COMMUNITY COLLABORATIVE DECISION-MAKING TOOLS: DETERMINING THE EXTENT OF 'GEOGRAPHICAL DIRTINESS' FOR EFFECTIVE DISPLAYS

William Cartwright[1], Chris Pettit[2], Anitra Nelson[3] and Mike Berry[3]

[1] School of Mathematical and Geospatial Sciences, RMIT University, Melbourne, Victoria, Australia
[2] Department of Primary Industries, Victoria, Australia
[3] Design and Social Context, RMIT University, Melbourne, Victoria, Australia

ABSTRACT

A research programme is underway to build and test a tool for community collaborative decision-making in an urban planning context. The project provides members of the public with a Web-delivered 3D product that allows users to 'move' through their local area and 'see' their local environment and to better appreciate how things like future development will look once built.

To test the effectiveness of the product it is being evaluated in three stages:

1. An initial qualitative evaluation with an expert group of users from the general community;
2. Testing with both the general community and professionals to better understand how the 'geographical dirtiness' of the Virtual Environment changes the perception of a space; and
3. Discovering the wayfinding aids needed in the model to support 'informed' searching & exploration.

The paper provides background to the research. Then it gives the results of the evaluations from the first two stages of the project

INTRODUCTION

A research team at RMIT is building virtual 3D audiovisual of urban spaces to test their potential to enhance community discussions of future neighbourhood developments. The project is being undertaken in an inner municipality in Melbourne, Australia that falls within the jurisdiction of the Moreland City Council. The study area provided a diverse locale that serves the purposes of all members of the research team. The study area contains a range of building types – housing, light industrial, commercial, retail and some open space. It could be considered to be typical of the somewhat crowded inner city areas that ring the Melbourne Central Activities District. An online facility was developed (see www.c-s3.info) to provide citizens with tools to view both current and possible future streetscapes and to create, and then take a virtual walk through their design. It was designed to be screened in community forums or used online (at home or in Internet cafes) to provide citizens and professionals with tools for visualising and discussing urban futures in this locality.

The research is two-pronged. It addresses:

(i) The use of New Media, and particularly Multimedia delivered via the Web, as a potential tool for improving Public Participatory Planning Support Systems (PPPSS) (this is being assessed by the social scientists in the team); and

(ii) The effectiveness of the use of the tool, with users from unknown and diverse backgrounds with potentially different skills for using geographical visualization tools and for developing mental maps (this part of the research is by members of the team from the geospatial sciences discipline).

(iii) This project simulates part of an Australian inner city area (in the City of Moreland) through the use of Web-delivered 3D tools. Of great interest to the team is how successful these simulations are, especially when delivered through the sometimes restricted 'pipe' of the Internet. We also interested to discover how users 'move' through this world and how complex, or 'dirty' (dirtied with elements like street furniture, powerlines, traffic, graffiti, etc.) a world needs to be before it can be considered to be 'real'.

PROJECT DEVELOPMENT

The approach had three underlying needs:

- It would be delivered as non-immersive 3D;
- It must use Open Source and a widely accepted format; and
- It had to be deliverable off hard disk, CD-ROM or via the Web.

From the users' perspective a number of criteria had to be met. It had to:

- Work with users with different, non-geospatial backgrounds;
- Work with different skills base;
- Work with different age groups (with the potential of having all age groups accessing the product);
- Work with different language skills; and
- Be able to be delivered on-line – at home and via the municipality's Web site or be accessible on computers at local Internet cafes.

Virtual Reality Modelling Language (VRML) was chosen as a development tool as it allowed open, extensible formats to be used and the 'built' worlds could be constructed in Web browsers that included a VRML plug-in. (VRML was used rather than X3D as there was no need to link to databases in this initial development phase). VRML is extensible, interpreted language and it became an industry-standard scene description language

Building the initial model

The first part of model development was to construct the actual VRML world. All buildings in the study area were surveyed to ascertain position, use and building height. Also, each building façade was photographed for use in 'stitching' the images onto the sides of VRML primitive shapes. As this area is busy day and night every day of the week, there was not one instance when the streets were free of objects – static and moving. Therefore considerable time was spent in 'cleaning' the images using *PhotoShop*. What were removed were trees, cars, signage, and any street furniture that, if not removed, would appear as a 2D image in the 3D world, thus degrading the perception of the Virtual World. (However, as explained later in the paper, these building facades were later 'dirtied' to produce models for the second stage of the project.). To remove all elements like street signs was an impossible task, so these were retained in most cases. (See the parking signs outside the shops in figure 2.) The photograph in figure 1 illustrates this point – all of the items in front of the buildings were removed to ensure a clear image. Figure 1 shows how the buildings appeared in the VRML package.

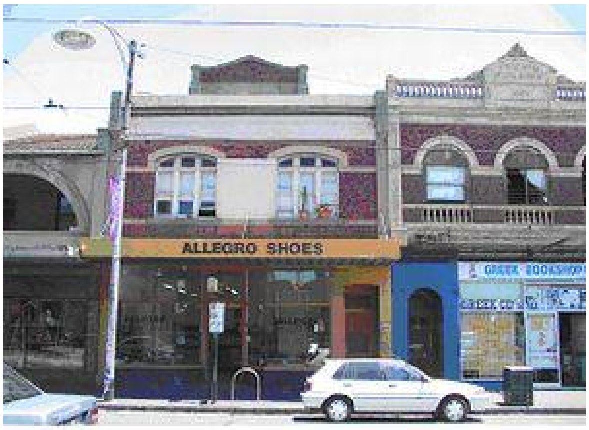

Figure 1. 'Raw' image taken in the retail shopping strip.

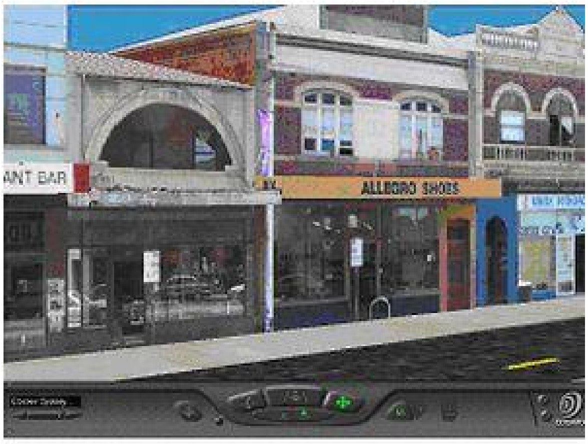

Figure 2. The same shop in the VRML world. Note the parking signs that still appear as 2D.

All buildings in the study area were subsequently inserted into the model. Part of the completed world is shown in figure 3, with detail shown in figure 4.

On the busy commercial retail strip it was important to add other media elements that would enhance the perception of a densely developed inner city area. And, one that had to cope with the problem of dense traffic. Sound recordings were made at every street intersection along the road and included in the VRML world, creating a 'soundscape'. (Soundscapes are generally attributed to Granö [1]. His pioneering work produced an agricultural soundscape, which illustrated cartographic representations with acoustic sensations of human activity, birdsong and grazing cattle on the Finnish island of Valosaari [2]. As the user 'moves' along the street they are 'enclosed' by one sound 'circle' and then another. Users can hear sounds created from recordings acquired from trams, trains, road vehicles and pedestrians.

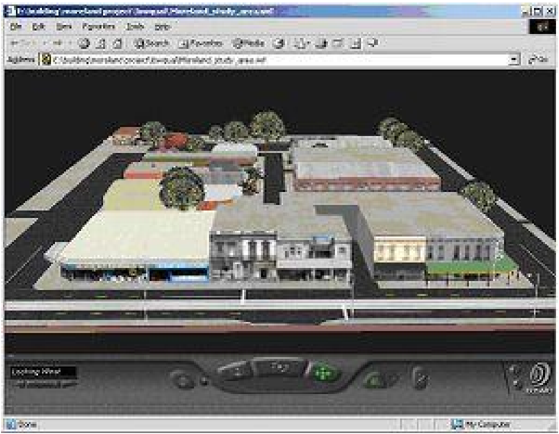

Figure 3. Project study area.

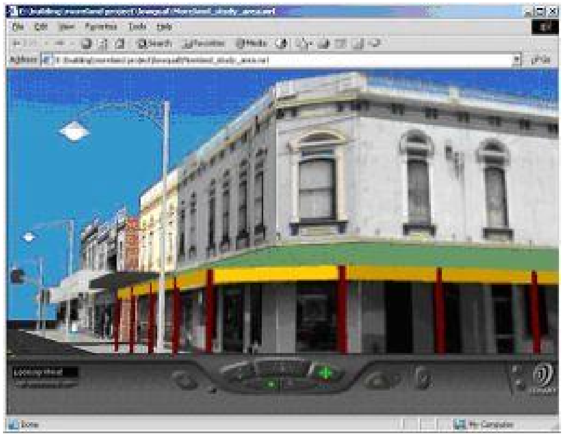

Figure 4. Detail from the study area.

ADDRESSING PROBLEMS ASSOCIATED WITH WORKING WITH VIRTUAL WORLDS

When users use traditional paper maps there is no guarantee that the 'reality' they build as a mental map is the reality that the map designer thinks they will build. According to Cartwright, G. F. [3], ordinary psychological principles do not exist or operate differently in the virtual world. Also, 'new realities' can emerge from maps that the designer did not consider could be [4]. The more senses that are involved at once, the more immersed one may become in virtual reality and / or cyberspace, and the harder it may become to distinguish the real world from the artificial [3]. But, perhaps the biggest problem associated with the development of such products is the distortion of reality. This may be related to the 'viewing media', and this is one aspect of the delivery (Web) process map authors have little control over. To this can be added the uncertainty, or, better still, lack of knowledge about whether different viewpoints, and therefore different realities, can be associated with the use of different viewing 'portholes'.

To be able to fully appreciate the model of the social and physical space within which particular users will work when searching for specific or the most appropriate information, users need to have access to the tools with which to construct their own 'virtual world'. Once constructed, this world enables users to virtually immerse themselves into a resource that can present the best picture of part of the real world from the user's perspective.

There is interest in using the expertise of many professions to understand how these geographical visualization tools 'work'. Fabrikant and Buttenfield [5, p. 264] noted: "Research questions such as "How do people learn about geographical information?" or "How do people develop concepts and reason about geographical space?" beg for an interdisciplinary approach, drawing upon expertise in cognitive psychology, geographic information science, cartography, urban and environmental planning and cognitive science".

EVALUATION OF THE TOOLS DEVELOPED IN THE PROJECT

We assume that when we provide users with a product that relies on their understanding of geography to 'work', we cannot assume that they really 'know' the geography of the area being studied. Perhaps they assume that they know the geography, whereas they only have a naïve version of reality – Naïve Geography. Naïve Geography was defined by Egenhofer and Mark [6] as "the body of knowledge that people have about the surrounding geographic world" – the primary theories of space, entities and processes [7]. And, as: … the field of study that is concerned with formal models of the common-sense geographic world" (p. 1). The term describes a formal model of common-sense geography [7, 1996]. This would form the basis for developing intuitive and 'easy-to-use' Geographic Information Systems. It "… captures and reflects the way humans think and reason about geographic space and time. Naive stands for instinctive or spontaneous" [6, p. 4].

So, if we build what can be called naïve geographical representations of real spaces, and, if users only have a naïve viewpoint of the geography of the study area, is the tool effective? Or, is it doubly ineffective due to the double imposition of naïve geographical understanding and naïve presentations (that is, presentations built on simplistic geographical models – eg flat earth and 'clean' environments, especially clean inner urban environments). Therefore, we cannot take for granted that the user group will automatically be able to make best use of our tools. Hence the need to evaluate the product.

We are evaluating whether this problem can be redressed using New Media geographical visualization tools. The evaluation is being undertaken in three stages:

1. An initial qualitative evaluation with an expert group of users to test the tool itself;
2. Testing how the 'geographical dirtiness' of the Virtual Environment changes the perception of a space; and
3. Discovering the appropriate wayfinding aids needed in the model to support searching and exploration.

Stages 1 and 2 of the evaluation are complete. The results of stage 1 have been reported elsewhere [8], but a brief summary of the results is provided in this paper for completeness. The focus of this paper is Stage 2 of the evaluation process and complete evaluation the results are provided.

Stage 1 Evaluation results

The alpha prototype online model was usability tested at a special workshop for local community members who have past experience in consultations on planning issues. They were asked to explore the models and signal difficulties in its online use. The participants were asked to complete a questionnaire to assess the potential of the tools and suggest further developments. Candidates were asked to rate the product according to 9 criteria:

1. Navigation. The ease with which users can move through the product.
2. Cognitive load. Consideration how much harder, or easier, the product was to use compared to the 2D products that they used in the past.
3. Mapping. Relates to how the program tracks as they use the program, and how it provides feedback. They were asked to reflect upon whether this 3D assists in understanding the spatial and locational aspects of the area more.
4. Screen design. The actual design components.
5. Knowledge space compatibility. The type of information provided in the product related to whether the prototype provided the needed tools for making decisions.
6. Information presentation. Considered whether the information presented provided 'extra' information about the area that would not have been possible with conventional 2D products.
7. Media integration. The 'putting together' of the different media types.
8. Aesthetics. The 'look' of the product, and its form.
9. Overall functionality. The perceived utility of the product.

An initial 'filtering' of candidates was made to ensure that only expert user/producers completed the assessment. This was one of the requirements of the Reeves and Harmon [9] method that underpinned this evaluation. Candidates were asked to rate the product in each of the nine evaluation areas (from 1 (Difficult) to 10 (Easy). General comments about the product were also solicited. During general discussion after the formal input via the questionnaire, general comments were also provided. Positive and negative comments are tabulated below.

Positive comments	Negative comments
Useful in planning decisions Useful adjunct to 'on-site' inspections. Don't necessarily need to 'dress' the bulk of the buildings (ie add image of building to VRML primitive shapes). There was some disagreement with this concept by some members of the group. Would provide the means for better decision-making	Would be improved if shadows were added Images need to look 'more VR' Vegetation in the sandbox is hard to visualise. Users were wary that images might be manipulated to create a certain image. Didn't like the scenario's limititing factors – i.e. it provided only a corridor to work within. Needs a purpose to drive the system.

Table 1. Comments from the focus group.

In summary, the test group generally liked the concept, but the actual product needed to be refined as per the feedback and use of 3D improved the interpretation of the area being studied. There was some comment on the use of navigation tools associated with the actual VRML browser plug-in and this was addressed in product development between this and the next stage of development. There were some comments on the need to provide high levels of detail for all buildings. This was also addressed in developing prototypes for Stage 2.

Stage 2 of the evaluation – How naive can the virtual world be?

This Stage evaluated how the 'geographical dirtiness' of the Virtual Environment changes the perception of a space. As the users of the product understood that the product was to be delivered on-line, they therefore had no information about whether users of the product had an understanding of the 'real' reality of the area, which is the models generally show a 'clean' neighbourhood, devoid of street furniture, people, cars, graffiti, etc. The model views shown in previous figures (2 – 4) show this clean virtual world. A walk through the area shows the real reality – one of a densely populated inner city area (figure 5), with associated things like graffiti on buildings (figure 6). To solve this problem more detail can be added, but this is a costly exercise in time. Therefore this stage of the research had also to determine how 'dirty' a model needed to be to depict an inner city area effectively. And, did the level of geographical dirtyness required to 'paint' the best picture change from inexpert user to expert user?

Therefore this stage of the evaluation the main task was to understand how complex a computer graphics 3D environment really needed to be to support community discussion of urban planning developments. The approach to this stage of the evaluation was designed to complete two tasks:

- To determine the test candidates' understanding of the geography of the test neighbourhood; and
- To determine how 'dirty' (complex/detailed) the computer visualization needed to be so as to provide a more usable product.

We wanted to better understand how the 'geographical dirtiness' (complexity) of the virtual environment changes the perceptions of users of a virtual space. Basically, our question was: how much detail (or dirtiness) is necessary for a visualization to 'work'?

Figure 5. Reality of the densely populated inner city study area.

Figure 6. Graffitti on walls in the area

Testing

Users were first asked to grade themselves as belonging to one of five typical user types:

- Grade 1: they had a simple understanding of the geography of the area – they knew the general pattern of the streets.
- Grade 2: they knew the major landmarks in the area – the major buildings. They did not have as much knowledge of the side streets.
- Grade 3: They knew all of the major buildings in all of the streets.
- Grade 4: They knew all of the intermediate buildings as well as the major buildings. They had a good understanding of the geography, but they did not know the exact details of every building and every street.
- Grade 5: They had a comprehensive knowledge of the area – they knew details of all buildings, including what they are used for, and every street and laneway.

Then users were asked to view each of five visualizations, each with an increasing level of geographical dirtiness and then to complete a feedback document. Candidates were asked to consider whether the amount of detail provided is sufficient for you to understand the general geography of the area. And, did it provide sufficient information for a community discussion on new developments in the area? The following sections provide brief snapshots and descriptions of the five scenarios built for testing. Level 1 was the simplest VRML world and Level 5 the most complex (and most 'populated').

Level 1 (figure 7) was a simple visualization of the part of the main road in the study area - Sydney Road. This was a 3D world that only contained transparent 'shells' of the buildings in the study area. This was considered to be a basic level of information for community discussion of urban developments in the area.

Level 2 (figure 8) had roads added and the surrounding buildings were colour-coded to indicate the current building use. A sky 'dome' was added, which provided the means for the model to appear to continue above the buildings, whereas the level 1 model only provided a flat dark blue backdrop.

Level 3(figure 9) had all of the buildings in full detail. Road detail remained as it appeared in level 2.

Level 4 (figure 10) had signage, suspended beneath verandas, above verandas and as sandwich boards on the street included. Road detail was enhanced with different textures on footpaths. Street furniture was also included – seats, bicycle stands, rubbish bins, parking signs, etc. Light poles and overhead tram power cables were also added.

Level 5 (figure 11) had cars, trams and people 'populating' the main road - Sydney Road. This model was further enhanced with synthetic shadows.

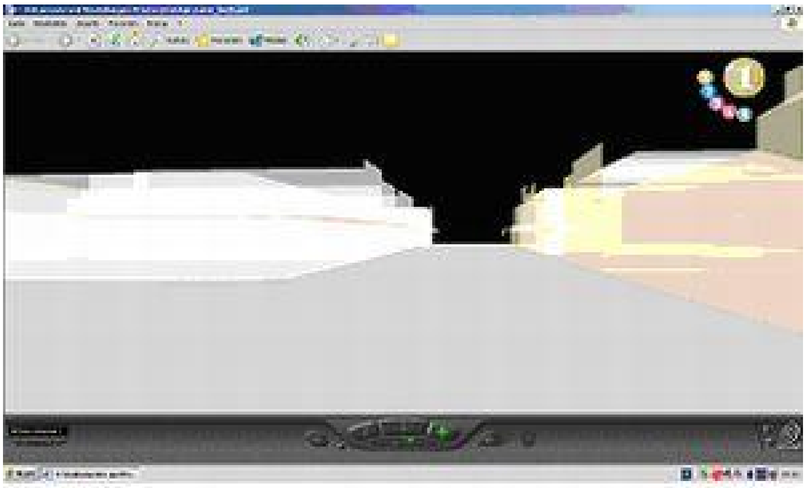

Figure 7. Level 1.

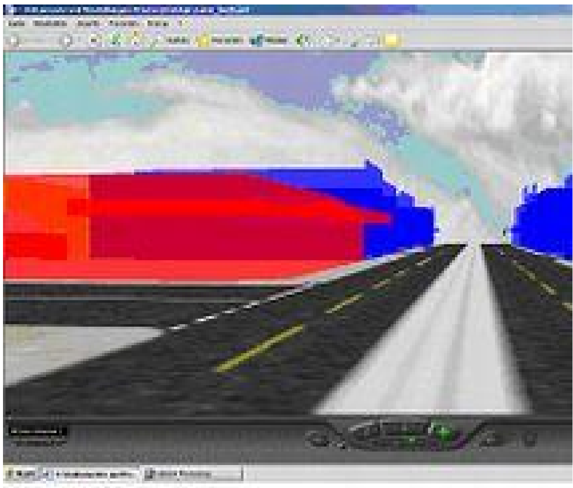

Figure 8. Level 2.

Figure 9. Level 3.

Figure 10. Level 4.

Figure 11. Level 5.

For this evaluation, two user groups were canvassed for their opinions: a community group and professional planners. Each group met on separate occasions. The community group was drawn from the local area and the professional group came from the Department of Primary Industry, and particularly from the group that deals with planning issues, and planners attending the Australian Planning Institute conference held in Melbourne in April 2005. The results reported in this section have grouped the professional planners as one composite group.

Candidates were asked to view each section independent of the following, more complex scenes. They were then rated the statements, listed below, for their accuracy in describing how they felt about each stage's visualization.

- There are adequate landmarks to assist me in orienting myself;
- The amount of detail is sufficient;
- Having the buildings shown as outlines is sufficient;
- I need more detail for this 3D model to provide me with an adequate mental representation of the area; and
- The addition of extra information would make it easier for me to build a mental image of the area.

The community group was asked one additional question: It is obvious where this area is located in my neighbourhood?

After rating each of the statements the candidates were shown the next level of information and they addressed the same questions. At the end of this formal processing a 'free comment' session was held, where candidates were encouraged to make more general comments on the various stages. The following sections report initially on results from the community group evaluation, and then provide results from the professional user group. The comments underlined were seen as important comments for further developing the product for Stage 3 of the evaluation.

Results – Community Group: Levels of Complexity

As the tool was designed to work for both community member and professional planner, it was important to ascertain what the community members needed in a virtual landscape so as it could be used as an effective tool. Comments that were seen to be important for developing a final, Stage 3 evaluation tool are highlighted in grey.

Level 1:

Person	Comments
1	Too hard to recognise which is the building next door Not enough differentiation between buildings Have trouble identifying the streets
2	Would be very limiting in terms of what this could be useful for Bit like a maze
3	I would have put "5" for questions 1-4 (on questionnaire) if the street names had been marked.
4	It is too difficult to get orientation reference points quickly when viewing at this level. The transparency is confusing – the distinction between buildings is too fuzzy
5	Works best when viewed from above i.e. when used like a 2D map/aerial view. Down at street level it is too difficult to pick out features

Table 2. Comments from the community group on Level 1.

Level 2:

Person	Comments
1	Aerial view assists in orientation but once I was back on street level had difficulty establishing locations. Multiple views a plus
2	Great map/model for zoning purposes Aerial good
3	Colour coding makes little difference
4	Slightly easier to orient oneself in space than level 1 but still not enough detail. Transparency is more acceptable when colour coded
5	Much better than level 1 but best when viewed from above – at ground level seems a bit confusing

Table 3. Comments from the community group on Level 2.

Level 3:

Person	Comments
1	Once again, aerial or semi-aerial view assists in orientation when looking at the whole area face on. Much easier to locate area when presented with detail, such as recognisable buildings
2	Depends on the purpose of the exercise and what you hope to achieve from the model. o Home use- plenty of detail required but ok here o Work – could use more detail in Sydney Rd
3	
4	Any further detail – eg not such a sharp cut off at boundary – would help marginally by allowing me to "place" the section in the overall landscape, but more detail is not really necessary. The sky is important
5	The first level to make sense at ground level, but is no more useful than level 2 when looking from above/aerial.

Table 4. Comments from the community group on Level 3.

Level 4:

Person	Comments
1	Probably you don't need this much detail if looking at major changes to the neighbourhood.
2	Great to add traffic congestion, people. Planning/development; painting facades/roofs all excellent
3	NO COMMENT
4	For some purposes (eg detailed urban design strategies) this level of detail would be helpful. But for many planning purposes the extra detail is not necessary or even helpful.
5	Signs and other detail are a great gimmick but maybe a bit of overkill. Could be very useful for some applications but previous levels of detail is sufficient for most visualisation needs associated with planning decisions (except maybe more detailed things). Trams/powerlines are good though as such a dominant feature of Sydney Rd

Table 5. Comments from the community group on Level 4.

Level 5:

Person	Comments
1	The figures of people are distracting Vistas at the end of the road make the picture look more realistic, but I'm not sure they are necessary This gives a more realistic view of Sydney Rd and surrounds
2	Extras are great but shadows generally not necessary. People not really necessary. Picture of street at the end is excellent.
3	
4	Shadows not necessary. Simple representations of people adequate, but don't need to make them so colourful or dominant. Not stopping at end of world is useful.
5	This is highly detailed – fun and interesting but unnecessary for a lot of planning purposes. Addition of cars/people helps to give the "vibe" of Sydney Rd – clutter, bustle, chaos confusing. Feels too much like computer game rather than helpful tool

Table 6. Comments from the community group on Level 5.

Part 3: General Comments:

The final stage of the evaluation asked two questions:
Q1. Leaving the models unchanged, which level of information did you prefer?
A. Levels 3, 4, or 5 were seen to be useful.
Q2. If a basic model only could be provided, which level of information could you work with and achieve a useful mental image of the study area?
A. 1, 2, 3, 4 and 5

After further discussing the models it was generally agreed "less is more!". Therefore it was ascertained that the simplest model possible needed to be built, but this model must contain certain design elements. From the formal questions and later discussion a number of design guidelines were assembled. These were used, along with the complementary informational from the professional user group to determine the contents of and adequate levels of detail for a virtual landscape that is: 1) Usable and useful and 2) A model that can be built and maintained without heavy development and maintenance costs.

A model that would 'work' would contain the following elements:

- Transparency must include colour coding.
- It would contain street sign.
- An aerial view must be included – for orientation
- Detail is only necessary at street level –it is not needed at the aerial view. This could be realised by using the 'level of detail' in VRML coding, whereby detail is 'added' when the user moves within a certain proximity to the model.
- Street furniture is not really needed for considering general planning aspects.
- The addition of extra elements in the model "makes it look like Sydney Rd" (people, cars, horizon), but people in the model can be distracting. Therefore this is a consideration that needs to be further investigated, so as to ascertain the usefulness of adding these items.
- The 'visual returns' from adding shadows are minimal and some candidates saw them as a distraction.
- 'End of the world' cannot be shown and adding images at the end of the streets improved the image. (This could be called the 'Truman Show' effect, after the movie where the main actor, Truman, lived his whole life on a massive movie set – the world did end, and this was shown at the movie climax.)
- The use of the sky on the inside of the enclosing sphere is necessary.

RESULTS – PROFESSIONAL GROUP: LEVELS OF COMPLEXITY

The professional group was shown each of the five levels in turn. After a 'guided tour' they were asked to rate the virtual world level of detail by indicating whether they agreed or disagreed with the statements provided on an evaluation proforma. The sections below tabulate the results from each evaluation candidate. This has been done statement by statement, with the rating for each level of detail shown in subsequent table rows. In the table a 1 represents the lowest or most negative impression – the candidates disagree with the statement. A grading of 3 indicates that the candidate generally agreed with the statement. A value of 5 is the highest value and this indicates that the candidate agrees with the statement.

So as to be able to consider whether the returned grading supported the fact that a level was inadequate, a generally adequate visualization and one that that the candidates that was appropriate and they could use in their professional activities, the table cells have been coded with different levels of tone, viz:

Inadequate
Generally adequate
Appropriate and usable

When looking at the tables the darkest grey infill indicates that this level of information 'works' for:

1. Orientation
2. Providing enough detail
3. An adequate mental representation of the study area.
4. That the information level is sufficient to build a mental image of the area.
5. The addition of extra elements does not make the image too complex. (Refers to level 5 only.)

Question 1
There are adequate landmarks to assist me in orienting myself.

	PERSON									
LEVEL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	1	2	2	4	2	3	3	3	2	1
2	2	3	2	4	2	3	3	3	2	1
3	3	5	4	5	4	4	5	5	4	4
4	3	5	5	5	4	5	5	5	5	5
5	4	5	5	5	5	5	4	5	5	5

Table 7. Results from questions related to orientation.

Looking at the table above it is obvious that, in general the professional candidates could work effectively with the landmarks in Levels 3 – 5. For all candidates Level 5 contained the best landmark information.

Question 2
The amount of detail is sufficient.

	PERSON									
LEVEL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	2	2	2	3	1	1	3	3	1	1
2	3	2	2	3	2	3	4	3	1	1
3	3	5	5	4	3	4	5	5	2	4
4	4	5	5	4	4	5	4	5	4	5
5	5	5	5	5	5	5	4	5	4	4

Table 8. Results from questions related to whether the amount of detail was sufficient.

Levels 4 and 5 have sufficient levels of detail, but Level 3 appears to be adequate.

Question 3
The third question addressed was "Having the buildings shown as an outline is sufficient". This question was asked to the planners at DPI but, upon reflection, the question was considered to be quite similar to the question that followed this one: "I need more detail to provide me with an adequate mental representation of the area." Thus the question was not used in the second 'professional' evaluation. Therefore the answers given by the first professional group were removed from consideration.

Question 4
I need more detail to provide me with an adequate mental representation of the area.

	PERSON									
LEVEL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	4	4	5	4	5	3	4	4	5	4
2	4	4	5	4	4	3	4	3	4	4

3	3	1	3	2	4	2	2	1	4	4
4	3	1	2	2	-	1	2	1	4	1
5	2	1	1	-	1	1	2	1	2	1

Table 9. Results from questions related to improving the ability to make an adequate mental representation of the area.

Levels 1 and 2 contain insufficient detail to be considered useful. The other three levels have enough detail.

Question 5

The addition of extra information would make it easier for me to build a mental image of the area.

	PERSON									
LEVEL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	4	4	5	4	5	4	4	5	5	4
2	4	4	5	4	4	4	4	5	5	4
3	3	1	3	2	4	2	3	5	5	4
4	3	1	2	2	5	1	3	-	4	
5	2	1	3	-	3	1	4	1	2	1

Table 10. Results from questions related to whether the addition of extra information would make it easier to visualise the study area.

Levels 1 and 2 need extra detail added. Level 3 is just adequate.

Question 6

The addition of extra elements – people, cars, trams, street furniture, etc. – makes the image too complex. (ie it has a negative effect, rather than improving the model. Note – this question was only associated with Level 5.

	PERSON									
LEVEL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
5	2	2	3	-	-	3	2	5	2	5

Table 11. Results from questions related to whether the addition of extra 'clutter' information actually improves the visualization.

The candidates were divided here. Some liked more detail, others were unplussed about the need for extra detail.

The questionnaires also asked for additional comments about how each level could be improved. Obviously, with an unlimited budget and with no time constraints, all desired elements for each level could be 'built'. But, a compromise was needed so as to be able to specify what could really be built for professional users of such tools. These comments are listed below:

Level 1

- Level of detail "just" ok for building a mental image but not sufficient for most, if not all, planning purposes;
- Seeing buildings through other buildings, through other buildings is confusing; and
- The level of detail required should depend strongly on the purpose of the study.

Level 2

- Needs a legend so user can tell what building type it is;
- The colour coded land use is more useful;
- The road texture made a big difference to being able to place the geography; and
- Can only the major landmarks be detailed?

Level 3

Vegetation and facades useful for various planning tasks associated with local area planning, master planning and environmental planning (biodiversity)

[Users were asked by the facilitator their thoughts on a Level 2.5]. (This) would be very useful, with landmarks etc included. (Combining photos of facades with level 2 colour scheme). This led to some further discussion on the attributes of a simplified Level 3 model. Here comments were included:

"If had a few key buildings at level 3, could have rest at level 2".
"If knew one building, I know what's next door"

Level 4

- Useful having street signs to help navigate/educate user where they are;
- Extra detail supplied in this level useful in asset management and traffic control tasks;
- Maybe too much detail; and
- For other types of planning studies this level might be sufficient.

Level 5

- Huge jump from 3 to 5;
- The cars and traffic are a good addition – potentially quite useful for planning;
- Unsure if the people are necessary;

- The photos for the end of the streets [“end of the world”] are important;
- Don’t think shadows are that important; and
- Perhaps all objects (including trees) should be represented at the same level of complexity.

PART 3: General Comments

As per the comments general comments asked of the community group, the same was done for both professional groups. These comments are shown below:

Q1. Leaving the models unchanged, which level of information did you prefer?
A. Levels 3, 4, or 5.

Q2. If a basic model only could be provided, which level of information could you work with and achieve a useful mental image of the study area?
A. 2, 3, 4 and 5. (Again, there was a range of preferences. And, after discussion related to the possibility of building level 2.5, there was interest in such a level being developed.

Other comments related to using a Level 2 model with landmarks. Also, it was thought that the colour coding of land use should probably have 2 tiers: 1. general industrial, residential etc and 2. restaurant, office etc. And, one respondent commented that the design guidelines might need to consider the area being studied – e.g. within 10 km of CBD and in an Activity Centre we need probably a level 4/5. In a new area (e.g. fringe) probably a level 3 would suffice. And, the comment that "people not necessary" was again given.

DISCUSSION FROM STAGE 2 EVALUATION

From the evaluations completed with the community and professional groups a wealth of information has been assembled that can be used for developing guidelines for building a world that satisfies the needs of both user groups, but also is 'buildable' with modest inputs of time and data maintenance. It was decided to base the model for final testing on the Level 2 world, and to enhance this by the addition of:

- Colour code land use;
- Include a legend;
- Add street signs for navigation and location awareness;
- Provide an aerial viewpoint for orientation;
- Use 'level of detail' to reduce detail at the aerial view, but have increased detail at street level;
- Avoid 'end of the world' models, and use images at the end of each street. (Perhaps include collision detection that disallows users penetrating these images);
- Include the sky image;
- Add appropriate landmarks;
- Include different road textures; and
- Add some street furniture for specific use.

These general guidelines were used to build the final model for evaluation. This model was called Level 2.5.

PREVIEW OF STAGE 3

The Level 2.5 model was designed around the guidelines developed during Stage 3 of the research, outlined in the previous section. It is 'built' on the Level 2 world, with landmark buildings, street signs, road surfaces, selected street furniture (power poles and lines) and 'end of the world' images (with appropriate collision detection added. As well, a legend has been added. The Level 2.5 model is depicted in figure 12.

Figure 12. Level 2.5.

The users of Level 2.5 will have different 'local knowledge of the study area. When evaluating how effective a Level 2.5 model really is, it will be necessary to ascertain how a priori knowledge of the area changes navigation and exploration abilities when 'moving through' and exploring the Virtual World? Here we intend to ascertain how what the users already know about the real world and how they apply this knowledge to the virtual determines the effectiveness of the Level 2.5 model. Once this is known, a final version of the model will be re-designed and subsequently tested to determine the level of detail required for users with and without a prior knowledge of the study area.

CONCLUSION

This paper has described a research programme that is testing a tool for community collaborative decision-making. It described the evaluation that is being conducted in three stages and it has described the results from the first two stages of the evaluation. From the evaluations thus far, the research team have found that both community members and professional users have deemed the tools to be useful adjuncts to what they usually employ when considering planning matters. It was found that preferences for the amount of detail desired in virtual landscapes vary from user to user. However, a 'compromise' model, one that includes basic planning and building information, supported by more detailed landmark building and adjunct information would provide a useful and usable tool. This model is being built and tested as in the next stage of this project.

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BIOGRAPHY OF PRESENTER

William Cartwright is an Associate Professor of Cartography and Geographical Visualization in the School of Mathematical and Geospatial Sciences at RMIT, Melbourne, Australia, where he specialises in applying New Media technologies to Cartography. He joined the University after a number of years in both the government and private sectors of the mapping industry. He is a Vice-President of the International Cartographic Association and a National Councillor of the Mapping Sciences Institute, Australia. He is a member of the ICA's Commission on Visualization & Virtual Environments and the Commission on Maps & the Internet. His major research area is New Media and cartography and the exploration of different metaphorical approaches to depicting geographical information. He holds eight university qualifications - in the fields of cartography, engineering, education, media studies, information and communication technology and graphic design.