parking** possibilities that are especially important in busy city environments and to get an idea of the **atmosphere**.

> *"Also for the **atmosphere**. You see okay it is a shopping street, there are **cars**, one can park on both sides, there are a lot of people wandering around. Those are all things you cannot get to know from a distance." (Lucia, Non-inhabitant, 44 years)*

> *"This is nice to see ah it is that street or are there **trees**, is there a lot of **traffic**, little traffic depending on what is filmed, is it a **busy** street, is it a broad street, a narrow street and that is something you cannot always judge." (Ronald, Inhabitant, 41 years)*

Furthermore ODV seems to have more added value for properties that are distant from the current place of residence since one will always prefer to visit a property on the spot to a virtual visit. In case one is looking for a house in his/her own town, the **threshold** to go and take a look on the spot is quite low. Yet when one is interested in buying or renting a property in a more distant neighbourhood, continuously going on location to take a first look at the outside and the street of a property is perceived as a lot of effort and time. In case of the latter, ODV would make the real estate search process more (**time**) **efficient**.

> *"Should it be in Hoeilaart (= current place of residence) then I would be tended to do it myself on foot or by car so in that case I would be in less need of it (…) should we fall on a property in Leuven for example then I again do see the usefulness of it. It is always a **gain of time**, even if you only have to drive thirty kilometres. When you are stuck in traffic in the evening then it takes so much time while now (=ODV) you can immediately get **a perfect view online**." (Lucia, Non-inhabitant, 44 years)*

We have already seen that due to the domestication of picture in the search process for a new home, real estate purchasers, especially people who already have a general view of the neighbourhood they want to live in, expect a photorealistic quality of a virtual city model that offers real estate services. Consequently ODV is evaluated positively by the respondents for its '**realness**'. Nevertheless Michèle argues that ODV would actually be **superfluous** when the virtual city model is more

(photo)realistic. In other words, according to people who are more or less familiar with a neighbourhood or city, a three-dimensional city model cannot represent the 'reality' and video is the only means to get an idea of how a particular street really looks like within the URBAN set-up.

> *"It is relevant when it indeed stays 3D as it is now. When it becomes more truthful, so when it is more photorealistic or whatever, it seems superfluous to me. So only to give a real view of how it really looks like on the spot because now via that three-dimensional representation you do not have a very clear view of it really looks like the façade of the house and such." (Michèle, New-inhabitant, 26 years)*

During the first iteration of the empirical field research one respondent, Goedele, mentioned that she would find it useful and interesting if someone would walk through a property with a video camera to film all the rooms and would upload the video on a real estate website in order to get a better view of the interior of a property. Similarly the respondents of the user tests spontaneously mentioned the added value an ODV **virtual tour inside** a property would have for them.

> *"What I am mainly interested in when I am looking for something is to take a look inside without having to move. I think that is mainly interesting because I know Brussels very well so I usually know how it looks from the outside. (…) I am like I would rather see from my home how something looks like from the inside." (Pauline, Inhabitant, 30 years)*

Obviously the previous and following citation illustrate that ODV inside a property would have added value for real estate purchasers in the sense that it would allow them to make a **better pre-selection** of potential premises, thus also taking the interior of a property in consideration. Both iterations of the user research indicated that the limited information on specific features of the interior of properties offered by real estate websites is perceived as a shortcoming. Hence ODV inside is **first** of all perceived as a more reliable tool in comparison to pictures to get a better view of (the structure of) the interior of a property. **Secondly** ODV inside is also appreciated as it would make a **private space** that normally is inaccessible without an official authorisation or appointment, **effortlessly accessible** from the comfort of the own home setting. Scheduling an appointment with the responsible owner or real estate

agent to receive an inside guided tour through the property is clearly considered as a **barrier** by the respondents. ODV inside is able to overcome that barrier and involves less **engagement** than contacting a broker, the latter is also a well-appreciated feature of online real estate search.

> *"(…) I think with a preliminary search if you could then have a 3D view of the inside then you can select really good. (…) I think if you receive a full guided tour of all rooms thus a kind of virtual tour that it will be of course less a **burden** first of all for the broker because you will only contact the broker when you are really interested to buy, not just to plan a visit as you already have a virtual visit." (Wouter, Non-inhabitant, 27 years)*

Even though the respondents are far less suspicious towards video than towards pictures, they still have some reservations and critical reflections towards ODV. A **first** critical reflection deals with the **moment** the video is recorded and its **update** frequency. Obviously future users will expect some information on the day and time the video is recorded, for instance to be able to assess the traffic and the truthfulness of the images. In the context of the required level of detail of a virtual city model, Lucia similarly argued that a photorealistic city model that is in line with Google Street View is much more difficult to keep up-to-date in comparison to a more generalised model. We also identified this same need for **transparency**, among the city trip as well as the real estate respondents, in the context of the selection of the POIs.

> *"That is so **subjective**, imagine it is filmed on a sunny day and when it rains the street looks totally different. And then I also ask myself the question that is recorded once, how frequently are those videos **updated**? Is it once a month, a year, every five years, every ten years? So it changes so rapidly that it is not per se interesting to receive video I think. It is a **snap-shot**." (Pauline, Inhabitant, 30 years)*

Secondly, in the context of their argumentation to have ODV inside a property, several respondents wander if that would actually be legally possible with regard to **privacy** issues.

"I would pay for it if you could see every house in Brussels from the inside, but you will never get that regulated with privacy and so it does not really seem realistic." (Michèle, New-inhabitant, 26 years)

"I do not know to what extent the law on privacy applies to that thing?" (Ludo, Non-inhabitant, 43 years)

Points of Interest: Everyone's interest?

- POIs that are implemented in a 3D city model can only have added value for real estate purchasers when they are selected based on their **usefulness** for future inhabitants.
- POIs and the offered information need to stay **synoptic**, for instance by offering an optional listing with the ability to select one or more nearby facilities.

The investigation of the domesticated real estate practices showed that most Belgian real estate websites do not offer any information on the neighbourhood of a property in terms of the available facilities, the average traffic, etc. Points of Interest, being predefined categories of relevant facilities, can serve as a possible respond to this shortcoming. Yet the POIs that are incorporated in the URBAN proxy, namely shops, restaurants, hotels and the 3D landmarks, are mainly aimed at tourists. Nevertheless we were able to identify two elements that need to be taken into account in order for POIs to be able to create added value for real estate purchasers, more specifically **utility** and **synopsis**.

In relation to the **utility** of the POIs, we notice a critical attitude among the respondents towards a possible commercially driven selection of the POIs. Obviously real estate purchasers have entirely different expectations towards the offered neighbourhood information in comparison to tourists who only plan to spend a short period in the city. A person who is looking for a house wants to know what a neighbourhood has to offer in terms of useful facilities that make a particular neighbourhood more interesting than another. Both iterations of the user research highlighted the importance real estate purchasers attach to having utility facilities in the close surroundings of a certain property, such as public transport stops, supermarkets, pharmacies, banks, sport facilities, schools and playgrounds in case

one has children, etc. Therefore the POIs that a 3D city model presents to real estate purchasers should be selected based on their usefulness for future inhabitants and not on a commercial basis. In addition it is clear that the POIs that are offered to tourists should be different than the ones that are offered to real estate purchasers. POIs are very **fluid** and thus can only be fixed on the basis of interaction with future users. POIs will only create added value when they respond to the needs and expectations of the specific target groups.

> *"Brussels has plenty of shops, that can be nice shops, less nice shops. If it is done on a **commercial basis** then you get all the shops or those that are registered and then it is the question whether it are nice shops. That is way I think it is more practical to have a kind of general thing of useful shops, a pharmacy in the neighbourhood, hospitals, a supermarket. (…) Hence not the nice places because nice places that is subjective, **useful facilities**." (Ronald, Inhabitant, 41 years)*

It is important to emphasize however that the presence of useful facilities is not necessarily a decisive factor in the purchase of a home, but it can play a certain role in the final purchase decision as one realizes that the nearby utility facilities would be very practical.

> *"I do not think that I will specifically look if there is a doctor at ten meters from my door, but if you have different categories that you just, maybe partly out of curiosity, that you just click like "what things are there in my neighbourhood?", something you otherwise would not know. That can be a playground, that can be a pharmacy of which you would not think otherwise but that you think like "ah yes damn that is indeed practical"." (Ludo, Non-inhabitant, 43 years)*

With regard to **synopsis**, similar to the city trip respondents, the real estate respondents express some anxiety concerning a possible information overload and hence chaos when it comes to providing more information on the neighbourhood of properties. Both iterations of the empirical field research indicated that a lot of real estate purchasers already know the neighbourhood(s) where they are looking for a new home. For those people who are already familiar with a neighbourhood, offering more community-related information would even hinder their search as they want to get a quick overview of the available properties in their pre-selected

neighbourhood(s). This is clearly linked to the finding, which we discussed earlier, that the lack of information with regard to the neighbourhood of a property on the Belgian real estate website Immoweb, is not perceived as a shortcoming by people who are familiar with the neighbourhood. This means that the information provided by real estate websites and possible future 3D city applications with real estate services needs to stay synoptic.

> *"(…) if you get entire lists of information that you have to go through then it would even be hindering and I think for a first acquaintance and for making an appointment to visit one I think that, if you want to be quick and look regularly, it (= Immoweb) offers enough information* ***and if you know the neighbourhood****." (Ronald, Inhabitant, 41 years)*

Even though the respondents have some reservations towards too much community-related information, they argue that an optional functionality that enables you to select utility facilities that are of personal interest to you would be useful in the pre-selecting process of interesting premises.

> *"Those are things that may be practical, maybe not as standard but as a kind of pop-up when you say "now I am interested in car garages in the neighbourhood". (…) It would be practical if you could see that in a listing, especially gas stations." (Ronald, Inhabitant, 41 years)*

This suggestion of including an optional listing that one can select in case one is interested in one or more nearby facilities, actually strongly resembles the 'Community Information' feature (see picture below) of the American real estate website REALTOR.com[14] that has been discussed as case study in D4.3.1. The American website's comprehensive offer of neighbourhood information is a striking difference with the Belgian Immoweb.be. Of course in a much smaller country as Belgium, inhabitants are in less need of full descriptions and socio-demographic information of communities like Realtor.com provides. Though an optional short

[14] REALTOR.com is the official website of the US national association of realtors. The site contains information on all properties listed by members of this organisation in every part of the US.

listing of useful facilities can also have added value for Belgian real estate purchasers, especially for people who are unfamiliar with a particular neighbourhood.



Figure 15: Screenshot of 'Community Information' feature of REALTOR.com

Willingness-to-pay

- As a generalised 3D model can only have added value for real estate purchasers who are **unfamiliar** with the neighbourhood where they are looking for a property, only these people might be willing to pay for a 3D visualisation of that neighbourhood.
- There is more willingness-to-pay for **ODV inside** than for ODV outside as the former would overcome a lot of barriers that currently exist in the self-selecting process of interesting premises: contacting a broker or owner to make an appointment to visit the property.

- The existence of **free alternatives** to self-select possibly interesting properties from the comfort of the own home setting, more specifically traditional real estate websites, lowers the willingness-to-pay.

The question whether future users will actually be **willing to pay** for a similar 3D city model that offers real estate services depends on the model's ability to create **added value** from a real estate purchaser's perspective. The added value can for instance lie in its ability to make the pre-selecting process, hence selecting potential properties by means of real estate websites from the comfort of the own home setting and without the need to engage oneself to a broker, more efficient. It has become clear that in this self-selecting process, users are confronted with some shortcomings to which a virtual city application can possibly respond to:

1. The lack of information concerning the neighbourhood of the property.
2. The inability to limit the search for a property to several streets.
3. The limited information on specific features of the interior of the property.
4. The inability to get a view of the street of the property.

In relation to the **first** shortcoming, the three-dimensional representation of a city can be useful to provide people who are un- or less familiar with a neighbourhood with an insight in the structure and the available facilities of a neighbourhood. Yet for the people who already know the neighbourhood where they are looking for a property, a generalised 3D visualisation of that neighbourhood will not have any added value as they already have a general view of the appearance and the available facilities of that neighbourhood. This explains why only the non-inhabitants among the respondents, excluding Ludo who knows Brussels quite well, are willing to pay for the generalised 3D model. For Lucia the 3D model on itself, thus without the additional hyper realistic omni-directional video, would already respond to certain needs such as situating a property within an unfamiliar city, receiving information on the available facilities, etc.

> *"(…) first of all you can clearly see where the house is situated, you can ask a couple of things about the neighbourhood. By the fact that you have different levels you can see the local, but you can also exceed it and overview more generally." (Lucia, Non-inhabitant, 44 years)*

The URBAN proxy already responds to the **second** shortcoming of traditional real estate websites, the inability to limit the search for a property to several streets, by means of the '**Search Radius**' functionality. The latter allows the user to select a particular area and ask for the available properties and predefined facilities, hence the POIs, in that area.

Clearly the need for **omni-directional video inside** a property as it was expressed by the respondents can be framed in the context of the **third** shortcoming in the self-selecting process of potential properties, that is the limited information on specific features of the interior of the property and the reservations one has towards regular property pictures. Video is perceived as more authentic and real than pictures with regard to getting a good view of (the structure of) the interior of a property. The importance the respondents attach to getting an authentic view of the interior of a property makes that some respondents are only willing to pay for a virtual city model with real estate services in case ODV indoor is included. For Wouter the amount could even run up to twenty euros per month.

> *"I would pay for it if you could see every house in Brussels from the inside (...). (Michèle, New-inhabitant, 26 years)*

> *"I think if it really is a nice offer of houses where you walk around inside with ODV, I think then there could even flow amounts up to twenty euros per month." (Wouter, Non-inhabitant, 27 years)*

Obviously the previous and following citation illustrate that ODV inside a property would have added value for real estate purchasers in the sense that it would allow them to make a **better pre-selection** of potential premises, thus also taking the interior of a property in consideration. Both iterations of the user research indicated that the limited information on specific features of the interior of properties offered by real estate websites is perceived as a shortcoming. Hence ODV inside is **first** of all perceived as a more reliable tool in comparison to pictures to get a better view of (the structure of) the interior of a property. **Secondly** ODV inside is also appreciated as it would make a **private space** that normally is inaccessible without an official authorisation or appointment, **effortlessly accessible** from the comfort of the own home setting.

Omni-directional video as it was presented to the respondents during the user tests, hence as an interactive video fragment of the streets that surround a particular property, can perfectly respond to the **fourth** and final shortcoming of real estate websites like Immoweb, namely the inability to get a view of the street of the property. Yet ODV outdoor will only have added value for people who are looking for a new house in a neighbourhood that is quite distant from the current place of residence. In case one is looking for a property in one's own town, one will always prefer to visit the property on the spot since the threshold to go and take a look is quite low. You can go and take a look at the outside of a property at any time of the day and without needing to engage with a broker or the owner. Therefore the respondents that are or were looking for a property in the town where they are currently living, cannot imagine they would personally pay for ODV outdoor since they do not see any added value of it in their personal real estate search practices.

> *"Walking around in the street I would rather do myself. For me the added value there is more missing than examining a house inside because for that you have to make an appointment, for that you have to contact a broker, you have to make a phone call, you have to check your agenda and their agenda if it suits. That are all barriers are overcome thanks to omni-directional video (= inside)." (Wouter, Non-inhabitant, 27)*

> *"If I speak from my own name then I would rather go and take a look on the spot if I had to pay twenty euros or something like that for it." (Ludo, Non-inhabitant, 43 years)*

Obviously as the previous citation illustrates, twenty euros for a virtual city model with real estate services of which the user is not convinced of its added value for his personal real estate search practices is a too high amount, even though the same amount is acceptable for Wouter in case one includes ODV indoor. The existence of free alternatives, such as Immoweb that has a comprehensive offer of available properties, also negatively influences the willingness-to-pay of the respondents. Traditional real estate websites do have some shortcomings, but they serve as a free alternatives that are domesticated in their current real estate search practices. Consequently the amount people are willing to pay for a virtual city model, eventhough it can be a better alternative than Immoweb, is still quite low, for instance five euros for one year as Michèle suggests.

"I do not know, I do not think that I would pay for it no because I have always just called (= the broker or owner of a property that looked interesting on Immoweb) and gone to take a look. (…) If it is five euros for one year then I might pay for it, but really doing a monthly contribution I do not think I would do." (Michèle, New-inhabitant, 26 years)

"Today I say no because why? (= not willing to pay) Because I cope with the means that I have." (Ludo, Non-inhabitant, 43 years)

Because of the existing free, but often less comprehensive, alternatives that people nowadays use to find a new home, some respondents formulate many high-end requirements to which a 3D city model should respond to before they would be willing to pay for such a model. For instance in case of Pauline, an inhabitant of Brussels who did not see any added value in the URBAN proxy, a virtual urban model should offer a photorealistic quality, an exhaustive description of the property and the rental conditions, plenty of pictures of the property, etc. In other words, for Pauline the 3D city model should be an **all-in-one application** providing users with all the information on a property that one can currently only receive by means of consulting different media and people.

"If I pay then I must receive a very detailed and realistic view of everything that is represented, then it actually almost has to be a picture. Then I must receive a full description of the property, but also what the rental conditions are, then I really want to receive everything if I pay for it. Then I no longer need to do extra phone calls to the owner to know how much the rent is and when it is available and what kind of contract it is, how much guarantee I have to pay. Then I really want to have everything, then I also want a visit or at least a lot of pictures of the property, then I pay." (Pauline, Inhabitant, 30 years)

While city trip respondents are more willing to pay for a mobile version of the tested 3D city model rather than for a desktop application, we did not identify this need for a mobile 3D city model for people who are looking for a house. Obviously the practice of selecting possible interesting properties by means of online real estate information is domesticated in the home environment. As a result a mobile virtual city with real estate services would not link in with the current domesticated real estate practices.

4 Conclusion

Our role within the URBAN project is twofold. On the one hand within task 4.3 we investigated and identified potential service innovation in relation to 3D city models as early as possible in the development trajectory. On the other hand within task 4.4 we aimed to connect these findings on current and future user practices of 3D city navigation to the actual technology development process. Consequently in order to embed the user research outcome in the last phase of development, we need to go futher than solely describing our user findings. One technique to bridge the gap between the user research and the design process is the formulation of "requirements". Cooper et. al. (2007) define requirements as "*the information and capabilities users need to accomplish their goals*". Besides technical requirements this also refers to non-technical requirements, including (latent) user needs, identified by means of social science, in relation to the use of 'social products'.[15] We will not go into depth on the various types of requirements (i.e. user, context and social requirements),[16] but only on the social requirements concerning the product itself and the product ecology that we have formulated.[17] Social requirements are defined as "(...) the requirements that are extracted from the social background and everyday life of people, with an emphasis on groups or communities and the social practices within" (Vermeir et al, 2008).

First on the level of the product itself, '**product recommendations**' translate the 'raw' social requirements into readily usable instructions for engineers and developers. These recommendations map out the several opportunities for product change and serve as starting point for the eventual product related choices that need to be made. Secondly on the level of the surrounding product ecology, '**product ecology recommendations**' imply the creation of a suited environment for the optimal use of the product.

Both iterations of the empirical field research enabled us to formulate product recommendations on both levels in relation to 3D city navigation. The following part

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[15] Forlizzi (2007: 1) defines social products as *"(...)artifacts, services or systems that have social meaning, and often, implications for people's social behavior and relationships"*.

[16] For more information on different requirements, in particular social requirement, please consult Lievens, Torben-Nielsen, Pierson & Jacobs (2008)

[17] The terms 'product recommendations' and 'product ecology recommendations' are inspired by Forlizzi's (2007) 'product ecologies'.

will address the question in what direction the design process of 3D city models should evolve in order to link in with the needs, expectations and practices of the target groups that we have identified as the most potential in relation to 3D city service innovation, more specifically city trippers and real estate purchasers.

A 3D city model could create added value by:

1) *Providing users who are unfamiliar with the destination area with a better view of a particular neighbourhood(s), for instance in relation to urban planning, building structures and the overview and location of available facilities.*
2) *Offering users an overview of the available facilities that are useful from the perspective of the personal user.*
3) *Merging the 3D city model with existing domesticated information tools and players.*

In relation to the **first** topic it is clear that a three-dimensional city representation can provide users who are unfamiliar with (parts of) a city with a general view of and spatial insight in that city. Thus for city trippers who plan to visit a city for the first time and real estate purchasers who do not know the neighbourhood of a property receiving a general view of an unfamiliar city is already useful. In fact for all types of city trippers, planners as well as explorers, receiving a prior vague idea of their vacation destination is sufficient in order to still be able to discover (new things of) a city on the spot. Yet for real estate purchasers who are more or less familiar with the destination area and hence already have a general view of the neighbourhood of a property only a photorealistic virtual city model will fit their expectations. Nevertheless the domestication of pictures in the practice of planning a city trip as well as in the practice of self-selecting potential properties identifies the need to leave the door open for the implementation of pictures in the URBAN design process. For real estate purchasers the authentic perceived ODV both outdoor and indoor would perfectly fit in the practice of selecting interesting properties. Yet considering the high costs and the privacy-related issues of ODV, we argue to at least implement other photorealistic data like pictures to respond to the high need for photorealism in the practice of seaching for a new home. For city trippers however adding normal pictures of relevant tourist facilities (e.g. hotels, parks, restaurants, etc.) would be sufficient. ODV is mainly perceived as a nice-to-have by city trippers and even evokes some resistance as the hyper realistic video fragments would go too far in offering tourists a pre-experience of their city trip.

The **second** topic relates to the implementation of POIs in a 3D city model. Rubben (2006) states that all digital city applications should take the profile and preferences of the user into account. Similarly we found that POIs can only have added value when they meet the personal needs and interests of the personal user. Consequently the POIs that are offered by future 3D city applications need to vary based on the user profiles and can only be fixed by means of interaction with future users. The fact that one general offer of POIs cannot respond to the specific needs of various user profiles needs to be taken into account during the URBAN design process. For example a virtual city application used by a real estate purchaser should only offer POIs that are useful from a future inhabitant's perspective (e.g. public transport stops, supermarkets, schools, etc.) and a low budget city tripper for instance only wants to receive budget friendly hotels, restaurants and shops as POIs. In addition the presented information on useful facilities should be layered in order to maintain synopsis. One should be able to dig deeper when one is interested. Thus receiving city-related information should be an optional functionality, for instance by means of pop-ups.

Considering the **third** topic we argue that a 3D city model should merge with current dominant market players such as the popular tourist website Tripadvisor in the context of online tourist information and the real estate website Immoweb in the context of the Belgian online real estate market. A virtual city model should not try to replace or copy dominant market players and tools since the willingness-to-pay is quite limited and the model will not be able to earn back the investments and incremental costs. In addition many dominant market players such as online tourist and map services (e.g. Tripadvisor, Google Earth) and real estate websites (e.g. Immoweb, Vlan, Hebbes) offer their services for free. A 3D city model should exploit its own strenghts, e.g. offering a three-dimensional insight in unfamiliar urban environments, and should not try to replace the existing traditional tools such as a paper travel guide for example (Rubben, 2006). A 3D city offer can create added value by responding to the shortcomings of the traditional players (cfr. the four shortcomings of real estate websites).

The previous three topics can be situated on the level of product recommendations. Yet in relation to **product ecology recommendations**, thus creating the suited environment for the ideal use of a product, especially a mobile 3D city model seems to be able to create added value from a city tripper's perspective. In other words, the user findings indicate that the best suited environment to use a virtual city model for city trippers is actually on the spot. A mobile 3D city model could namely offer

navigation and localization support on the spot, which are the main concerns of city trippers. As we have mentioned before the three-dimensional aspect would provide the city trippers with a spatial insight in unfamiliar urban environments and would improve the navigation and orientation practices during their trip. Similarly Burigat & Chittaro (2007) argue based on their research on navigation in 3D virtual environments that 3D enables users more easily to determine where they are, where everything else is and how they can get to particular places or objects.

Finally we address some critical reflections concerning our research set-up. First of all we confronted users with a kind of proxy technology of the main demonstrator (to be ready at the end of the project in December 2009) to allow them to have a rather (immersive) truthful experience of 3D urban navigation (Torben Nielsen et. al., 2008). The URBAN proxy was installed on a portable computer so that the users could perform the user tests and thus navigate through the 3D city environment in the "safe" environment of their own home setting. Nevertheless, we cannot equal this with a 'real-life setting' in which users are considered as co-producers and use a technology during a considerable period of time, like within a Living Lab context. The users were only confronted with the URBAN proxy once during the user tests, the preliminary proxy only had a few functionalities that were initially foreseen in the task 4.3.1 user-grounded scenarios and the proxy did not yet work optimally. These factors all hindered a genuine immersive experience. Furthermore both iterations of the user reseach are conducted within the framework of UDI, hence we aimed at integrating the user experiences as feedback in the following URBAN design and development activities. Though the question whether our finial user findings and formulated product recommendations are actually useful and concrete enough for the other URBAN partners will have to be investigated within task 4.4.2. In the context of task 4.4.1 we already discussed the kind of obstacles we encountered for integrating user research in the technological R&D process. In the final research phase for task 4.4.2, we organise a final interactive workshop with the project partners in order to embed the user research outcome in the last phase of development. This helps us to assess the usefulness and range of the UDI approach in the context of the URBAN project.

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6 Annex

1. Step-by-step plan of the city trip user tests
2. Step-by-step plan of the real estate user tests
3. Scenario-based tasks of city trip respondents
4. Scenario-based tasks of real estate respondents
5. Questionnaire of Evaluative interview on the URBAN prototype for city trip respondents
6. Questionnaire of Evaluative interview on the URBAN prototype for real estate respondents
7. Detailed description of the city trip respondents
8. Detailed description of the real estate respondents

6.1 Draaiboek gebruikerstesten city trips

1. Marinka legt het doel en de opzet van de gebruikerstest uit: **(5 minuten)**
   - Het doel is de ervaringen van mensen mbt de stadsapplicatie in kaart te brengen en hun feedback te verzamelen. Het zijn dus zeker niet de respondenten zelf die worden getest. Enkel inzicht krijgen in welke diensten relevant zouden zijn om in een dergelijk stadsmodel in te bouwen.
   - Eerst zal de respondent een zoekopdracht op het internet uitvoeren dat gevolg wordt door een kort gesprek over het online zoeken naar toeristische informatie.
   - Vervolgens legt Marinka kort uit hoe de stadsapplicatie van Brussel werkt en krijgt de respondent 10 minuten de tijd om er vrij doorheen te navigeren.
   - Daarna ontvangt de respondent een fictief verhaal/scenario over het plannen van een city trip naar Brussel met daaraan een aantal opdrachten gekoppeld. Geen moeilijke opdrachten, ook niet aarzelen om meer uitleg of hulp te vragen.
   - Na de opdrachten volgt nog een interview waarin er wordt gepeild naar de ervaringen met het stadsmodel van Brussel.

2. Marinka stelt de respondent de volgende vragen met het oog op het maken van een profielschets van de respondent: (**5 minuten**)
   - Geboortejaar?
   - Hoe zou u uw internetgebruik omschrijven? Zowel voor privé- als professioneel gebruik.
   - Wat was de bestemming en de duur van uw laatste city trip?
   - Hoe vaak gaat u gemiddeld op city trip?
   - Heeft u reeds een volgende city trip gepland? Indien ja: Heeft u al informatie opgezocht met het oog op deze city trip?

3. Marinka start de laptop op. Marinka overhandigt de respondent de taakomschrijving en geeft aan dat de respondent enkel de eerste opdracht dient

uit te voeren. De respondent begint met de zoekopdracht. De steekkaarten mogen na uitvoering onder elkaar gelegd worden. Marinka vraagt de respondenten **luidop te vertellen** wat ze zien en doen op het internet. (**10 minuten**)

4. Als de respondent de online zoekopdracht heeft beëindigd, stelt Marinka de volgende vragen aan de respondent: (**15 minuten**)
   - In welke mate plant u uw city trip op voorhand?
   - Wat zoekt u doorgaans allemaal op voorhand op en via welke weg zoekt u dit op?
   - Biedt het internet u voldoende informatie om een city trip eventueel van A tot Z te plannen?
   - Heeft u tijdens het plannen van uw laatste city trip ook kaarten geraadpleegd om de ligging van bepaalde dingen te kunnen bekijken?
     - Indien ja: welk type van kaarten? (bv. Google Maps of papieren stratenplan)
   - Wat zijn de dingen waar u voornamelijk op let bij het boeken van een accommodatie voor een city trip?
   - Is de ligging van een hotel tijdens een city trip belangrijk voor u?
   - Vindt u gewoonlijk voldoende informatie over de ligging van een hotel?
   - Bekijkt u doorgaans veel foto's van een hotel alvorens het te boeken?
   - Neemt u gewoonlijk een papieren reisgids mee op city trip?
     - Indien ja: Wat zoekt u hierin op?
   - Hoe heeft u zich in de stad georiënteerd?
   - Hoe heeft u zich hoofdzakelijk doorheen de stad verplaatst? (openbaar vervoer?)
     - Heeft u zich hierover op voorhand geïnformeerd?

5. Marinka start het stadsmodel van Brussel op en legt de basis functionaliteiten van de stadsapplicatie uit: (**5 minuten**)
   - 3 views.

- Zoekfunctie voor opzoekingen op basis van adres.
- Zoekfunctie voor opzoekingen op basis van Points Of Interest.
- Overzicht POIs (inclusief zoekstraal). Vastgoed POI voor huizenzoekers!
- Oriëntatiecirkel.
- Navigeren door middel van muis en pijltjes.
- Zoekstraal.

6. De respondent krijgt de tijd om vrij te navigeren in het 3D stadsmodel. De respondent wordt gevraagd luidop te denken en dus te vertellen waar hij/zij allemaal aan denkt tijdens deze eerste kennismaking met het stadsmodel. **(10 minuten)**

7. Marinka peilt naar de respondent zijn/haar eerste indruk van het Brussels stadsmodel. Wat is de respondent allemaal opgevallen? **(5 minuten**)

8. Marinka stelt de stadsapplicatie in op Helicopter View.

9. Marinka vraagt de respondent om de taakomschrijving terug voor zich te nemen en de rest van de opdrachten één voor één uit te voeren. De steekkaarten mogen onder elkaar gelegd worden. (**20 minuten**)

10. Na het beëindigen van de taakomschrijving vangt het evaluatief interview tussen Marinka en de respondent aan (zie 'vragenlijst na gebruikerstest city trips'). (**30 minuten**)

6.2 Draaiboek gebruikerstesten vastgoed

1. Marinka legt het doel en de opzet van de gebruikerstest uit: **(5 minuten)**
   - Het doel is de ervaringen van mensen mbt de stadsapplicatie in kaart te brengen en hun feedback te verzamelen. Het zijn dus zeker niet de respondenten zelf die worden getest. Enkel inzicht krijgen in welke diensten relevant zouden zijn om in een dergelijk stadsmodel in te bouwen.
   - Eerst zal de respondent een zoekopdracht op Immoweb.be uitvoeren dat gevolg wordt door een kort gesprek over het online zoeken naar een woning.
   - Vervolgens legt Marinka kort uit hoe de stadsapplicatie van Brussel werkt en krijgt de respondent de tijd om er vrij doorheen te navigeren.
   - Daarna ontvangt de respondent een fictief verhaal/scenario van een zoektocht naar een nieuwe woning in Brussel met daaraan een aantal opdrachten gekoppeld. Geen moeilijke opdrachten, ook niet aarzelen om meer uitleg of hulp te vragen.
   - Na de opdrachten volgt nog een interview waarin er wordt gepeild naar de ervaringen met het stadsmodel van Brussel.

2. Marinka stelt de respondent de volgende vragen met het oog op het maken van een profielschets van de respondent: (**5 minuten**)
   - Geboortejaar?
   - Wanneer heeft u voor het laatst naar een woning gezocht?
   - Naar wat voor type van woning heeft u toen gezocht?
   - Huidige woonplaats?
   - Hoe zou u uw internetgebruik omschrijven? Zowel voor privé- als professioneel gebruik.

3. Marinka start de laptop op en opent de internet browser (zodat de respondent makkelijk naar de website immoweb.be kan gaan). Marinka overhandigt de respondent de taakomschrijving en geeft aan dat de respondent enkel de eerste opdracht dient uit te voeren. De respondent begint met de zoekopdracht in

Immoweb. De steekkaarten mogen na uitvoering onder elkaar gelegd worden. Marinka vraagt de respondenten **luidop te vertellen** wat ze zien en doen op Immoweb. (**10 minuten**)

4. Als de respondent de zoekopdracht op Immoweb heeft beëindigd, stelt Marinka de volgende vragen aan de respondent: (**15 minuten**)
   - Via welke wegen heeft u tijdens uw laatste zoektocht naar een woning gezocht?
   - Vindt u op een vastgoedwebsite zoals Immoweb alle informatie die u nodig heeft over een woning?
   - Biedt een gewoon stratenplan zoals u in Immoweb kreeg een voldoende goed beeld op de ligging van een woning?
   - Heeft u tijdens uw zoektocht naar een woning ook kaarten geraadpleegd om de ligging van een woning te kunnen bekijken?
     - Indien ja: welk type van kaarten? (bv. Google Maps of papieren stratenplan)
     - Indien nee: Is de ligging van een woning belangrijk voor u?
   - Hoe belangrijk is de omliggende buurt van een woning?
   - Wat wou u allemaal weten over de buurt van een woning?
   - Heeft u voldoende informatie gevonden over de omgeving van een woning?
     - Indien ja: via welke weg(en)?
     - Indien nee: op welke noden kan er volgens u nog ingespeeld worden?
   - Heeft u het internet gebruikt om informatie te vinden over de buurt van een woning?
     - Indien ja: hoe?
   - Wat zijn de dingen waar u voornamelijk op let in verband met de omgeving van een pand als u ter plaatse gaat kijken?
   - Hoe ziet zo'n bezoek er doorgaans uit? (Op welk(e) tijdstip(pen)? Hoe lang duurt het? Spreekt u mensen aan op straat? ...)

5. Marinka start het stadsmodel van Brussel op en legt de basis functionaliteiten van de stadsapplicatie uit: (**5 minuten**)
   - 3 views.
   - Zoekfunctie voor opzoekingen op basis van adres.
   - Zoekfunctie voor opzoekingen op basis van Points Of Interest.
   - Overzicht POIs (inclusief zoekstraal). Hotel POI voor toeristen!
   - Oriëntatiecirkel.
   - Navigeren door middel van muis en pijltjes.
   - Zoekstraal.

6. De respondent krijgt de tijd om vrij te navigeren in het 3D stadsmodel. De respondent wordt gevraagd luidop te denken en dus te vertellen waar hij/zij allemaal aan denkt tijdens deze eerste kennismaking met het stadsmodel. **(10 minuten)**

7. Marinka peilt naar de respondent zijn/haar eerste indruk van het Brussels stadsmodel. Wat is de respondent allemaal opgevallen? **(5 minuten**)

8. Marinka stelt de stadsapplicatie in op Top View en zoomt vervolgens in totdat de locatie van het pand en station Brussel-Kappelekerk zichtbaar zijn.

9. Marinka vraagt de respondent om de taakomschrijving terug voor zich te nemen en de rest van de opdrachten één voor één uit te voeren. De steekkaarten mogen onder elkaar gelegd worden. (**20 minuten**)

10. Na het beëindigen van de taakomschrijving vangt het evaluatief interview tussen Marinka en de respondent aan (zie 'vragenlijst na gebruikerstest vastgoed'). (**30 minuten**)

6.3 Scenario-based tasks for city trip respondents

Op city trip naar Brussel

Lees per blok eerst aandachtig het verhaal in de linkerkolom alvorens over te gaan tot de opdrachten die omschreven zijn in de rechterkolom.

Scenario	Opdracht
1. Je plant een tweedaagse city trip naar de Belgische hoofdstad en wenst wat informatie over Brussel op te zoeken. Naar welke informatie wil je allemaal op zoek gaan?	- Som de voornaamste dingen op die je graag zou opzoeken met het oog op een toekomstig bezoek aan Brussel. - Open het internetvenster en zoek online naar deze voornaamste dingen die je zonet hebt opgesomd. Vertel luidop wat je allemaal doet en ziet op het internet.
Scenario	**Opdracht**
2. Met het oog op de Brusselse city trip beslis je het stadsmodel van Brussel te raadplegen.	Marinka start het stadsmodel van Brussel op.
Scenario	**Opdracht**
3. Als architectuurliefhebber wil je wel eens een kijkje gaan nemen naar de bekende Sint-Michiel-en-Goedelekathedraal. Daarom geef je de naam van de kathedraal als zoekterm in.	- Klik in de onderste balk op '**Search**'. - Typ achter '**Address**' '*kathedraal van Sint-Michiel en Sint-Goedele*' in. - Druk vervolgens op '**Go**'.
Scenario	**Opdracht**
4. Je ziet nu de kathedraal vanuit de lucht. Je wilt wel eens een kijkje van dichterbij gaan nemen. Bijgevolg daal je neer tot op straatniveau en je wandelt rond in de buurt van de kathedraal.	Klik in de onderste balk aan de linkerzijde op de knop '**Street View**' en wandel rond in de buurt van de kathedraal.
Scenario	**Opdracht**

5. Je hebt gehoord dat het koninklijk paleis jaarlijks zijn deuren opent voor het publiek. Het idee van door het paleis te kunnen wandelen spreekt je wel aan dus vlieg je naar de locatie voor wat extra informatie.	- Klik op **'Helicopter View'**. - Klik op de knop '**POIs**' en vervolgens op het icoontje met de punaise. - Zoek het **'Koninklijk Paleis van Brussel'** en vlieg er naartoe.
Scenario	**Opdracht**
6. Je hangt nu boven het paleis en dubbelklikt op het icoon met de punaise. Er verschijnt een klein venster met de volgende boodschap: "*Het Koninklijk Paleis met al zijn pracht is opengesteld voor het grote publiek dagelijks van 21 juli tot 1 september tussen 13u-15u*".	Als je boven het paleis hangt, dubbelklik dan op het icoon met de punaise.
Scenario	**Opdracht**
7. Een vriend die in Brussel woont heeft je vertelt dat er veel goede restaurants te vinden zijn in Brussel. Zou er in de buurt een leuk lunchadresje zijn voor na een eventueel bezoek aan het paleis? Je zoekt in een straal van 1 kilometer rondom het paleis naar de aanwezige restaurants.	- Druk op het icoon met het rode kruis om je vorige zoekactie te wissen. - Onder de rij met alle blauwe iconen zie je **'Search radius (km)'** staan. Vink deze funcie aan. - Stel nu de zoekstraal in op 1 kilometer. - Druk vervolgens bij '**POIs**' op het icoon met mes en vork.
Scenario	**Opdracht**
8. Je klikt op een van de restaurants. Er opent een extra venster met de naam van het restaurant 'Skievelat Sablon', het adres, het telefoonnummer en de website.	Klik op de rode ballon van het restaurant met nummer 1.
Scenario	**Opdracht**
9. Je dubbelklikt in de buurt van het restaurant en hangt nu boven het restaurant 'Skievelat Sablon'. Je kijkt even rond om te zien of het restaurant goed gelegen is.	- Dubbelklik vlak naast de rode ballon van restaurant 1. - Je bent nu in '**Helicopter View**' en je kan zo de ligging van het restaurant bekijken.
Scenario	**Opdracht**

10. Om parkeerproblemen te vermijden, zal je de trein nemen van je woonplaats tot Brussel Centraal. Je bent benieuwd hoe de route vanaf het Centraal station tot aan je geplande eerste stopplaats, de Grote Markt, er ongeveer zal uitzien en vraagt daarom een routebeschrijving op.	- Klik op de knop '**Top View**'. - Druk op het icoon met het rode kruis om je vorige zoekactie te wissen. - Vink ook de functie '**Search radius (km)**' uit. Duid het Centraal station als startpunt aan door de **linker control** toets '**ctrl**' in te drukken en tegelijkertijd met de muis op Brussel Centraal op de kaart te klikken. - Duid nu de Grote Markt als eindpunt aan door de **linker shift** toets in te drukken en tegelijkertijd met de muis op de Grote Markt op de kaart te klikken.
Scenario	**Opdracht**
11. Je ontvangt nu automatisch de routebeschrijving van het treinstation naar de Grote Markt. De berekende route is aangeduid met een blauwe lijn die je zowel op straatniveau als al vliegend boven de daken kan volgen.	- Klik op '**Helicopter View**' en zoek de blauwe lijn die op de straat loopt. - Ga boven de blauwe lijn hangen en klik op '**Street View**'. Volg op straatniveau een stukje van de blauwe route. - Ga vervolgens over tot '**Helicopter View**' en volg al vliegend de rest van de blauwe route tot aan de Grote Markt.
Scenario	**Opdracht**
12. Op de Grote Markt vindt er blijkbaar een evenement plaats. Je klikt op het evenementsymbool en ontvangt de volgende boodschap: "*Iedere zaterdag van juli gratis jazz concert op de Grote Markt*". Dat is interessant om te weten.	- Druk in de onderste balk op '**POIs**' en vervolgens op het icoon met de luidspreker. - Dubbelklik nu op het icoon met de luidspreker dat op de Grote Markt is verschenen.
Scenario	**Opdracht**
13. Je hebt al volop zin gekregen in een uitstap naar Brussel. Nu moet je enkel nog een leuk hotel vinden om één nacht door te brengen. Daarom vraag je een overzicht van de aanwezige hotels in Brussel op.	- Klik in de onderste balk op het icoon met het rode kruis om je vorige zoekactie te wissen. - Klik op het icoon met het bed.
Scenario	**Opdracht**

14. Je dubbelklikt op het Hilton hotel te Brussel en daalt neer tot op helikopterniveau. Vervolgens ga je het hotel op straatniveau eens van dichtbij bekijken.	- Dubbelklik vlak naast de rode ballon van het hotel met nummer 2 zodat je in '**Helicopter View**' terecht komt. - Ga nu vlak voor het Hilton hotel hangen. Klik op de knop **'Street View'**.
Scenario	**Opdracht**
15. Het Hilton hotel ziet er alvast interessant uit, maar je bent ook benieuwd naar de andere hotels in Brussel. Je keert bijgevolg terug naar het overzicht met alle aanwezige hotels en klikt nu op hotel Amigo. Er opent een extra venster met de naam, adres, telefoonnummer en website van het hotel.	- Klik in de onderste balk op '**Top View**' en vervolgens op de rode ballon van het hotel met nummer 1.
Scenario	**Opdracht**
16. Hotel Amigo lijkt ook zeker interessant te zijn want je ziet vanuit de lucht dat het hotel vlak bij de Grote Markt ligt. Je neemt ook nog eens een kijkje van op straatniveau.	- Dubbelklik vlak naast de rode ballon van het hotel met nummer 1 zodat je in '**Helicopter View**' terecht komt. - Druk in de onderste balk op het icoon met de punaise zodat je kan zien welke bezienswaardigheden er in de buurt van het hotel liggen. - Ga ten slotte vlak voor het hotel hangen en klik op '**Street View**'.
Scenario	**Opdracht**
17. In de straat van het hotel staat het symbool van een videocamera. Je klikt erop zodat een video van de straat van het hotel en diens omgeving begint af te spelen. Je kijkt in het videofragment in allerlei richtingen rond. Het ziet er alvast een leuke straat uit.	- Klik in de onderste balk op het symbool met de **videocamera.** - Dubbelklik nu op het symbool met de videocamera dat is verschenen.
Scenario	

18. Je besluit staat vast, het wordt hotel Amigo want dit hotel blijkt toch wel erg goed gelegen te zijn. Nu enkel nog het hotel boeken en je bezoek aan Brussel kan beginnen!

6.4 Scenario-based tasks for real estate respondents

Op huizenjacht in Brussel

Lees per blok eerst aandachtig het verhaal in de linkerkolom alvorens over te gaan tot de taken die omschreven zijn in de rechterkolom.

Scenario	Opdracht
1. Je bent al enkele maanden op zoek naar een nieuwe woonst in de Belgische hoofdstad, onder andere via de vastgoedwebsite Immoweb. Je geeft je persoonlijke zoekcriteria in op Immoweb en er verschijnt een lijst met de panden die overeenstemmen met jouw criteria.	- Ga naar de website www.immoweb.be en zoek naar een woning in een omgeving naar keuze. Vertel luidop wat je allemaal ziet en doet op Immoweb.
Scenario	**Opdracht**
2. Je beslist om de ligging van het huis ook eens te bekijken in het stadsmodel van Brussel.	Marinka start het stadsmodel van Brussel op.
Scenario	**Opdracht**
3. Je ziet Brussel vanuit de lucht. Het huis dat op Immoweb je interesse heeft gewekt gelegen in de Wolstraat te Brussel is aangeduid met een rode ballon met nummer 1 op de kaart van Brussel. Je merkt op dat het pand dichtbij het Egmontpaleis en de Onze-Lieve-Vrouw ter Zavelkerk is gelegen. Dat lijkt dus alvast een mooie buurt te zijn.	- Klik in de onderste balk op het scherm op '**POIs**'. - Druk nu op het icoon met het '**FOR SALE**' plaatje.
Scenario	**Opdracht**

4. Ook al wil je graag in het centrum van Brussel wonen, je apprecieert toch enige rust. Je merkt op de kaart van Brussel op dat het station Brussel-Kapellekerk in de buurt van het huis gelegen is. Het is moeilijk om op basis van de kaart in te schatten hoeveel de afstand bedraagt tussen het huis en de spoorweg. Zou je geluidshinder ondervinden van het station? Daarom bereken je de afstand in vogelvlucht. Je krijgt ook automatisch een routebeschrijving tot aan het station. Dat is interessant want je zou het liefst met de trein naar het werk pendelen.	- Duid het pand in de Wolstraat als startpunt aan door de linker control toets '**ctrl**' in te drukken en tegelijkertijd met de muis **vlak naast** de rode ballon met nummer 1 op de kaart te klikken. - Duid vervolgens de sporen van Brussel-Kapellekerk als eindpunt aan door de linker **shift** toets in te drukken en tegelijkertijd met de muis vlakbij de sporen op de kaart te klikken.
Scenario	**Opdracht**
5. Het huis ligt in vogelvlucht op een halve kilometer van het station dus je zou alvast niet wakker kunnen worden van treingeluiden. Je bent toch ook een beetje benieuwd hoe de route van het huis naar het station er ongeveer uitziet. Daarom volg je een stukje van de berekende route die met een blauwe lijn is aangeduid.	- Klik in de onderste balk aan de linkerzijde op '**Helicopter View**'. - Zoek de blauwe lijn die op de straat is aangeduid. - Volg deze blauwe lijn door er boven te vliegen tot aan het eindpunt dat is aangeduid met een blauwe pijl die naar beneden wijst. - Schakel daarna over naar '**Street View**' en volg een stukje van de blauwe lijn op straatniveau. - Keer nu terug naar '**Helicopter View**' en vlieg terug tot aan het huis.
Scenario	**Opdracht**
6. Benieuwd welke winkels er zo al in de buurt van het huis liggen. Een aantal leuke winkels op wandelafstand van je woning is altijd mooi meegenomen. Je zoekt dan ook in een straal van 1 kilometer naar de aanwezige winkels.	- Klik in de onderste balk op '**Top View**'. - Onder de rij met alle blauwe iconen zie je '**Search radius (km)**' staan. Vink deze funcie aan. - Stel nu de zoekstraal in op 1 kilometer door het pijltje naar rechts te verslepen. - Druk vervolgens bij '**POIs**' op het icoon met de winkelkar.
Scenario	**Opdracht**

7. Je wilt nu wel eens een kijkje gaan nemen naar de winkels die in de directe omgeving van het pand liggen. Je dubbelklikt op de locatie van het huis waardoor je neerdaalt tot net boven de daken van de huizen. Zo zie je de nabij gelegen winkels vanuit de lucht. Je komt onder andere het logo van GB Express en Délifrance in de straat van het huis tegen. Je zou dus al niet ver moeten wandelen voor vers brood en enkele basisproducten.	- Dubbelklik op de kaart **vlak naast** de rode ballon met nummer 1. - Vlieg even rond naar de aanwezige winkels in de buurt van het huis. - Vlieg vervolgens terug tot je weer boven het huis in de Wolstraat hangt.
Scenario	**Opdracht**
8. Je daalt opnieuw neer tot op straatniveau en staat nu recht voor het huis. Op het huis staat het symbool van een videocamera. Je klikt erop zodat een video van het pand en diens omgeving begint af te spelen. Je kijkt in het videofragment in allerlei richtingen rond.	- Wis je vorige zoekactie door in de onderste balk op de knop met het **rode kruis** te drukken. - Klik nu op de knop met het '**FOR SALE**' plaatje om het huis dat te koop staat terug aan te duiden. - Klik in de linkerzijde van de balk op '**Street View**'. - Ga voor het te koop staand huis staan. Klik vervolgens in de onderste balk op het symbool met de **videocamera.** - Klik nu op het symbool met de videocamera dat op het huis is verschenen.
Scenario	
9. Datgene wat je gezien hebt heeft alvast jouw interesse gewekt. Je overweegt dan ook naar de makelaar te bellen om een afspraak te regelen om het huis eventueel eens te bezoeken.	

6.5 Vragenlijst na gebruikerstest city trips

Algemeen

- Aan de hand van enkele opdrachten heeft u voor een eerste keer kennis kunnen maken met het stadsmodel van Brussel en hoe dit gebruikt zou kunnen worden bij het plannen van een city trip. Wat is uw algemene indruk?
    - Wat vond u goed en wat vond u minder goed? Waarom?
- U heeft zelf reeds verschillende city trips gedaan. Zou het stadsmodel dat u zojuist heeft uitgetest u kunnen hebben geholpen bij het plannen van deze trips?
    - Indien ja: Op welke manier?
    - Indien nee: Waarom niet?

Geteste functionaliteiten

- Tijdens de opdrachten bent u naar het koninklijk paleis gevlogen voor wat extra informatie over de opendeurdagen. Is het voor u nuttig dat je up-to-date informatie kan vinden in het stadsmodel?
- En informatie over evenementen zoals u heeft gezien op de Grote Markt?
- Bij het zoeken naar nabij gelegen restaurants rondom het koninklijk paleis heeft u de zoekstraal op 1 kilometer ingesteld.
    - Vond u dit interessant?
    - Voor welk type van zoekacties zou zo een zoekstraal volgens u nog interessant kunnen zijn?
- Bij het restaurant ‘Skievelat Sablon’ stonden het adres, de contactgegevens en de website van het restaurant vermeld. Is dit voldoende informatie die u over een restaurant wilt kunnen raadplegen in een stadsmodel?
- U heeft de route berekend tussen Brussel Centraal en de Grote Markt. Heeft u tijdens het plannen van een city trip ook al eens routebeschrijvingen opgezocht?
    - Voor welke types van routes?
    - Zoekt u regelmatig routebeschrijvingen op via het internet?
    - Zo ja, via welke website(s)?

- Tijdens de opdrachten heeft u de berekende route tussen het Centraal station en de Grote Markt die werd aangeduid met een blauwe lijn op de grond zowel in Helicopter View als in Street View gevolgd.
    - Hoe heeft u dit ervaren?
    - Vindt u het handig om over te schakelen tussen beide niveaus?
    - Geeft u een voorkeur aan een welbepaald niveau en waarom (niet)?
    - Heeft u ook interessante informatie uit Top View kunnen halen?
    - Zijn de 3 niveaus allemaal noodzakelijk? Zou je bepaalde niveaus willen verwijderen of toevoegen?
- Tijdens de opdrachten heeft u 2 hotels van dichtbij bekeken, het Hilton hotel en hotel Amigo. Heeft u voldoende informatie gekregen over beide hotels?
- Als laatste opdracht heeft u een stukje ODV bekeken na het klikken op het symbool van een videocamera.
    - Zijn video-opnames van op de straat volgens u relevant bij het plannen van een city?
    - Het feit dat u in de video naar alle mogelijke richtingen kon kijken is dat een meerwaarde of is een gewoon videofragment waarbij u enkel in één richting kan kijken reeds voldoende voor u?

Brussels stadsmodel: aanbevelingen?

- Heeft u tijdens het navigeren door het stadsmodel opgemerkt dat bepaalde gebouwen meer gedetailleerd waren dan anderen?
    - Indien ja: Om welk soort gebouwen ging dat meestal?
    - Indien nee: Screenshot laten zien.
    - Vindt u het relevant dat belangrijke gebouwen van een stad meer gedetailleerd worden weergegeven? Waarom (niet)?
    - Is het voor u voldoende dat enkel de belangrijkste gebouwen van een stad meer gedetailleerd worden weergegeven of zouden alle gebouwen en huizen zo moeten worden weergegeven?
- Kon u bepaalde plaatsen van Brussel herkennen in de stadsapplicatie?
- Vond u de manier waarop Brussel werd gerepresenteerd voldoende realistisch?

- Zou u bereid zijn om te betalen voor een stadsmodel zoals hetgeen u heeft uitgetest?
    - Indien ja: Hoeveel?
    - Indien ja: Voor wat soort van pakket? Inclusief of exclusief ODV?
    - Indien nee: Wanneer wel?
    - Indien nee: En in geval van een full pakket, bv. inclusief ODV?
- Heeft u al eens gehoord van Google Street View? Deze toepassing bestaat nog niet voor België, maar ik heb hier een voorbeeld vanuit Frankrijk. Google Street View is gebaseerd op een andere technologie om de stad (welbepaalde straten) te representeren. Het laat toe om op bepaalde punten in welbepaalde straten 360° rond te draaien.
    - Aan welk van beide representaties geeft u de voorkeur?
    - Als het algemene stadsmodel gratis zou zijn en Google Street View betalend, voor welk stadsmodel zou u dan kiezen?
    - Hoeveel bent u bereid om meer te betalen voor een fotorealistisch stadsmodel zoals Google Street View tov het algemene stadsmodel?
- U heeft zelf ervaring met het plannen van city trips. Welke diensten/functies zouden vanuit die ervaring volgens u nog interessant kunnen zijn om toe te voegen aan het stadsmodel?

6.6 Vragenlijst na gebruikerstest vastgoed

Algemeen

- Aan de hand van enkele opdrachten heeft u voor een eerste keer kennis kunnen maken met het stadsmodel van Brussel en hoe dit gebruikt zou kunnen worden bij het zoeken naar een woning. Wat is uw algemene indruk?
    - Wat vond u goed en wat vond u minder goed? Waarom?
- U heeft tijdens het afgelopen jaar zelf naar een woning gezocht. Zou het stadsmodel dat u zojuist heeft uitgetest u kunnen hebben geholpen in deze zoektocht?
    - Indien ja: Op welke manier?
    - Indien nee: Waarom niet?

Geteste functionaliteiten

- U heeft de afstand berekend in vogelvlucht tussen het te koop staand huis en de spoorwegen van station Brussel-Kapellekerk berekend. Vindt u dat een relevante functie bij het zoeken naar een woning?
    - Waarom (niet)?
    - Heeft u tijdens uw zoektocht ook afstanden berekend?
- Bij het berekenen van de afstand in vogelvlucht heeft u automatisch ook een routebeschrijving ontvangen. Heeft u tijdens uw zoektocht naar een woning ook routebeschrijvingen opgezocht?
    - Zoekt u regelmatig routebeschrijvingen op via het internet?
    - Zo ja, via welke website(s)?
- Tijdens de opdracht heeft u de berekende route tussen het huis en het station Brussel-Kapellekerk die werd aangeduid met een blauwe lijn op de grond zowel in Helicopter View als in Street View gevolgd.
    - Hoe heeft u dit ervaren?
    - Vindt u het handig om over te schakelen tussen beide niveaus?
    - Geeft u een voorkeur aan een welbepaald niveau en waarom (niet)?

  - Heeft u ook interessante informatie uit Top View kunnen halen?
  - Zijn de 3 niveaus allemaal noodzakelijk? Zou je bepaalde niveaus willen verwijderen of toevoegen?

- Bij het zoeken naar nabij gelegen winkels heeft u de zoekstraal op 1 kilometer ingesteld.
  - Vond u dit interessant of had u liever naar de belangrijkste winkels in heel Brussel centrum gezocht?
  - Voor welk type van zoekacties zou zo een zoekstraal volgens u nog interessant kunnen zijn?
- Als laatste opdracht heeft u een stukje ODV bekeken na het klikken op het symbool van een videocamera.
  - Zijn video-opnames van de buitenkant van een woning en diens straat en omgeving volgens u relevant bij het zoeken naar een woning?
  - Het feit dat u in de video naar alle mogelijke richtingen kon kijken is dat een meerwaarde of is een gewoon videofragment waarbij u enkel in één richting kan kijken reeds voldoende voor u?

Brussels stadsmodel: aanbevelingen?

- Heeft u tijdens het navigeren door het stadsmodel opgemerkt dat bepaalde gebouwen meer gedetailleerd waren dan anderen?
  - Indien ja: Om welk soort gebouwen ging dat meestal?
  - Indien nee: Screenshot laten zien.
  - Vindt u het relevant dat belangrijke gebouwen van een stad meer gedetailleerd worden weergegeven? Waarom (niet)?
  - Is het voor u voldoende dat enkel de belangrijkste gebouwen van een stad meer gedetailleerd worden weergegeven of zouden alle gebouwen en huizen zo moeten worden weergegeven?
  - Is het weergeven van de juiste kleur en verhouding van een woning waarin u eventueel geïnteresseerd bent dus zonder de details van ramen, deuren, enzovoort voldoende?
- Kon u bepaalde plaatsen van Brussel herkennen in de stadsapplicatie?

- Vond u de manier waarop Brussel werd gerepresenteerd voldoende realistisch?
- Zou u bereid zijn om te betalen voor een stadsmodel zoals hetgeen u heeft uitgetest?
    - Indien ja: Hoeveel?
    - Indien ja: Voor wat soort van pakket? Inclusief of exclusief ODV?
    - Indien nee: Wanneer wel?
    - Indien nee: En in geval van een full pakket, bv. inclusief ODV?
- Heeft u al eens gehoord van Google Street View? Deze toepassing bestaat nog niet voor België, maar ik heb hier een voorbeeld vanuit Frankrijk. Google Street View is gebaseerd op een andere technologie om de stad (welbepaalde straten) te representeren. Het laat toe om op bepaalde punten in welbepaalde straten 360° rond te draaien.
    - Aan welk van beide representaties geeft u de voorkeur?
    - Als het algemene stadsmodel gratis zou zijn en Google Street View betalend, voor welk stadsmodel zou u dan kiezen?
    - Hoeveel bent u bereid om meer te betalen voor een fotorealistisch stadsmodel zoals Google Street View tov het algemene stadsmodel?
- U heeft zelf ervaring met het zoeken naar een woning. Welke diensten/functies zouden vanuit die ervaring volgens u nog interessant kunnen zijn om toe te voegen aan het stadsmodel?

6.7 Detailed description of the city trip respondents

	< 40 years	40 to 60 years
The (mainly) online planner	*Annelies*	*Rob*
The (mainly) offline planner	*Thomas*	*Els*
The explorer	*Evelien*	*Noëlla*

Name: Annelies

Age: 23 years

Place of residence: At a student room in Leuven during the week, at the parental house in Bilzen during the weekends.

Most recent city trips: She conducted 3 city trips in 2008. In November 2008 4 to 5 days to Barcelona. In August 2008 2 days to Amsterdam. In February 2008 to Paris.

City trip planning behaviour:

- ***Online***: For a city trip abroad Annelies spends a lot of time on online searching for the most advantageous **flight** tickets. She always looks for an **accommodation** by means of Google. She compares the offered prices and the (central) location of the different accommodations. Further she also reads online reviews of former visitors. Based on this information, she books her accommodation online. By entering search queries in Google, she always looks for the most important **sights**, the 'must do's', of a particular city. In addition she usually prints a list with nice restaurants and trendy bars to take along.
- ***Offline***: She always takes an additional paper travel guide along that she starts to read on the road. The travel guide is used to **navigate** through the city and to look for **facilities** such as shops, restaurants, bars, etc. on the spot.

Average internet usage:

- Currently in the context of her master thesis she consults the internet continuously to search for legal issues.
- For entertainment purposes she uses the internet approximately 1 hour per day: check private mails, Facebook, Google and read an online paper.

Name: Rob

Age: 48 years

Place of residence: Bilzen

Most recent city trips: He conducted 2 city trips in 2008. In November 2008 4 days to Zeeland. In February 2008 3 days to Brussels.

City trip planning behaviour:

- ***Online***: He always searches for an **accommodation** by means of Google and browsing through the different search results. The central location and the price are the most important attention points. He also pays attention to the ratings of the different hotels and searches for reviews of former visitors. He books his accommodation online. By entering search queries in Google, he always looks for the important **sights** of a particular city. Then he prints the list with these 'most do's' to take along.
- ***Offline***: He always takes an additional paper travel guide along that he uses to **navigate** (with the practical street maps) through the city and to look up some extra information on certain sights on the spot. He usually asks for good **restaurants** at the **hotel desk**.

Average internet usage: He consults the internet daily for professional as well as private purposes, in total approximately 1,5 hours per day. He looks up all kinds of information such as addresses, phone numbers, etc. At his work internet is continuously at his disposal.

Name: Thomas

Age: 25 years

Place of residence: Leuven

Most recent city trips: He conducted several city trips in 2008. In the summer of 2008 several cities in Bulgaria, among which Sofia. In the end of February and the beginning of March 2008 5 to 6 days to Keulen and Frankfurt.

City trip planning behaviour:

- ***Online***: He consults the internet for up-to-date tourist information, e.g. events, concerts, etc. He chooses his accommodation based on offline information, but

he always books it online. In case he does not have a paper travel guide with a city maps, he will print maps of **Google Maps** to take along.

- ***Offline***: He prefers to ask former visitors among his **social networks** what **accommodations** and **sights**/particular things they suggest in a particular city. When he does not know former visitors, he will choose an accommodation and sights/activities based on the information provided by a traditional paper travel guide. In addition he examines the city maps in his travel guide in advance to gain an insight in the structure of the city and in the positioning of the accommodation towards the city centre and other sights. He starts to read the travel guide and the city information in detail on the road.

Average internet usage: He consults the internet on a daily basis and quite intensively for educational and private purposes, at least two hours per day. In the context of his master thesis he uses Google Earth frequently and he sends a lot of e-mails.

Name: Els (= spouse of Rob)

Age: 48 years

Place of residence: Bilzen

Most recent city trips: Idem Rob.

City trip planning behaviour:

- ***Online***: She consults the internet to look for events and activities that take place in the period she visits the city and prints that information to take along and for **up-to-date** information like opening hours. Usually she consults the **official website of the city**.
- ***Offline***: She chooses for a particular **accommodation** based on an article she reads in a **magazine** or something like that or based on the suggestions of someone in her **social network**. She always buys a traditional paper travel guide that she entirely reads before departure. She reads about the **activities** and **sights** in a particular city and how to get there.

Average internet usage: She does not use the internet quite often. She does not have internet at her disposal at work. She consults the internet approximately once per week to check her e-mails, for online banking or for online searches.

Name: Evelien

Age: 23 years

Place of residence: Beverst

Most recent city trips: In March 2009 2,5 days to London. In January 2009 1 day to Venice.

City trip planning behaviour:

- ***Online***: She always spends a lot of time on online searching for the most advantageous **flight** tickets. Sometimes she also reads the general description of the destination on **Wikipedia** to know something about the climate and the culture. She always searches for an **accommodation** by entering 'hostels' or 'youth hostels' in Google and browsing through the different search results. The central location and the price are the decisive factors and she also reads the online reviews of the hostels.
- ***Offline***: Usually the day before departure she goes to buy a **paper travel guide** to take along. Sometimes she start to read it on the road, but often she only starts to read about the possible activities or suggested restaurants on the spot.

Average internet usage:

- For professional purposes she almost continuously consults the internet to search for jurisdiction.
- For entertainment purposes she mainly uses the internet to check her private e-mails and Facebook, in total approximately one hour per day.

Name: Noëlla

Age: 48 years

Place of residence: Beverst

Most recent city trips: In May 2008 four days to Barcelona.

City trip planning behaviour:

- ***Online***: She usually plans a city trip very last minute. When she has the time, she looks on Google for the '**top ten sights**' of the destination. Since she does not have the patience to intensively look for **flight** tickets on the internet, she always asks a family member to search for and book a flight ticket online.

- ***Offline***: She chooses her **accommodation** based on the suggestions of people from her **social network** that have already visited the city or from travel television programs or magazines. She sometimes takes a **travel guide** along that she only starts to road on the road. Otherwise she will go to a tourist office on the spot to take along some brochures on the activities and sights of the city.

Average internet usage: She consults the internet approximately two hours per day for online searches, e-mail and Facebook.

6.8 Detailed description of the real estate respondents

	< 40 years	40 to 60 years
Non-inhabitant of Brussels	*Wouter*	*Ludo, Lucia*
New inhabitant of Brussels	*Michèle*	
Inhabitant of Brussels	*Pauline*	*Ronald*

Name: Wouter

Age: 27 years

Place of residence: Deinze

Recent real estate experience: He is looking since December 2008 for an apartment to buy in Ghent and has not found one yet.

Real estate search behaviour:

- **Real estate websites**: He uses real estate websites, Immoweb, Hebbes and Zimmo, in 90% of his search practices.
- **Real estate agency**: He gives his search criteria to several travel agents who contact him when a property that responds to his criteria becomes available.

Average internet usage: He uses the internet very intensively for work as well as private purposes, approximately 10 hours per day.

Name: Ludo

Age: 43 years

Place of residence: Sint-Martens-Bodegem

Recent real estate experience: From October to November 2008 he searched for a house for his parents-in-law in his own region Schepdaal-Bodegem-Lennik.

Real estate search behaviour:

- **Real estate websites**: He mainly used the internet in his search for a property: consulting the websites of local real estate agencies and Immoweb.

- **Driving around**: Paying attention to 'for sale' boards while driving through the neighbourhood.
- **Regional newspaper**: Checking the classified advertisements.

Average internet usage: He consults the internet on a daily basis. At his work he uses the internet sporadically for instance to check the website of a competitor. At home he browses the internet approximately 1,5 hours per day in the evening.

Name: Lucia

Age: 44 years

Place of residence: Hoeilaart

Recent real estate experience:

- In February 2009 she searched for a student room/studio for her husband in the surroundings of the Free University of Brussels.
- She is currently searching for a large house near her current place of residence to cohabit with her husband, child, mother and brother. They have already visited several properties.
- She is currently helping her brother search for an apartment to buy at the Belgian coast. They have already visited several properties.

Real estate search behaviour:

- **Real estate publicity brochures**: They contain the properties of diverse real estate agencies and can be found at the newspaper traders and the bus stops
- **Regional newspaper**: They contain only the available properties in the region.
- **Showcase of real estate agencies**: She always looks at the properties that are displayed on the showcase of the real estate agencies she passes in her neighbourhood.
- **Real estate websites**: She consults Immoweb, Hebbes and the websites of the real estate agencies from the neighbourhood.

Average internet usage:

- For work purposes she daily uses the internet to search for and book hotels and flights for her boss, to search for information and to consult the websites of costumers.

- At home she daily uses the internet approximately 30 to 60 minutes in the evening to search for properties. In the weekends she spends more time online.

Name: Michèle

Age: 26 years

Place of residence: Brussels since September 2002.

Recent real estate experience: She has looked from the end of July until the end of August 2008 for an apartment to rent in Brussels.

Real estate search behaviour:

- **Real estate websites**: She mainly consulted Immoweb multiple times per day in her search for an apartment.
- **Vlan**: She consulted the paper as well as online version of Vlan but did not find it practical to use.
- **Real estate agencies**: She gave her search criteria to the real estate agencies that were mentioned in the advertisements on Immoweb and Vlan.
- **Word-of-mouth**: She asked her friends and acquaintances to keep an eye open for properties that matched her personal criteria.
- **Driving around**: She drove around in Brussels twice or three times to look for advertisements and noted the phone numbers to make a phone call for some additional information.

Average internet usage: She uses the internet approximately 3 to 4 hours per day for work as well as private purposes.

Name: Pauline

Age: 31 years

Place of residence: Vorst, Brussels

Recent real estate experience: She has looked from the middle of June until the end of August 2008 for an apartment to rent in Brussels.

Real estate search behaviour:

- **Word-of-mouth**: She told people as much as possible that she was looking for an apartment in Brussels and put it on her Facebook as well.

- **Driving around**: She drove around with her bicycle in the neighbourhoods of Brussels where she wanted to live to look for advertisements displayed on the windows of houses.
- **Real estate websites**: She mainly consulted the websites Immoweb and 'Wonen in Brussel' of which she received e-mails each time a property that fitted her personal search criteria was uploaded.

Average internet usage: She uses the internet approximately 5 to 6 hours per day for work as well as private purposes, including a lot of e-mailing.

Name: Ronald

Age: 41 years

Place of residence: Brussels

Recent real estate experience: After two year he is still looking for an apartment to rent or to buy in Brussels or the periphery of Brussels.

Real estate search behaviour:

- **Real estate websites**: He almost exclusively consults Immoweb as it has the most comprehensive offer of available properties.
- **Keeping an eye open**: When he is in Brussels he always keeps an eye open for advertisements displayed on the windows of houses.
- **Regional newspaper**: He regularly looks at the classified advertisements in 'Brussel deze week', but the majority of those properties are also available on Immoweb.

Average internet usage:

- For work purposes he consults the internet approximately 30 minutes per day for small search assignments.
- For private purposes he uses the internet approximately 1 hour per day for Immoweb, news, vacations, products and to keep is own weblog up-to-date.