Digitally Distributed Urban Environments: The Prospects for Online Planning.

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ABSTRACT

Planning is about communication, the communication of space and place in relation to built form. The advent of digital networks provides the opportunity to radically change the concept of communication not only within the urban planning system but also within wider fields related to the development of the built environment. How we communicate is increasingly becoming digital and the rise of the Internet in particular during the last decade, has freed planning from the constraints of working hours and the reliance on specific locations and times to portray information. Information can now be visualised, communicated and manipulated at any location, any place, at any time, as long as we have the political, cultural, and economic means that give us access to the relevant technologies. These technologies are on the edge of a new revolution in our ability to design, communicate and plan at a distance. The revolution on the horizon is one of the 'inhabited virtual place', a place where the environment is represented digitally in three dimensions and communication is achieved through avatars, defined as an individual's visual embodiment in the virtual environment. Avatars in these emerging environments are the stakeholders, the occupants and the commuters of the digital realm. As such they are also the citizens that will design, occupy and manipulate built form in the development of digital planning with a say in the future planning process. These developments contribute towards a digital 'Online' planning system which is explored in a series of working examples throughout this thesis.

EXPLANATORY NOTES AND LINKS TO RELATED WORK

Note on examples and online demonstrations

As the nature of this thesis is digital, to fully understand the examples, it is preferable to view them side-by-side with this document in a web browser. As such a companion web page has been set-up containing links to all the examples covered in this thesis. The thesis is also available, in full colour, online in Adobe Acrobat format. The website may be viewed by pointing your Internet browser (Explorer version 5 or above, or a compatible browser is recommended) at:

http://www.casa.ucl.ac.uk/digitalplanning/

The site also contains information on the latest research that has been placed online post publication.

If readers wish to go directly to any examples they may be found at the following locations:

30 Days in ActiveWorlds
http://www.casa.ucl.ac.uk/30days/
Hackney Building Exploratory Interactive
http://www.casa.ucl.ac.uk/hackney/
London Bridges Interactive Visualisation
http://www.casa.ucl.ac.uk/londonbridges/
Online Planning
http://www.onlineplanning.org
Online Planning Journal
http://www.casa.ucl.ac.uk/planning/
Shared Architecture
http://www.casa.ucl.ac.uk/public/meta.htm
The GlassHouse
http://www.theglasshouse.org.uk/
Virtual London
http://www.casa.ucl.ac.uk/virtuallondon/
Wired Whitehall
http://www.casa.ucl.ac.uk/vuis/
Woodberry Down Regeneration
http://www.hackney.gov.uk/woodberry/

The example of Dounreay Nuclear Power Station is not available online due to security issues.

<u>Note on the use of the term 'he'</u>

In this thesis, when we refer to the avatars or users of cyberspace, we use the term 'he' not she or he/she. We will assume the reader accepts this terminology.

<u>Note on the use of the term 'web'</u>

For grammatical clarity, we refer to the World Wide Web in its shortened form as 'web'

<u>Note on the use of ACRONYMS and UK government definitions</u>

We usually define all acronyms although in certain cases where government departments and ministries are referred to, particularly in the UK, we do not define this. This is partly because they are continually changing but the references to such instances at the end of the thesis clarify the sources. We also use a number of terms associated with UK government and local government which are know to UK readers but may be foreign to non-UK readers but the meaning of these is clear from their context.

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CHAPTER ONE

Introduction

1.1 Overview

Planning is about communication, the communication of space and place in relation to built form. The use of digital networks provides the opportunity to radically change the concept of communication not only within the urban planning system but also in wider fields related to the development of the built environment. How we communicate is becoming increasingly digital. The rise of the Internet in the last decade has reduced the reliance on space and time to portray information. Information can now be visualised, communicated and manipulated at any location, any place, any time, as long as we have the political, cultural, and economic balance that commands access to the relevant technologies. These technologies define the edge of a new revolution in our ability to design, communicate and plan at a distance.

The revolution on the horizon is one of the inhabited virtual place, a place where the environment is represented digitally in three dimensions and communication is achieved through avatars[1], defined as an individual's visual embodiment in the virtual environment. Avatars in these emerging environments are the citizens, the occupants and the commuters of the digital realm. As such they are also the citizens that will participate, occupy and manipulate built form in the development of digital planning. They will have a say in the future planning process. This is the next horizon for the technological realm of the Internet, which is explored throughout this thesis. It is currently in the realm of academia and not part of the day-to-day activity that we call planning. Indeed planners have failed to use computers in planning to any great extent since their introduction in the 1950s. However, as Klosterman (1998) states, planners' continued failure to use computers extensively for core planning functions results less from limitations of their hardware and software tools than from a limited understanding of the proper role these tools should play in planning. This thesis is designed to address some of these problems.

[1] An avatar is a term from Hindu – we define it fully in Chapter 4.

The key to the future is understanding the network as another tool and identifying the roles it can play in the planning process. Indeed, the network is leading to an emerging toolkit for digital planning, a toolkit not aimed at the planning profession *per se* but at the wider internet community pushing the boundaries of Online communication and visualisation. The majority of these tools are in the realm of freeware and shareware, enabling innovative visualisations and participation systems to be developed without inhibitive development or distribution costs. Examples are provided of networked virtual spaces linked with geographical information systems, providing users with the ability to walk, communicate and interact with a virtual planning environment irrespective of physical location. These emerging virtual spaces provide the opportunity to democratically open up the planning system to the public, to make the planning system dramatically more accessible. The ideologies behind the development of what is essentially a 'toolkit' for digital planning have been drawn from fields as far apart as traditional planning theory to advanced gaming technologies which collectively are providing methodologies and insights into the development of virtual planning and design.

The toolkit for digital planning is based on the visualisation of the real world in the ether that constitutes the network. It is about creating a representation of real space in the virtual, via a user's desktop environment. As Benedickt (1996) states, knowledge of space is hardwired into us, and it is this knowledge that digital planning should aim to tap into when portraying a virtual environment over the World Wide Web. But digital planning is not about virtual reality, it is about portraying reality in a virtual world. There is a fine line between this and the science fiction realism of virtual reality. With ever increasing computer power, it is important not to lose sight of this goal of visualisation and portrayal, allowing citizens a voice in the built environment of the future.

As such, the built environment is no longer limited to the physical world for it is becoming possible to build vast sprawls of urbanity in networked worlds. Emerging from the 1990s gaming world of SimCity, environments are now developing online that allow citizens to build their own utopia over the Internet. Batty (1997) defines these environments as the emergence of a 'Virtual Geography'. Unplanned virtual geography is expanding as more users are linked to the Internet. These users can build a three dimensional house, skyscraper, beach hut or whatever their imagination and a combination of the available virtual building blocks allow. At first glance such environments may appear playful and non relevant to the planning process as a whole. But considering that people can build their own utopia online, the question needs to be asked what are they building? Does the planning system ever give people a completely free reign on what they could build? The answer is essentially no for various reasons, mainly practical and economic, but also professional. Surely planning should be left in the hands of planners, trained professionals educated through accredited courses to plan for the public? Yet virtual geography allows people to build their own utopian vision, a vision in which some participants spend more time in than the real world. These worlds can be used for planning experiments, community builds, and 'what if' scenarios.

Such worlds are experimental, but a toolkit for digital planning, it can be argued, is established through this thesis, ready to be put into practice. Developments during this research have already been used in planning practice, providing an insight into the impact of emerging technologies on the planning process. One among many conclusions is that the planning process will move away from a process of confrontation towards a new era of collaboration. The use of networked communication and networked visualisation provides such an opportunity for effective, low cost public involvement in the planning process. 'Communicative planning' (Forester, 1989), 'argumentative planning' (Fichers and Foresters, 1993), 'planning through debate' (Healey, 1993) or inclusionary discourse (Healey, 1996) are terms which have been used in planning theory to explore concepts of public participation and the inclusion of community in the planning process (Thomas and Jones, 1998). Planning Policy Guidance Note 12 (DTLR, 1999, p.192) states that local people should participate actively in the preparation of plans from the earliest stage.

Yet the planning profession has continually failed to effectively involve the public. Exercises such as 'Planning for Real' which we explore in Chapter 3, may be one way to consult and inform the public, but these only take place in any one location at any one time. What happens to the people who cannot attend because of issues of availability or physical ability? Digital planning removes the restrictions of time and location and, with the addition of multi-lingual information and systems such as Online voting, procedures can be put into place to ensure consultation is carried out in a democratic manner. It does add the problem of access to the relevant technology, but this can be addressed if the political will and economic reality allows. Such an example is explored in Chapter 8 relating to the development of the Woodberry Down Public Planning Support System.

The ability to plan and design using digital networks offers the planning system and the planners a unique challenge - to restructure itself with a modern public-orientated profession, leading the way in the development of Online services, e-government and e-democracy. The tools, methodologies and techniques are laid out in this thesis, based on both research and real-world examples.

1.2 Detailed Outline of the Thesis

1.2.1 Part 1: Contexts

Chapter 2 examines the development of digital planning and its use in planning practice. The aim is to establish a background to the current emerging technologies used in the development of a digital planning toolkit. It considers the waves of innovation that have taken place in the development of computing technology to the present day and theorises on why computers have not to date made a significant impact on the planning process. It also considers the Government White Paper 'Modernising Government' (Cabinet Office, 1998) and its impact on the planning system with regard to requirements for the electronic dissemination of information through the e-government initiative.

Chapter 3 examines both digital and non-digital examples to communicate issues of design in the planning process. A focus is provided by Arnstein's (1969) Ladder of Participation allowing analysis to be carried out on the effectiveness of both digital and non-digital communication. Finally a review is carried out to examine how the planning system is currently utilising digital networked technologies to provide a context for the research examples explored as the basis of this thesis.

1.2.2 Part 2: Tools for Digital Space

Chapter 4 explores the concept of space and the problem of representing space and place over the Internet. It introduces digital embodiment, in the form of avatars and examines the types of space that are currently emerging Online. Following this it documents how these spaces have been influenced by gaming technologies and examines the emerging digital geographies.

Chapter 5 reviews the requirements of creating a virtual environment that can be distributed via the Internet. It focuses on Brutzman's (1997) six components of 'Internet

Distributed Three-Dimensional Graphics'. It examines methods of portraying real-world space over the Internet at four levels of detail and abstraction, namely panoramic, prismatic primitive, prismatic with roof detail, and full architectural rendering. It examines techniques to produce models from standard 35mm or digital photographs, aimed at the creation of rapid three-dimensional structures to gain a sense of location and place Online.

1.2.3 Part 3: Development and Application

Chapter 6 documents the development and utilisation of research towards the development of a public planning support system (PPSS). It begins with the development of 'Wired Whitehall', a World Wide Web site developed to explore the use of panoramic-based digital visualisation to portray a virtual tour over the Internet. Wired Whitehall leads on to the first use of augmented reality in the United Kingdom for a Planning Inquiry on behalf of Wates Built Homes in Wandsworth, South London. The chapter continues with a move to the third dimension in the form of 'Shared Architecture' and the ability to build three-dimensional models into collaborative environments. Finally a focus is provided in the form of 'Hackney Building Exploratory Interactive' and the use of digital visualisation as a tool for the public understanding of science.

Chapter 7 takes a side step and examines the implications of emerging collaborative three-dimensional spaces on the Internet. It documents an experiment '30 Days in ActiveWorlds' aimed at creating a virtual utopia built by users worldwide. What was built, by whom and why is documented, thus providing an insight into life in a virtual world.

Chapter 8 explores the use of the preceding ideas in the placement Online of a PPSS for the residents of the Woodberry Down Estate in Hackney, North London. Developed as part of a regeneration scheme, it documents the development of the system from first consultation with residents and the redevelopment team to the placement Online of a virtual tour and bulletin board system. It discusses the political, economic, cultural and technological boundaries that need to be overcome to develop a functional system.

Chapter 9 details more ambitious plans for Virtual London, building on the research to date. It documents the organisations involved and speculates on the future of city wide digital planning systems moving towards the prospect for increasing numbers of people taking part in 'Online Planning'.

Chapter 10 draws together conclusions from the research examples and theory explored in the thesis. It also speculates on the future of digital planning and how technologies are at the point of changing public consultation in the planning system.

Part I

Contexts

"How can the planning process truly aim to improve the quality of life for the whole of society if society is only given a limited say in the process?"

Peter Hall, *Cities of Tomorrow*, 1995, p213

"He is not seeing real people, of course. This is all a part of the moving illustration drawn by his computer according to the specifications coming down the fibre-optic cable. The people are pieces of software called avatars. They are the audio-visual bodies that people use to communicate with each other in the Metaverse."

Neal Stephenson, *Snow Crash*, 1992, p35

CHAPTER 2

Digital Planning

In 1965, Gordon Moore predicted in his paper 'Cramming more components onto integrated circuits' that integrated circuits would eventually lead to such wonders as home computers – or at least terminals connected to central computers, automatic controls for automobiles, and personal communications equipment. Moore looked at the advancing chip-making capabilities at Intel and proposed that computer technology would double in capacity every eighteen months (Seig, 1997). To date this has remained true. The advances predicted by Moore led Newton *et al* (1998) to state that it is now technologically possible for practitioners in local, regional and national organisations to effectively plan-at-a-distance – from their own desks. This is digital planning. However, more than a decade on, we are effectively saying, and indeed predicting the same, that we now have the ability to plan digitally utilising new and emerging technologies. Technology affects what we plan, how we plan, who plans, and is set against the wider context of why we plan (Batty, 1991). It affects the three major professional activities of planning: analysis or the deployment of knowledge, design or the activity of invention, and the management of public participation through the engagement of planning with its clients and publics (Harris, 1999).

Emerging technologies and network infrastructure are seen as bringing about a transformation to digital planning which may be as important an innovation in the planning system as the introduction of the development plan itself (Smith and Dodge, 1997). However, the planning profession is not traditionally an innovator in the field of technology: it is an adopter using existing software, computers and networks and adapting this to how, what and who plans To state the case of the United Kingdom, it is also a late adopter with only 11% of local authorities in the year 2000 providing planning application information over the Internet (RTPI, 2000). Despite slow adoption of new technologies, reasons for which are examined later, there is a new excitement in the world of computer-based planning, reflecting the emergence of new computers and the role which computers can play in planning research and practice (Klosterman, 1991).

This optimism is not however something new for in the past, innovation in the use of computers and planning has been envisaged as occurring in 'waves' (Barrett and Leather, 1984). Each wave has been characterised by the introduction of new software and hardware into public use and the professional market on a wave of high expectation publicity and optimism, similar to the current wave of optimism surrounding digital networked technologies. Each new innovation or technical advance is deemed to be able to either solve complex problems, reduce man hours or enable tasks to be conducted which would previously have been unachievable. Indeed the computer has had a significant impact on how we plan, Yeh (1988) described the computer as being an indispensable tool for planners and planning departments. Indispensable it maybe but the use of computing in British planning dates back at least to the early 1960s, (Bardon, 1988). This can be seen to coincide with the first wave of computing innovation, characterised by the introduction of large mainframe computer systems. We illustrate these waves of computing in Figure 2.1.

2.1 The Mainframe

The first wave of computing innovation emerged during the early 1960's, characterised by the introduction of large mainframe computer systems. The 1960's primary concern in planning was system organisation to support the value-neutral process of rational planning (Klosterman, 1995). The mainframe computer was based on the ability to run large amounts of data through a pre-defined system with the production of numerical outputs relating to spatial analysis. The systems approach, which this use embraced, was initially used by academics utilising mainframe computers and custom written software to aid the analysis of spatial models. Its aim was to use computers in the planning process to produce plans faster, which were more precise and more comprehensive (Fite, 1965).

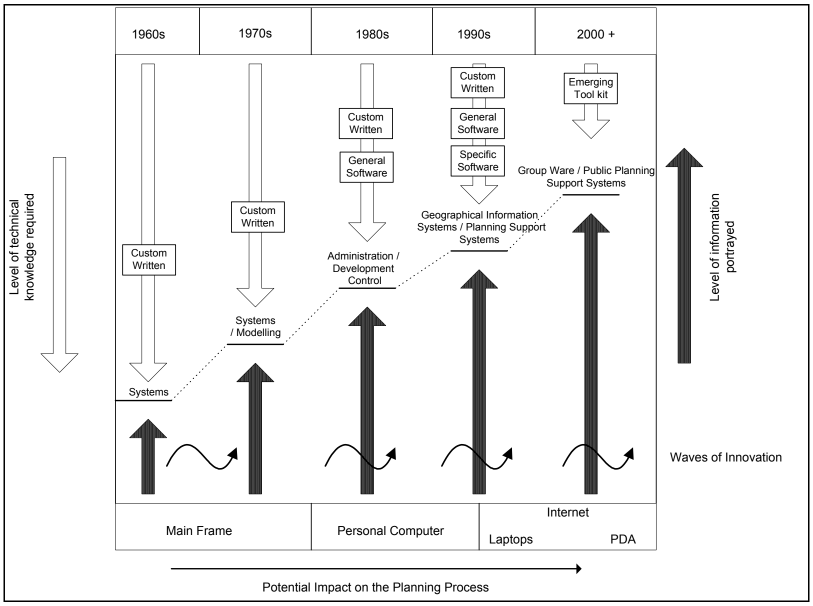


Figure 2.1. Computing, Software, Information and Technical Knowledge in Planning.

The use of mainframe computers in local authorities was limited mainly to financial departments, due to the mainframe's ability to process data. Barrett and Leather (1984) state that planning departments did not contemplate the use of computing in the planning system until the lead up to the 1968 Town and Country Planning Act. The Act led planners to examine applying computer-based modelling and forecasting techniques to formal planning and organising information to support the new planning system. The move towards the use of computers in planning was underlined by a number of studies examining the implications of computers in the planning system. Notable among the studies was the joint local/central research project on the information needs of the new planning system, culminating in the influential 'General Information System for Planning' report by the Department of the Environment in 1972 (Barrett and Leather, 1984).

During the 1970's the use of computers in planning practice increased, utilising the systems approach for mainframe computing applications. An example of the systems approach to planning can be seen by examining the sub-regional study of Nottinghamshire and Derbyshire. Predictions of population growth, employment trends and levels of accessibility were used in an attempt to assess future patterns of development. The data was processed using a mainframe computer, producing an output in the form of a comparative score, utilising a systems model known as 'Development Potential Surface Analysis'. The level of score produced related to an optimal choice of development location-based on the inputted variables. Such studies based on the systems approach, were deemed unsuccessful as the outputs were produced using logical decision making separating such predictions and their embodiment in strategic plans from the actual development control process. Barrett and Leather (1984) argued that the systems approach failed because of the divorce of planning theory developments from the reality of the organisational and political world in which planning took place. In reality, such systems running custom written software were mere number crunchers requiring a high level of expertise but with results of questionable relevance.

2.2 The Personal Computer

Computers cannot decide the outcomes of socially-based decisions, they can only present information and ease the processing of large amounts of data. The ability to present and process information characterised the second wave of computing in the late 1970s and 1980s with the introduction of the personal computer. The desktop sized personal computer provided convenient data input and storage, utilising pre-programmed software packages. They started to appear in local authority planning offices in the early 1990s, but it was not until the late 1980s that they began to be used widely and personal computing became a common occurrence in planning practice (Bardon, 1988). The personal computer represents the second wave of innovation in digital planning, allowing relatively low cost computers a place on the desk of planners. Computers began to move away from the dominant prior usage as solely scientific aids for doing fast arithmetic (Batty, 1980). The person al computer when it arrived on the desks of planners and academics, was touted as a new revolution. Batty (1980) amongst many has stated that the computing revolution is as fundamental as the invention of the written word. This is undisputed but in terms of impact on planning practice, particularly the core of planning, that of plan-making, the computer has not been as revolutionary as widely predicted.

Barrett and Leather (1984) identify four main areas of application of computers in the planning system during the early 1980's;

- Analytical applications such as modelling and forecasting, survey and census analysis;
- Development, maintenance and integration of management databases;
- Operational management or administrative uses, including planning applications processing;
- Communication-based applications, including mapping and graphics.

The introduction of the new technology into planning arrived with high expectations. Barrett (1982) commenting on the introduction of computers into the planning profession, stated that micros are the solution to all the problems experienced with large scale 'mainframe' computers; every desk can and should have one. Their impact was noticeable but not so much as a planning tool *per se*, more as a tool to aid administrative efficiency. The move towards administrative efficiency is illustrated by the report of the Local Authorities Management Services and Computer Committee (LAMSAC) Planning Applications Group (1989). The report concluded that the objectives of computerisation in local authorities were improved presentation of documents, minimisation of the use of clerical staff and fast information processing, thus relieving professional planners and officers from administrative and clerical work. The use of computers by planning departments increased throughout the 1980's, but advancement was predominantly in the field of administration.

2.3 Geographical Information Systems

The third wave of computing, in relation to the planning process, may be defined as the introduction of information organised around geographical locations in the creation of a Geographical Information System (GIS). GIS held much initial promise for use by the planning system. Information based on location presented the opportunity for advanced data integration and spatial analysis, a concept developed from the first wave of computing. Budic (1995) identifies planning applications applicable to the utilisation of GIS:

- Landuse Planning;
- Zoning;
- Growth Management;
- Impact assessment;
- Economic Development;
- Transportation Planning;
- Capital Budgeting;
- Infrastructure planning;
- Facilities Planning;
- Environmental planning;
- Housing and Community Development;
- Neighbourhood Planning.

Martin (1996) states that the main use of GIS technology in the planning system has been for environmental applications, due to the use of data which can be easily layered onto maps. GIS offers planning authorities the most comprehensive computer package available for location-based spatial analysis, to date. However the uptake of GIS by planning authorities has been slow with only 58% of local authorities in the year 2000 having a fully functional GIS system for use in planning (RTPI, 2000). It is important to examine the factors which have contributed to this slow uptake and adapt the concept of digital planning accordingly. Budic (1995) identifies seven factors which have affected the success of GIS utilisation in planning departments;

1) Political Support: strong political support is essential for the development of an effective GIS within planning departments. Political support ensures financial backing for GIS development and aids interdepartmental co-operation in implementing GIS technology.

2) Staff Support: an effective and efficient use of GIS requires specialist staff trained in GIS technology. If a GIS is to be implemented without the aid of specialised staff, it is more likely to be under utilised. This is a common problem in the use of GIS. Indeed Allinson (1994) states that most local authorities who have acquired a GIS have yet to 'unpack the boxes'.

3) Period of Utilisation: a GIS system is not an 'out of the box' application, for the implementation of a GIS is a time-consuming exercise. The initial input of data is a cumbersome process and staff have to be trained to enable full utilisation.

4) System Sharing: the use of GIS is applicable to a wide range of topics across government departments. If a GIS is used across departments, savings can be made in database management and specialist personnel. Cross-departmental utilisation will also ensure a wider, more comprehensive database, and a higher chance of political and financial backing for the project.

5) Comprehensiveness of the Database: a GIS database covering a wide range of information will enable the use of the system for a wide range of applications. An interdepartmental system is more likely to have a wide range of available data than a single departmental application. This is especially relevant to the use of GIS by planning departments due to the wide range of variables considered in planning applications. The use of an interdepartmental database enables planning departments to utilise a database which would otherwise be uneconomic to develop.

6) The Number of Applications Utilised: to successfully utilise a GIS, it needs to be applicable to a wide range of applications, particularly in relation to planning departments. The wider and larger the number of applications, the more likely a GIS is to gain financial and political support.

7) The Type of Task: the complexity of a task for which a GIS is utilised increases over time. During the initial implementation stage a GIS is likely to be used for routine operations and simple data analysis. As a GIS develops, it can be used for complex activities such as site suitability analysis.

Budic's seven factors affecting the success of GIS utilisation by the planning system, may be seen as a characterisation of the use of computing in planning in general. To generalise Budic’s view and apply it to the successful use of computing in planning in general, we can identify 8 interlinked factors which we illustrate in Figure 2.2.

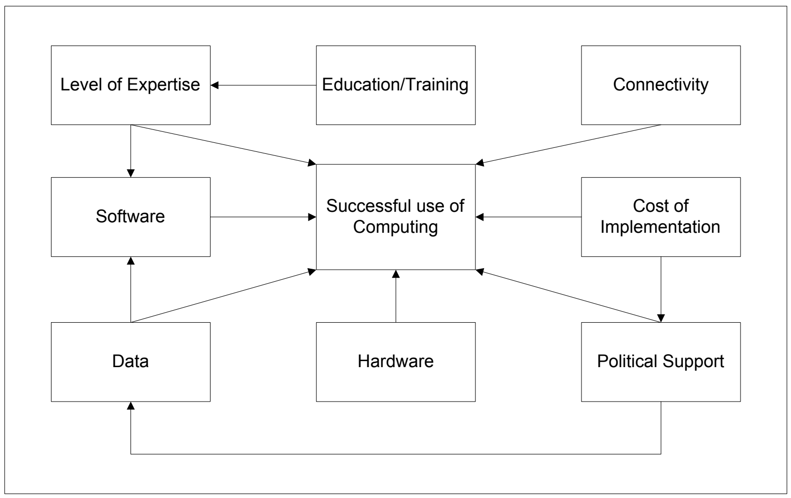


Figure 2.2 Factors in the Successful Implementation of Computing in Planning.

By definition, software and hardware are central to the successful use of computing in planning, but hardware is no longer all-important. The level of computing power has increased in accordance with Moore’s Law and cost has remained modest. Indeed since the early 1980s as Batty (1980) states, even though there may still be serious objections to the use of computers at all in planning, at least the issues are clear and no longer clouded by cost. It is the production and use of software in planning, which is arguably the most important part of the debate. It is no longer the hardware behind the computer that is innovative but the software. Planning is, as we have stated, a wide ranging activity and the use of the microcomputer in planning has been much hindered by the lack of specialised software (Yeh, 1988). Klosterman (1998) builds on this statement with the view that a small number of software developers will continue to produce commercial packages, but will necessarily be driven by market demands to produce packages for larger and better funded areas of planning and its administration.

Klosterman (1998) also argues that planning academics will continue to develop extremely interesting prototypes that are rarely available in practice. The fact that

Klostermann identifies academics in providing prototypes is a key factor. Both the production and the use of software has been, to date, a specialist activity that is more orientated towards academia than planning practice. More often that not qualified planners in practice do not possess the skills to use specialist software packages such as GIS. GIS is a professional tool and as such numerous academic courses have appeared over the last decade to provide training and qualification in geographical information and remote sensing systems. This is key to the problem in the use of GIS in planning for it is not a planning activity *per se*. A simple concept but one often overlooked is that planners are not educated to use GIS. It is noted that planning schools are increasingly offering GIS courses which are part of a planning qualification, but these are often optional courses rather than a core part of the planning curricula. This lack of education leaves a clear void in the ability for planners to utilise computers in planning, above and beyond administrative tasks.

A similar situation is arising concerning education in digital planning using the Internet. To put it simply, there are no accredited courses. Planners are thus missing out on one of the main tools to communicate in the digital age. The development of planning-based Internet sites is often, as in GIS, left to specialists. It could be argued that this is a good thing and planners should be left to plan, but with computers offering so much opportunity as a planning tool, planners need not only to be aware of the possibilities but also to be trained in how to fully utilise them. Until this happens, the specialist academic community will continue to develop interesting prototypes with little chance of them reaching practice.

Central to the move from academia to practice is political support. Support for the introduction of new technology to assist plan-making is all too often held back by key members in the planning process not having the foresight to experiment with new technological innovations before they come into common usage. This is examined further in Chapter 8 with the introduction of a Public Planning Support System for Hackney in north east London. It is this boundary between using computers for planning in academia where it has always thrived, and using them in practice that makes the planning profession an adopter rather than an innovator.

Data is dependent on the software utilised and its application. Digital capture and network data sharing is making ever increasing amounts of data available to planners. Indeed, it is often which data not to use rather than acquiring the correct data that is a problem. Do planners need all the information that is currently available? GIS allows planners to deal with vast amounts of data but the recognition that GIS by itself is not adequate for planning indicates a growing recognition that knowledge lies a step beyond data (Harris, 1988). Data does not in itself aid planning; it is the way the data is handled and processed that can aid or restrict the planning system. Connectivity is an emerging factor which will be examined further in Chapter 4.

Allinson (1994) makes the bold statement that 'Geographical Information Systems have nothing to offer...the third wave of computing is dead'. The third wave did not however, die; it just took time to be adopted by planning practice as a result of the factors already identified. Currently GIS is the single most common piece of software in planning departments ignoring standard office packages such as Microsoft Word. However as we have seen, the planning profession is not a large enough group to justify much investment in software development (Yeh, 1998). As such the use of software in planning to address both the wide-ranging functions involved and the lack of specialised software has developed around Planning Support Systems (PSS). Introduced by Harris in 1989, PSS developed in parallel with GIS as a combination of computer-based methods and models that support planning functions (Yeh, 2001). We illustrate in Figure 2.3 the traditional PSS, which requires an expert-user to operate, and we define its extensions as Public Planning Support Systems (PPSS) which are based around community access and non-expert users. This is the focus we will develop here.

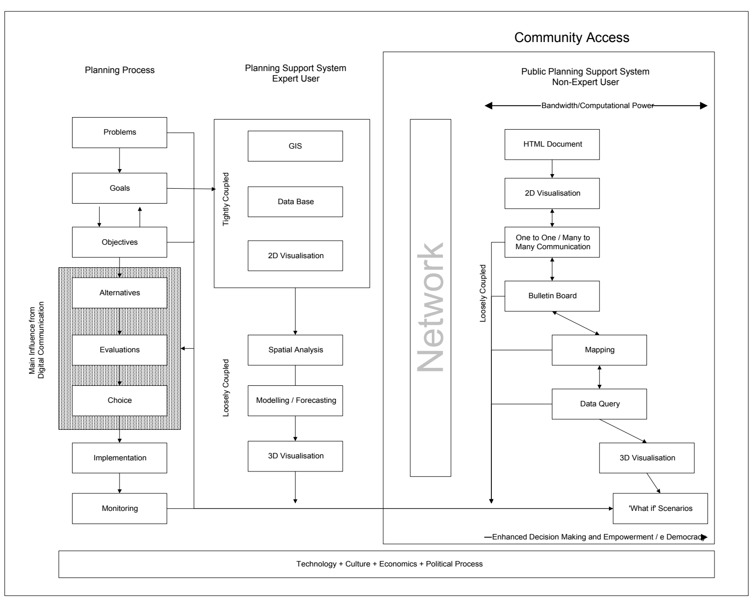


Figure 2.3 Traditional Planning Support Systems and Emerging Public Planning Support Systems.

2.4 New Information and Communication Technologies

Central to Figure 2.3 is the network, part of which embrace emerging new information and communication technologies (NICTS). Simultaneous access to data and information is a key characteristic of NICTS, and this notion of accessibility is increasingly based less on physical proximity but more on the concept of telepresence as a substitute for the physical (Rizzi, 1999). NICTS are the fourth wave of computing and planning as identified in Figure 2.1, and are centred on the rise of networked communications in the form of the Internet. As we have noted the past use of computing in planning has been about analysis, models and predictions whereas the future is about the network. The network is the enabling factor that has the potential to move computing into the heart of the planning system for new ways of portraying place, space and information, in short, for communication. The network and related NICTs as we determine over the following chapters, are the enabling presences that have the potential to move planning away from its traditional characteristic of confrontation towards one of collaboration.

The network in not however an emerging technology for the Internet was conceived in the 1960's in the early days of the mainframe computer. The first networks of computers were formed by collaborations between the US Department of Defense and several research institutions via the Defense Advanced Research Program Agency (DARPA) (Jones, 1995). The network, termed ARPANET, was developed as part of the US Defense Department's bid to keep their computers operational in the event of nuclear war (Batty et al, 1994). The ARPANET network enabled messages to be sent from person to person via the use of Email. The utilisation of Email enabled the creation of specific mailing lists with Email sent to a central point from which the message was resent to others subscribing to the list (Jones, 1995). Mailing lists developed to cover specific subjects defined as 'newsgroups'. In 1983 the US Defense Communications Agency mandated a common protocol, a set of conventions that determines how data will be exchanged for all ARPANET hosts (Gilston, 1995). This allowed the growth of the network into what may be seen as the true Internet (Gilston, 1995). ARPANET was decommissioned in 1990, its functions absorbed into the broader structure of the Internet.

The Internet constitutes a variety of different digital media. Media lying within its broad remit include:

> **Electronic Mail (Email):** The passing of electronic messages through a network (Marx et al, 1996).
>
> **File Transfer Protocol (FTP):** providing the capability of transferring files between networked computers (Watkins and Marenka, 1995).
>
> **Newsgroups:** a collection of discussion groups on the Usenet network, each newsgroup contains information on a specific topic, contributions are made via Email;
>
> **Gopher:** a document search and retrieval system which excels in a distributed, heterogeneous system, (Watkins et al, 1996);
>
> **World Wide Web (WWW):** a graphical interface to the Internet, viewed using software called a 'Browser'. The World Wide Web, or web for short, is the main communications platform explored throughout this thesis and it is therefore important to briefly expand the concept and development of web technologies.

The web was developed in 1991 at the European Particle Physics Laboratory (CERN) in Switzerland (Marx et al, 1996) as a medium for allowing the linking of text and graphical information utilising a language termed Hypertext Mark-up Language (or HTML as it is widely known). HTML is a form of Hypertext which was developed in the 1960's by Ted Nelson, allowing users to click on a piece of information on a computer screen to bring up another piece of related information on the *same* machine. It is this ability to link related pieces of information on *different* machines in *different* places which underpins the development of HTML and the Wide World Web.

HTML is displayed on the computer using a piece of software known as a 'Browser'. Browsers differ according to their development platform, the most popular browsers being those developed by Netscape and Microsoft, known as Netscape Communicator and MS Explorer accordingly. At the time of writing, however Explorer is gaining the ascendancy and it is likely that this will become the de facto interface. The browser is instrumental in the concept of PPSS (Figure 2.3), allowing a graphical interface and a central point for the communication of information. The components of the PPSS are not however specific software packages aimed at planning; indeed the majority of the packages were developed without any thought about the planning process. This is a key characteristic of NICTs.

If planning is to embrace these new technologies, it needs to adapt existing communications software to its needs rather than await custom-written software. The adoption of software gives rise to the concept of Groupware. Laurini (1998) defines groupware for urban planning as new technologies which allow different people to work together to achieve fairly well defined goals with the assistance of computers. Software and indeed computers in general in planning have moved on from the second wave. They are no longer focused on number crunching activities based on models of how cities develop. Although these are still valuable parts of digital planning, computation has a more specific role, that of a communicator of information. Johansen (1998) summarises the use of groupware to communicate information across the network in Figure 2.4.

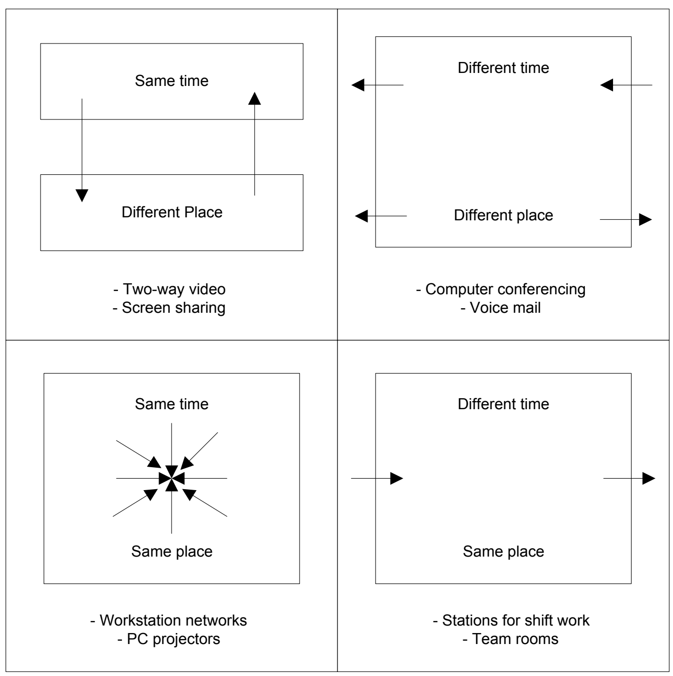


Figure 2.4. Johansen's (1998) Four Square Map of Groupware Options.

Relating to Johansen's (1998) four square map, groupware can be applied for use in urban planning in distinct combinations:

Same Time/Same Place: general same room planning meetings; 'Planning for Real' exercises; Planning inquiries.

Different Time/Different Place: asynchronous communication via email/HTML pages. Data is stored for retrieval at a later time via digital means.

> **Same Time/Different Place**: digital real-time meeting system, such as Microsoft's NetMeeting allowing *real-time* audio and visual communication. Similar usage as same time/same place.
>
> **Same Place/Different Time**: these include bulletin board and message systems, allowing users to post a message or comment for reply at a later time but on the same system which is in one place. Such systems are central to the development of a PPSS.

These four combinations are already increasingly blurring towards the any time/any place category (Thompson, 2001). It is this ability to communicate and visualise anytime anyplace which is leading to the development of PPSS. It should be noted that PSS and PPSS are essentially the same concept with the same origins and they exist mutually side-by-side. The fundamental difference however is the level of technical ability and the level of data analysis possible. PSS is still in the realms of the expert-user (Figure 2.3), allowing integrated spatial analysis, modelling, forecasting and visualization tied to GIS. PPSS is a way of communicating the output of these processes in a form in which simple data queries can be carried out in accordance with two and three-dimensional visual and textual information. As with PSS a PPSS integrates a range of software and systems, many of which are explored in the following chapters. Systems such as Computer Support Collaborative Work (CSCW), Virtual Teams (Lipnick and Stamps, 1997), Co-Design (King, 1989), Collaborative Planning Systems (Shiffer, 1992, 2001) and Virtual Design Arenas (Doyle et al, 1998) are central to the development of a PPSS. The basis for all these aspects of groupware and their role in digital planning and PPSS is community, communication, and the trend towards participatory democracy. The development of the network and its integration with groupware is the basis of the drive towards the concept of electronic government, or e-government - the wiring of the population to access and influence government services which includes planning in both its local and central roles.

2.6 e-Government

A key theme running throughout recent UK government publications is access to information and the facilitating of democracy through electronic communication. These aspects have been driven by the Prime Minister's speech in October 1997, stating that within five years a quarter of all dealings by the public with government will be accomplished electronically through their telephone, TV or computer. This includes local authority services, and as part of this the planning sector is required to increasingly move towards the electronic dissemination of information. The logic of digital planning and the development of new forms of visualization and communication via networked media and PPSS is not only timely, it is essential if the target of 25% is to be met by 2002.

The Government White Paper *Modernising Government* (Cabinet Office, 1998) describes how information technology is changing our lives in the way we work, the way we do business, the way we communicate with each other and how we spend our time. New technology offers opportunities and choice. It can give us access to services 24 hours a day, seven days a week. It will make our lives easier. While companies, educational establishments and individuals over the last decade have taken advantage of networked technologies, government has not kept pace. With the publication of Green and White papers relating to information technology, the government intends to be at the head of future technological developments. The White Paper on *Modernising Government* (Cabinet Office, 1998) also states that the government must bring about a fundamental change in the way we use information technology. We must modernize the business of government itself - achieving joined-up working between different parts of government and providing new, efficient and convenient ways for citizens and businesses to communicate with government and to receive services.

The paper goes on to state that information technology will:

- make it easier for businesses and individuals to deal with government;
- enable government to offer services and information through new media such as the Internet or interactive TV;
- improve communications between different parts of government so that people do not have to be asked repeatedly for the same information by different service providers;
- give staff at call centres and other offices better access to information so that they can deal with members of the public more efficiently and more helpfully;
- make it much easier for different parts of government to work in partnership: central government with local authorities or the voluntary sector; or government with third-party delivery channels such as the Post Office or private sector companies; and
- help government to become a learning organisation by improving our access to information.

The White Paper illustrates how information technology can aid the decision making process within the planning function of local government. Essentially it details the development of a PSS aimed at the expert-user (see Figure 2.3). The majority of communication throughout the process is paper-based, although some authorities use specific software to aid the planning process such as GIS or automatic document generators. Despite the use of GIS and other planning support packages, the main aspects of consultation and communication are still predominantly paper-based and have fallen far short of the goal of 25% usage of electronic communication by 2002.

The White Paper illustrates how the whole process may be integrated into a single information technology system. It states that the system would integrate the planning process into other administrative systems within the local authority. Such a system would automatically generate standard notices and provide templates or standard forms for reports which could automatically include information already provided, prompting the user only for that still required. Documents (forms, architectural drawings, etc.) would be scanned into the system and accepted electronically. Mobile information technology could also help on site visits. Technology may also help to improve the quality of decision-making through:

- automated audit trails – allowing progress of cases to be followed and checked;
- Online access to a wide range of data sets (e.g. traffic flow analysis, regulations, strategic plans, census data, land use); and
- Geographic Information Systems, allowing data to be superimposed on a map.

While the integration of the planning process into a single information technology system is a step forward, it can only be seen as a step to catch up with technology already used in the private sector.

Building on the 1998 White Paper on *Electronic Government*, the underlying strategy is laid out in the publication *E-Government, A Strategic Framework for Public Services in the Information Age*, published in 2000. It details the government's plans to facilitate 'e-citizenship' with the aim of:

- building services around a citizen's choices;
- making government and its services more accessible;

- ensuring that new technology does not create a digital divide between those with ready access to electronic media and those without; and
- using information more effectively.

To achieve this aim the Government has set a further target of 100% of all local government services being able to be accessed electronically by 2005. In terms of planning, a number of changes are being proposed in response to the White Paper on *Electronic Government*. A survey on NICTS in Planning, carried out by Land Use Consultants and Business Efficiency, prepared for the Department for Transport, Local Government and Regions (DTLR, 2001) states that in terms of planning services, the target of 2005 will require the availability of full development control, enforcement and policy services. Related electronic services will include the submission of and payment for planning applications, making enforcement complaints, submission of consultation responses, viewing local policy documents and more general queries. As a move towards the 2005 deadline, all local authorities were required by Government to produce an 'Implementing Electronic Government Statement' (IEGS). The statement, submitted in July 2001, is aimed at being a diagnostic tool by central government, allowing them to identify local authorities that will require additional help in meeting the targets. The Borough of Hackney has published its IEGS Online with its vision for service delivery by 2005 being:

- to deliver cost effective, high quality information and services to citizens;
- to review, rationalise and consolidate public access at a local level;
- to resolve a high proportion of all customer enquires at first contact (web, telephone or face-face);
- to avoid duplication internally and with partner organisations;
- to actively promote 'joined up' service delivery;
- to empower citizens with knowledge to increase involvement in the council's decision making process;
- to make the council's decision making process more transparent and accountable to the citizen;
- to improve ways of working with the council through better use of knowledge-management and the application of modern technology.

The main access point for local residents to gain information about Hackney services will be the Hackney Portal, a digital centre point linking all the electronic processes of delivery.

The aims of e-government are commendable, although it is difficult to see how these aims will be achieved. The process is surrounded by the current 'buzz words' and governmental spin, from 'e-government', 'e-democracy' and 'e-citizenship' to 'portals'. In a climate where the technology is ever-changing, the question is whether or not the technologies implemented in 2005 will be those we are using currently in 2003. Will these be two or more years out of date or will they be research-led technologies providing a truly forward thinking prospect of e-government?

To help fund local authorities in the 2000 Spending Review, government identified £350m to support councils in meeting the 2005 100% electronic services delivery target (DLTR, 2002). The funding is to be distributed via 'Pathfinder' projects and to date, twenty-five such projects have been initiated by the DTLR. These address various aspects of how to deliver improved services by electronic means. An example is 'Geographically-based multi-agency digital TV', run by a partnership between all local government authorities and the police in Somerset. The aim is to deliver unified services to the people of Somerset, via the Somerset Online Portal web site and Digital TV. It is proposed to target the phone-assisted digital television services to the 'information poor' in both the rural and town communities. Another example, relating more directly to planning is 'Mapping the Future', a project in the London Borough of Wandsworth (Wandsworth, 2002). The project builds on their existing planning website (see Chapter 3 for full details) and aims to add the ability to:

- submit planning applications Online - this will include drawings, payments, photographs even video clips and will link with the government's Planning Portal;
- access planning data via a map-based front end;
- view the Council's Unitary Development Plan Online, with links between the map and the text; and
- register for local government services when you move into or out of Wandsworth

The Wandsworth prototype system aims to link in with the central government's planning portal. The portal is an important development in the growth of digital planning in the United Kingdom. The portal has been set up partly to address the issues of Electronic Government and the needs of planning in the lead up to 2005 and partly to coincide with the publication of *The Planning Green Paper* (2001) which proposes a fundamental change to the planning system. The most important aspect of the Green Paper in terms of digital planning is the emphasis on community planning and public involvement in the planning system. The Green Paper states that the current system is strongly 'consultative' but despite that, too often fails to engage communities. The result of all this is that communities feel disempowered. It proposes the development of what it calls 'real' community participation in the preparation of new Local Development Frameworks and especially in drawing up action plans which bear on local areas and may result in the regeneration or conservation of particular neighbourhoods. In his foreword to the Green Paper, the Minister for the DTLR says:

> *"Some fifty years after it was first put in place, the planning system is showing its age. What was once an innovative emphasis on consultation has now become a set of inflexible, legalistic and bureaucratic procedures. A system that was intended to promote development now blocks it. Business complains that the speed of decision is undermining productivity and competitiveness. People feel they are not sufficiently involved in decisions that affect their lives.*
>
> *So it is time for change.*
>
> *We need good planning to deliver sustainable development, to harness growth to build a better future. We need a better, simpler, faster, more accessible system that serves both business and the community. That is exactly what the Green Paper seeks to achieve".*

Consultation on the paper ceased on March 18th 2002, so where will the UK planning system be in 2005? The Planning Portal has published a 'Vision Statement' which states that citizens will be able to access any aspect of the planning system using the communication method of choice. This includes electronic access via Internet technologies and traditional paper-based access. Such a statement is hardly visionary. Indeed it is possible to say that it has already been achieved as the telephone must be considered electronic communication. The proposals for digital access are mainly aimed at professionals already involved in the planning system. The portal aims to develop 'GIS – a personalised portal' providing details of local development plan and application data. An electronic case management system is also proposed, aimed at processing and tracking all documents electronically through the Planning Inspectorate. This is similar to the document tracking system that is already in place through many e-commerce

Internet sites. Rather than being the forward-thinking statement involving visualisation for the public to aid a better understanding of development, it is merely a flashback to the 'paperless' office concept of the 1980s. If the community are to be truly involved in the planning system, it requires a look at community networks already operating over the Internet, methods of Internet-based visualisation and a fundamental media shift in planning communications. In short, it requires a look at the services it can deliver and how best to deliver them.

Service is central to the public sector for it is not about business but about communication, efficient two-way communication as a way of delivering service. This is the main reason why the government has focused on the electronic delivery of information as part of e-government. Not only does it promise an increase in service but it also makes such quality service economically viable.

2.7 Emerging Waves

We have defined the Internet as the fourth wave in the development of computers and planning, yet within this wave are several sub-waves of emerging technologies. Technology is still changing at a rapid pace and new innovations continually are coming onto the market. Many of these innovations are based around communications and visualisation and there is still enormous potential for their use in digital planning.

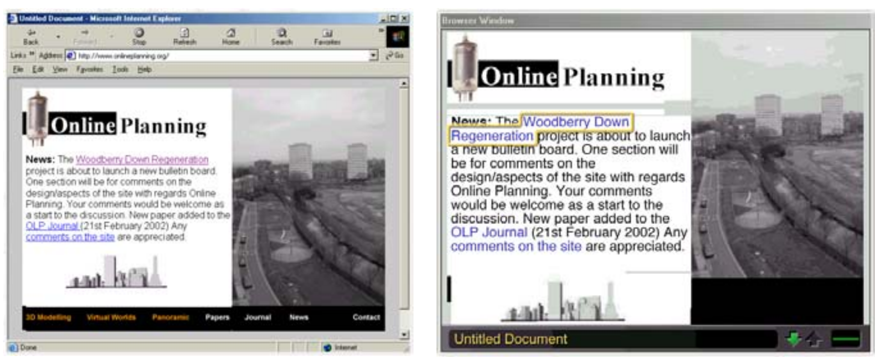
A massive niche market for electronic goods is currently emerging aimed at the business-user. Such devices can be used for digital planning and examples will be presented here in this thesis. Yet to reach a mass market requires a device that is in the majority of homes and that must be television, one of the most important communication devices of the 20th century. Since the first publicly available broadcast in 1936, television has become the command centre of our culture (Postman, 1998). Yet until recently, television has been asynchronous as the user has not been able to interact with the broadcast medium. This has begun to change with the introduction of digital television, launched in the UK in 1998. This differs significantly from the standard analogue service which has dominated broadcasting to date in that it allows two-way interaction between the television and the user.

The level of interaction is however limited due to the amount of bandwidth available to the broadcaster. Bandwidth is an important aspect of communications and visualisations and is discussed further in Chapter 4. In the UK, digital television is available to subscribers via satellite or terrestrial through a standard aerial. Digital satellite provides a much higher level of bandwidth and provides the possibility of over 300 channels. Terrestrial, on the other hand, has limited bandwidth and a maximum of approximately 40 channels. In addition to the standard television broadcast, digital television also broadcasts a signal which allows interactivity to be introduced into programs. This can be either in the form of text, graphics or video-based presentation and is currently used mainly for interactive 'news-on-demand' services. Linking the provided set-top boxes to a telephone line allows users to order movies, to shop, and most importantly, to cast a vote online.

The ability to interact and vote via the television set is attractive to local authorities with the need to meet the 2005 deadline for e-government. An indication of the level of digital television interaction is the fact that over a third of all eviction votes for the television programme 'Big Brother' were cast via digital television (BBC Interactive, 2002). It is easy to use and allows information to be broadcast interactively into people's homes. In addition to this are the government's plans to 'switch off' the analogue terrestrial services as early as 2006, which will further spur a high percentage of homes in the UK to gain access to digital television services. Digital Television is however limited in the amount of information it can deliver and this is especially true for terrestrial digital which suffers from long download times for information and limited capacity to add additional information channels.

To increase the level of interactivity through terrestrial digital television, the current provider has introduced an additional unit to provide full Internet access via the set-top box. This is similar to 'WebTV' which arrived on the now familiar wave of hype with the buzzword of 'convergence'. It was predicted that the merging of the television and the computer would allow Internet access to and interactivity with information without the cost or inconvenience of owning a computer. The development of WebTV has been driven predominately by the computing industry, notably Microsoft, in a bid to widen the home market. The size of the potential market can be illustrated when you compare that in the mid-1990s, 20 million homes in the USA had personal computers with modems, while some 68 million had cable television (Rose, 1998). WebTV and set top boxes do however have one serious drawback in the display of information on the television itself. Television can only display a 640x480 screen resolution, whereas the standard for website development is 800x600. This has resulted in either services being written specially for viewing via WebTV or Internet sites which are hard to navigate due to a portion being out of view. Figure 2.5 illustrates the Online Planning web pages, around which this thesis is written (http://www.onlineplanning.org) in both Internet Explorer 6 and WebTV format.

WebTV automatically attempts to resize borders of the page which results in broken up graphics. Due to limitations in screen resolution, the navigation buttons are out of view and none of the JavaScript behind the page is operational due to compatibility issues with WebTV. In addition to this, the Internet is an evolving medium, especially with the use of JAVA and plug-ins to provide enhanced multi-media content. WebTV is not able to utilise such plug-ins and as such is unable to give access to the most innovative sites on the Internet. Yet as digital television will be in the majority of peoples' homes by 2010, this may well be the preferred delivery method for e-government. The drawbacks of the medium are obvious.



Webpage in Internet Explorer 6 Webpage in WebTV

Figure 2.5. WebTV or Internet Browser: A Comparison.

As has already been mentioned, there are many new waves of digital devices, linked to the Internet, currently aimed at the business market. The majority of these devices concentrate on connectivity and portability. Of note for digital planning are Personal Digital Assistants (PDA's). The first PDA was introduced in 1993 by Apple Computer Inc in the form of the Newton™. Marketed as a portable information device, it was developed to store personal information and synchronise with the user's computer system for data sharing. The Newton™ was not a commercial success but led the way to the introduction of the Palm Pilot PDA by Palm™ in 1996. PalmPilots have been well received by the market which is now saturated by similar devices from the majority of the well-known manufacturers. A common theme in current PDAs is the ability to access data via wireless networks. Such networks provide 24-7 access to the Internet through a service provider with data transmitted via mobile telephone systems. In addition to this is the integration of Geographical Positioning Systems (GPS) within high-end devices, allowing users to pinpoint their location with 15 meters accuracy. The combination of GPS and access to the Internet opens up a new realm of mobile digital planning, based on location-aware devices and this is the current leading wave in the use of computers applications in planning. Applications of such devices are discussed in Chapter 10 in relation to the development of public participation in Hackney, London.

Future waves are problematical to predict, but smart phones and the introduction of the UMTS (Universal Mobile Telecommunications System), more commonly known as the "third-generation (3G)" phone, are the next wave on the horizon. 3G is riding on a wave of hype and expectation prior to its planned introduction in 2003. It promises broadband, packet-based transmission of text, digitised voice, video, and multimedia at data rates up to and possibly higher than 2 megabits *per se*cond (Mbps) (3G-Generation, 2002). With these new networks, it is also planned to add in GPS via triangulation according to proximity to local transmission masts. Indeed this is already possible: a mobile game has been launched allowing mobile users to track and 'shoot' each other via the handset. Mobile phones are mass market and as such offer the possibility of widespread adoption of technologies which can subsequently be used for digital planning. It should be noted however that the introduction of video and multimedia via mobile phones must be viewed with caution as the first phase of introduction of the 3G network will not include such capabilities.

Central to all these emerging technologies and questions surrounding their widespread adoption and their use for digital planning is the network. Access to the network is all-important and is the basis of a trial scheme in London called Consume. Consume is a project aimed to show people how to share their Internet connections, software and experiences using wireless networks. Consume is utilising radio-based network technology known as 'Wi-Fi'. Wi-Fi allows users to set up localised nodes of connectivity that anyone with a wireless card can join.

The ultimate idea is to free people from the need to pay high monthly bills for Internet access by letting everyone share the air (Stevens, 2002). Connectivity is achieved via a series of antennas situated on the roofs of buildings; all that is required is a low cost personal computer and a wireless network card. These local wireless networks are similar in nature to ones currently being developed in the United States, Seattle's *Wireless.net* being the most well-known. The project is aimed at low-income communities and there are already workshops in teaching how to set up simple antennas. Stevens (2002) states that activity is especially strong in the Hackney and Hoxton areas of London with even squatted properties linking up to the network to swap music, share information and generally 'commune'. Such networks are attractive as they not only allow a community to work together due to the local area and do-it-yourself nature of the network but they also allow communities to communicate and interact digitally. In addition to this, Wi-Fi allows fast transmission of data allowing multimedia to be streamed directly into people's homes, opening up the potential of powerful local information communication.

Questions of the legality of such networks have been raised in the UK. However as long as the network is controlled and they do not aim to make a profit, the use of Wi-Fi is legal. It is envisaged that such networks may well become the backbone of local community information access, with access to digital information available at low cost via a system as simple as turning on the radio but with the benefits of fast data transmission.

As a footnote to this chapter, it should be noted that ITV Digital, the terrestrial digital television provider in the United Kingdom went into administration on the 1st May 2002. Digital television is still available through the terrestrial system, but only free from the channels that are currently broadcasting. Members of Parliament on the Culture Select Committee described the collapse of ITV Digital as a 'body blow' to the government's plans for switching the whole country to digital by the year 2010 (Douglas, 2002). The licences for broadcast held by ITV Digital are currently being re-advertised by the broadcasting authority, and despite rumours that Microsoft may take over, there are doubts over the future of digital terrestrial in the UK as a viable concern.

The placement into administration of ITV Digital illustrates the vulnerability of emerging technologies. ITV Digital arrived on the inevitable wave of hype, fuelled by the government's desire to use the technology for e-government in the drive to place government services online by 2005. The failure of terrestrial digital television places this target further beyond reach, especially in terms of WebTV. It also calls into question the current trials of e-government using digital set top boxes. It is too early to predict the future of digital television services in terms of widespread adoption by the public, but it appears that a rethink is required. The government's main access route into peoples' homes for digital technologies has suffered a notable setback.

CHAPTER 3

Participation, Communication and Networked Visualisation in Planning

The need and requirement to communicate information in relation to changes to the environment is rooted in both philosophical and pragmatic considerations. The former is related primarily to the general belief in democratic societies that the individual has the right to be informed and consulted (Sewell and Coppock, 1977). It is a simple concept, yet one in which the planning system, despite legislation continually fails to excel. As Hall (1995, page 213) states in the question posed at the beginning of this thesis: "How can the planning process truly aim to improve the quality of life for the whole of society if society is only given a limited say in the process?" Consultation, communication and participation have been buzzwords in planning for over forty years, yet the current level of public participation in the planning process is still a cause for concern.

3.1 Participation

The process of public participation is subject to further reform in both the *Planning Green Paper* (2001) and as a result of the e-government initiative. The role of the public in the planning process was first highlighted by Skeffington's report (MHLG, 1969) on public participation in planning. The report detailed participatory machinery to implement the sections of the 1968 Town & Country Planning Act which legally obliged Local Authorities to consult the public when developing both Structure and Local Plans (Green, 1971). Central to these proposals was its definition of participation, defined as 'the act of sharing in the formulation of policies and proposals', a description at best somewhat vague. Despite this vagueness, the report was hailed as a milestone in the development of public participation. Defined as the active involvement of the public, it divided this constituency into two categories:

- **Joiners:** active members of society, those who participate in groups and societies and an interest in local issues; and
- **Non-Joiners:** people affected by planning decisions, but due to circumstances need help to make and register their opinions.

To aid the non-joiners, the Skeffington Report recommended the introduction of community development officers to stimulate local opinion. It also recommended the holding of town forums, the commissioning of films and the teaching of planning in further education establishments as part of a liberal education (Garner, 1979). However in terms of Development Plans, the only statutory public participation required is the 'Examination in Public'. Once such examinations are complete, commentary is limited to the media while the decision-making process as such is fixed. The same is true for Local Plans except for the fact that objections received are heard in a Public Inquiry open to all members of the public. As the RTPI (1980) states, public participation was often scaled down by local authorities merely to meet their legal requirements due to:

- **Cost:** public participation takes up officers' and councillors' time as well as requiring direct expenditure on printing, audio visual aids, postage etc;
- **Delay:** public participation usually lengthens the time taken to prepare plans and make decisions. However, it should be noted that major developments raise complex issues and failure to debate these issues could result in high costs for society in the longer term; and
- **Erosion of Representative Democracy:** public participation often tests our representative democracy in so far as it means members of the public are not prepared to leave planning entirely to their elected representatives.

In addition to the above points is the issue of professionalism. As Garner (1979) clearly states "the planners, the officials, are trained…. Surely planners and the elected representatives should know best? Why not leave it to them?" In today's current climate of e-democracy and political spin, such attitudes may seem out of place, yet public participation is still an issue to be addressed in the planning system.

So far we have not been explicit about the types of communication but information related to the built environment can be characterised as being through three forms of media and method: **non-digital**, **digital**, and **digital-networked**. Non-digital is by far the most common method of communication and it includes the traditional two-dimensional paper plan and the physical scale model. Each of these methods aims to communicate information and allow varying levels of feedback. The amount of communication and feedback achieved directly influences the level of public participation and thus the level of involvement that the citizen has in the planning process. Using Arnstein's (1969) classification, at the lowest level the amount of communication can be viewed as being merely manipulative. At the second level, there is therapy consultation.

Information is merely distributed to achieve public support as a means of public relations. Arnstein defined 8 stages leading towards full citizen control of the planning process which we illustrate in Figure 3.1. As a result of the Skeffington Report (1969), over the last thirty years planners have embarked on a series of well meaning but somewhat amateurish exercises in information-giving (Hague, 1999). Resulting in public participation of, at best, level 3 on Arnstein's Ladder, planning became a system of public relations in which the purpose of such relations was to make life easier for the planners (Damer and Hague, 1977).

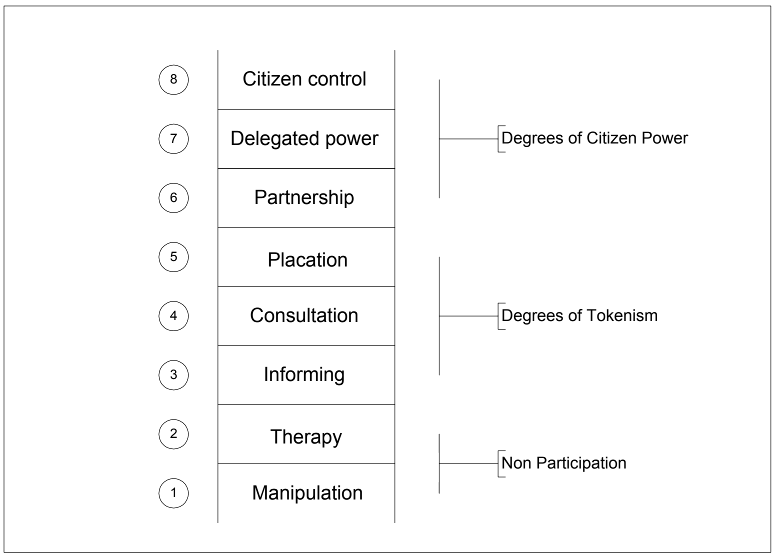


Figure 3.1. Arnstein's Ladder of Participation (Arnstein, 1969).

To move up Arnstein's Ladder requires a fundamental shift in the way we use communication in planning. A move towards the use of digital networked technologies provides such an opportunity. A number of methods can be used to achieve the highest level of 'Citizen Control' on Arnstein's Ladder, both in terms of the digital and non-digital. Table 3.1 examines various methods at the planners disposal. Citizen Control in terms of non-digital access is focused on group activities involving the community. Community participation is central to non-digital public access but in terms of digital access, the individual has more importance, this being a key difference between the digital and non-digital styles of participation.

Objectives	Non-Digital	Digital	Digital Networked
Citizen Control **Delegated Power** **Partnership**	Public Decision Making Groups 'Planning for Real' Groups/Citizen Consultation	'Non-Fixed' Computer Aided Visualisation	Online Discussion Forums Collaborative Virtual Design Studios Online Interactive 'What if?' Visualisation Community Networks
Placation **Consultation**	Public Surveys Public Meetings Presentation of Design Information	'Fly-through' Computer Aided Visualisation	Internet-based Questionnaires Email Online Discussion Forums
Informing **Therapy** **Manipulation**	Individual Letters of Notification Exhibitions **Explanatory Leaflets** Newspaper Articles Posters Distribution of Plans to Libraries	Static Computer Aided Visualisation	World Wide Web Site Online Visualisation

Table 3.1 Non-Digital, Digital and Digital-Networked Devices for Public Participation in the Planning Process using Arnstein's Ladder of Citizen Participation.

As noted earlier by Thomas and Jones (1998), 'Communicative planning' (Forester, 1989), 'augmentative planning' (Fischer and Forester, 1993), 'planning through debate' (Healey, 1992) and 'inclusionary discourse' (Healey, 1996) are terms which have been used in planning theory to explore concepts of public participation and the inclusion of community within the planning process. Healey (1997) identifies the many different strands and emphases of such theory as:

- recognition that all forms of knowledge are socially constructed, and that knowledge of science and techniques of experts are not as different from 'practical reasoning' as instrumental rationalists have claimed;

- recognition that the development and communication of knowledge and reasoning take many forms, from rational systematic analysis, to storytelling and expressive statements, in words, pictures and sound;

- recognition, as a result of the social context within which individuals form interests, that individuals do not arrive at their 'preferences' independently, but learn about their views in social contexts through interaction;

- recognition that in contemporary life people have diverse interests and expectations, and that relations of power have the potential to oppress and dominate not merely through the distribution of material resources, but through the fine-grain of taken-for-granted assumptions and practices;

- realisation that public policies concerned with managing co-existence in shared spaces seek to be efficient, effective, and accountable. This is relevant to all those with a 'stake' in the place; such policies need to draw upon and spread ownership in the above range of knowledge and reasoning.

- realisation that this leads away from competitive interest bargaining towards collaborative consensus-building and that such consensus-building practices and ideas can be developed and shared. These must have the capacity to endure, to co-ordinate actions by different agents, and to transform ways of organizing and ways of knowing in a significant manner; in other words, to build cultures; and

- A realisation that planning work is both embedded in its context of social relations through its day to day practices, and has a capacity to challenge and change these relations through the approach to these practices; context and practice are therefore separated but socially constituted together.

The key to communicative planning is essentially good communication, communication that involves all sections of the community, irrespective of culture, social or economic origins. In a sense this may seem an obvious statement; however, it is a statement that is difficult to achieve as is shown by our current failure to effectively communicate planning information. Yet as Planning Policy Guidance Note 12 (DETR, 1996) states, local people should participate actively in the preparation of plans from the earliest stage.

In a special report on the 'General Principles for Public Participation' by the Urban Design Group (1999), a series of issues are stated which apply to virtually all situations in public participation. While much of the list is common-sense and indeed obvious, the fact that a special report was required to state such facts underlines the inability to effectively consult the public in planning matters. A selection of the Report's recommendations are documented below:

- **Involve all those affected:** community planning works best if all parties are committed to it;

- **Local ownership of the process:** the local community should have responsibility for the overall process;

- **Spend money:** effective participation processes take time and cost money;

- **Be honest:** avoid open agendas and be open and straightforward about the nature of your activity;

- **Be visual:** people can participate far more effectively if information is presented visually rather than in words;

- **Follow up:** participation need to stay the course, irrespective of the length of the development process; and

- **Have fun:** the most interesting and sustainable environments have been produced where people have enjoyed creating them.

Despite the obvious nature of the points put forward by the Urban Design Group to enable the public to participate openly in the preparation of plans, both in terms of local development plans and matters of development control, a media shift in planning communication is required. Such a media shift may be driven by the rise of the networked society and the requirements of local authorities to become increasingly communicative via electronic forums. However for such a shift to take place, there has to be willingness on the part of the local authority to encourage public involvement. Battelle (1999) states that we are going through another dramatic media shift. However this is not about whether or not a politician or a government agency should have a web page, it is about whether or not a politician or government agency wants to play by the rules that are creating the new economy and a new culture.

Involvement, while undoubtedly making the planning process increasingly open and democratic may slow the overall process down and have negative implications in terms of good policy and good governance. Speed and efficiency have been forces diminishing public involvement in planning since the late 1970's. A 'New Right' agenda to 'streamline' the system and reduce delays and costs to developers has been responsible (Thornley, 1993). For a media shift to occur, it has to be of low cost with high returns, while at the same time providing a visual and community-led device for effective public involvement. This is an important point, central to all the applications and examples documented throughout this thesis.

3.2 Communicating to the Public

As we have stated, communication of planning information can be seen in three distinct categories - non-digital, digital and digital-networked and we will elaborate each of these in more detail.

3.2.1 Non-Digital

Under the current development plan system, the two-dimensional site plan is commonly used to communicate planning and design information. While the use of two-dimensional site plans is suitable for professionals of the built environment, they are often unsuitable for the layperson. We live in a three-dimensional world, visualising and understanding spatial relationships in three dimensions. The communication of planning and design information in two-dimensional form can often lead to a misinterpretation of design and planning issues. A majority of people find it hard to understand and read a two-dimensional map whereas most respond more effectively to a three-dimensional image or model.

To supplement two-dimensional site plans, developers and local authorities often use artist's impressions. Artist's impressions are not however suited to convey the detail of planning and design issues. A typical example is in the design of a new supermarket; the artist's impression invariably depicts a utopian vision of the development set against the backdrop of a sunny day. As Levy (1995) states, even highly rendered images which are professionally acclaimed for their artistry are, at times, inappropriate or poorly understood by the viewer. Such misunderstandings take place because a new development or change to our environment cannot be portrayed in sufficient detail in two-dimensions. Figure 3.2 illustrates an artist's impression of the proposed redevelopment of Bracknell Town Centre in Berkshire, UK.

Figure 3.2. Artist's Impression of the Redevelopment of Bracknell Town Centre.

The sketch style depiction of the redevelopment allows room for error in its interpretation and it only offers a single fixed viewpoint. To allow a three-dimensional view of an area, a scale model is the only option using non-digital methods. However due to the cost of production, such accurate models are limited to high profile developments. They also suffer from portraying an oblique view of development, rather than a street level human scale view. This can however be achieved through the use of a periscopic type lens (a modelscope, so called) which allows views of the development at street level, but again additional costs limit it to major developments. The physical three-dimensional model can be of value to allow a community to gain a better understanding of their area, especially if the model is actually built by the community in question. This is the basis of 'Planning for Real', a method of public participation pioneered in the UK by Gibson, formally of the Neighbourhood Initiatives Foundation (Neighbourhood Initiatives, 2002). First used in the East End of Glasgow in 1997, 'Planning for Real' is a technique which provides a means through which the public can have a more meaningful say in local planning matters (Dando, 2002). The technique involves all forms of non-digital consultation including public meetings, leafleting, informal groups, displays and publicity through the media.

The process is focused on the local community and engages closely with local organisations to ensure that appropriate meeting times and venues are arranged. The process starts off with an action plan in which a series of options cards are used to identify issues of importance to the community and any issues which are specific to the local neighbourhood. There are a series of blank options cards available to the residents enabling them to make their own more detailed views known. Once the issues are identified, a three-dimensional model is constructed, commonly out of cardboard and polystyrene at about a 1:300 scale. The community achieves a sense of ownership and involvement in the process by creating the model as it also allows the creation of individual buildings such as the residents own houses. Figure 3.3 illustrates members of a community examining a three-dimensional model of their area.

Once the model is constructed, the community members again use a series of colour coded cards as well as stickers to voice their views on a series of initiatives or problems that need attention. For example, a card may be placed on the model indicating an area that requires improvement in housing. People can then place stickers which agree or disagree with the view or use blank cards to construct a more detailed opinion. Issues are ranked in order of the time needed for improvement (now/soon/later). All these issues are subsequently taken into account and an Action Plan produced which is again presented to the community.

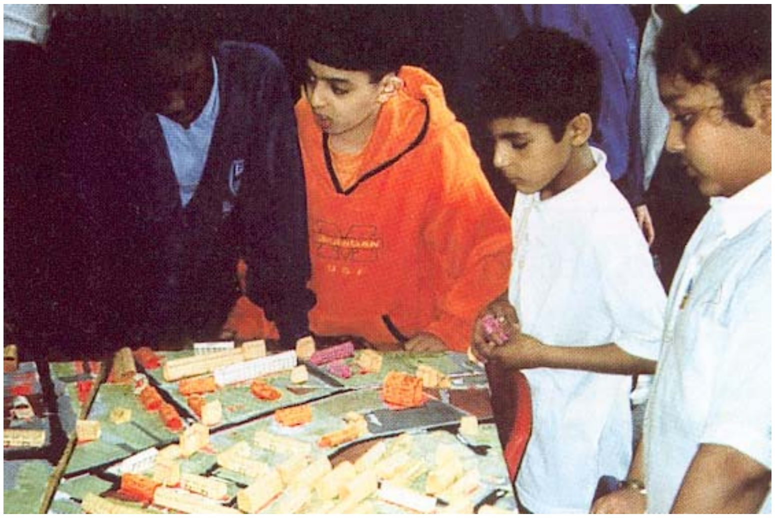


Figure 3.3. Residents Engaged in 'Planning for Real'.

'Planning for Real' is very much a 'hands-on' approach to community involvement in the local planning process. It sets out to encourage as many people as possible to have a say without the need to speak in front of a local meeting or public audience. The use of cards and stickers also anonymises the process, allowing people to have a free and open say in the planning of the local community. As such it is non-confrontational and acts as a method to stimulate contacts between the community and the officials involved in the plan making process. However, it is also time consuming and the level of detail of a model created out of wood and polystyrene is questionable for detailed development. It works as an overview of an area and its needs, and it acts as a method to involve the non-joiners in the planning process. As such it is a positive move towards Citizen Control on Arnstein's Ladder (Table 3.1).

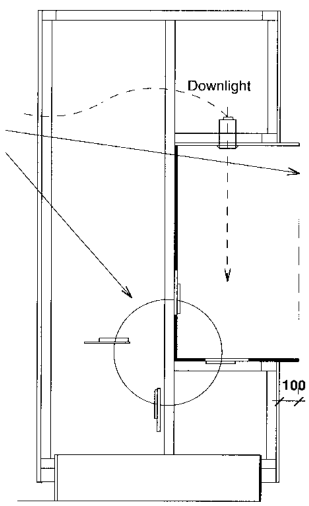
The Hackney Building Exploratory, an interactive centre for environmental education in Hackney, north east London, has taken a similar approach aimed at educating the public, especially children, about their surrounding environment. The Exploratory produced a three-dimensional model of the Borough of Hackney between 1997 and 1998 based on the work of 8 local primary schools and a collective of local artists. The model, created in 8 sections, is modelled using recycled materials and mounted on a detailed Ordnance Survey map base as illustrated in Figure 3.4.

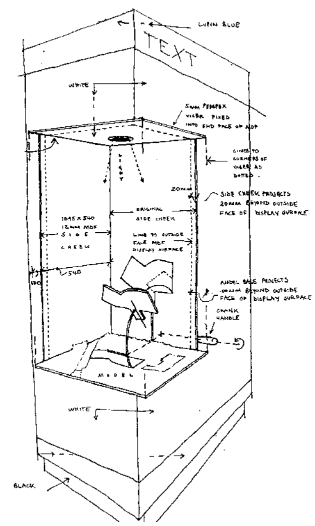
Figure 3.4. The Hackney Building Exploratory 'Hackney Model' (http://www.thebuildingexploratory.org.uk).

'Planning for Real' and similar three-dimensional models are educationally innovative and allow a high level of community involvement. However, they suffer from being non-digital in nature, in that the experience portrayed is limited and can only take place at set times in a set place. This issue is explored in Chapter 7 when we make the Hackney Building Exploratory digital and enable its access over networks, thus linking people remotely.

Another variation on 'Planning for Real' is the 'Design Roadshow', a key example of which has been developed by the Architecture Foundation in the UK (http://www.creativespaces.org.uk/). Aimed at providing opportunities for residents to become involved in planning and decision-making on a local scale, it involves both the designers and residents in developing views on an area's future. An important distinction between the 'Design Roadshow' and 'Planning for Real' is the fact that the 'Design Roadshows' are architecture-based. Designs are drawn up in conjunction with the residents and then planning applications submitted which ensure that the designs take into account the views of the local community before the planning process is initiated. Most public participation during 'Design Roadshows' is non-digital, although the Architecture Foundation has also utilised digital technology aimed at gaining an insight into local residents' views and allowing school children an exciting and interactive way of visualising their own designs.

In terms of non-digital public participation, it is worth examining the case of the development of the Teviot Community Centre in Tower Hamlets, London. The Teviot Centre was designed by Penoyre and Prasad Architects with the final design-based on a Roadshow organised by the Architecture Foundation in November 1998. The roadshow was developed with the architects to ensure that the new community centre was genuinely useful and to ensure that the challenge was met to engage the future users of the building in serious design discussions about its aesthetic, civic, atmospheric and spatial qualities (Penoyre and Prasad, 1998). The initial roadshow was solely to talk to the local community and gain their input in the design process. As a review in the Independent Newspaper (1988) stated: "residents know exactly what works well, and what doesn't, what is pleasant, what depresses them, how far they have to go for some fresh air, what are the local no-go areas and what could quickly be improved" (Whittam-Smith, 1998). After the initial discussions, a series of four scenarios for a community centre were produced and presented to 8 consultation groups in the area. A key part of this presentation process was a block model of the design options. The models were displayed in an innovative manner utilising a custom-designed display unit as shown in Figure 3.5.





Side on Design of Options Booth Three-Dimensional View of Booth

Figure 3.5. Custom Designed Booth to Display the Four Design Options (Penoyre and Prasad, 1998).

The booth was designed to show all the options in the context of the local area; a handle integrated into the side of the booth allowing each option to be rotated into and out of the scene. Figure 3.6 illustrates option 3 being modelled inside the display.

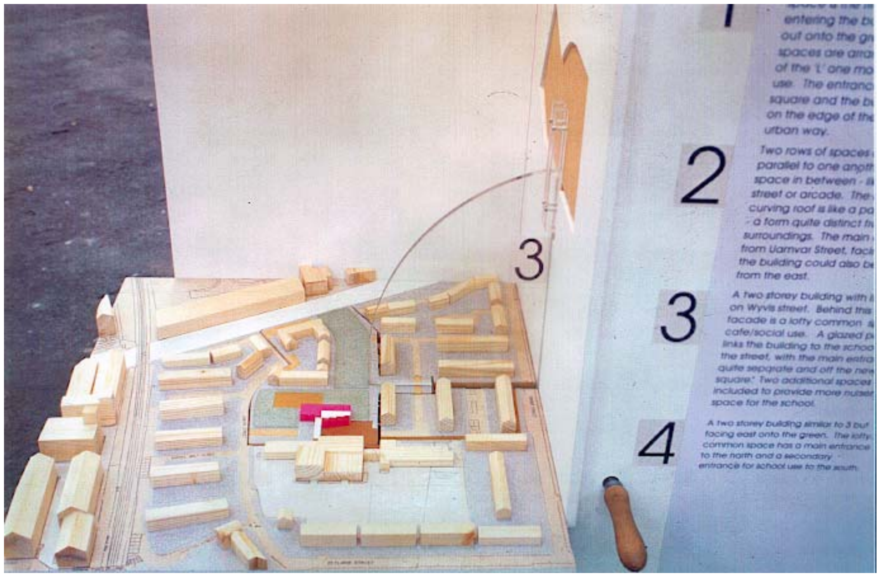
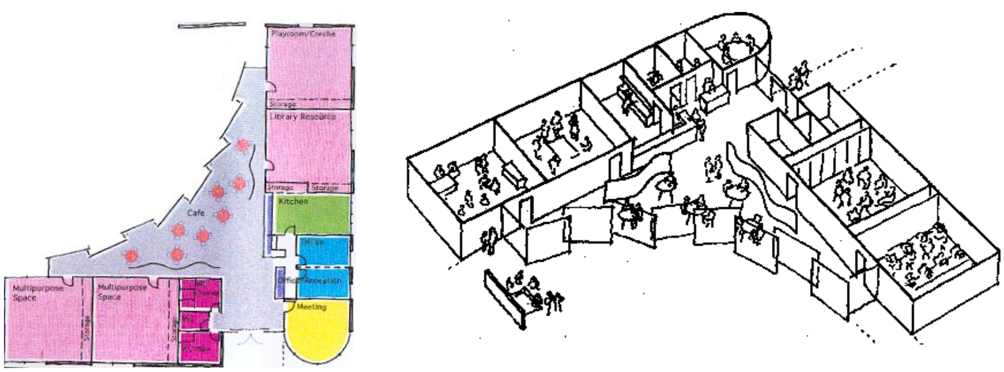


Figure 3.6. Option 3 Inserted into a Block Model of the Local Area (Penoyre and Prasad, 1998).

The purple block in the centre of the scheme indicates the design option for the community. The models themselves were only designed to illustrate basic shapes and massing in the proposed scheme. To illustrate a more detailed view of each option, a series of architects' sketches were also included, as illustrated in Figure 3.7.



Site Plan of Option Corresponding Oblique Internal Layout

Figure 3.7. Architectural Sketches of Design Options (Penoyre and Prasad, 1998).

The consultation booth also acted as a post-box whereby residents could post a comment form in relation to any of the four options presented or could provide a general view on what type of building should be constructed on the plot. The consultation form required comments on the following themes:

- **The building and its setting:** a sample answer stated that it would provide an excellent, local resource (much needed) on a highly populated estate. However, residents at the other end of the Teviot Estate need to be considered as well. Other resources need to be provided in tandem, for example locations and designs for shops;

- **Its internal arrangement:** on the sample sheet provided no answer was given;

- **One storey or two?** the resident stated that two stories would obviously create more space but has the potential of causing access problems for some users;

- **Should the centre be closely integrated with or quite separate from the school? or something in-between?** the integration with the school, which is located directly below the proposal in Figure 3.5, was a crucial design issue in the development of the Centre. The resident suggested that something in between be developed, although essentially it should be a community facility for all residents;

- **Which way should it face?** in the direction of the natural light was the given answer;

- **Its character?** no answer was provided; and

- **Any other comments?** it was viewed that the new community should be developed in conjunction with existing facilities which would offer an opportunity for the currently under-utilised community facilities to be fully exploited.

Finally residents were asked if they would like to be involved further in the consultation process and if so, to provide contact details. It is not possible to analyse the responses for they are no longer available and on the basis of a single response and form it would be unfair to present conclusions. However, the questions put forward may not do justice to the design options presented and the innovative use of the options booth. Questions such as 'Which way should it face?' in context of the site is not a question that has major implications for the local residents. Similarly the questions on its internal arrangements are not answerable in a constructive manner in relation to the site plans presented. It is also questionable if such issues should be raised at the design stage, as this could be considered the role of the designer and not the resident. There is a fine line to be drawn between asking the community for their views on issues relating to design and planning and those questions that are designed to make the residents feel involved. Issues such as size, mass, setting and utilisation are an integral part of the design process, but these are not questions that the community finds it very easy to respond to in this conceptual form.

Notable in the consultation process was the Architecture Foundation's work with the local school, a main potential-user of the community centre. A simple model with the buildings constructed out of foam plastic was developed and presented to various classes to enable a discussion of the design options as shown in Figure 3.8.

Figure 3.8. School Children Discussing the Design Options (Penoyre and Prasad, 1998).

Similar in nature to the 'Planning for Real' models, the presentation allowed the children to move models around to examine various options. In conjunction with this, the children were also asked to design their own community centre and create a plan view of the internal layout. Figure 3.9 illustrates a sample layout created as part of the exercise.

Figure 3.9. Open Plan Layout Designed as Part of the Consultation Exercise with Children (Penoyre and Prasad, 1998).

While the benefits to the designers of such a process can again be questioned, the exercise is clearly valuable in terms of both education and involvement of the local community.

3.2.2 Digital

Digital technologies have been part of the planning system since the introduction of the mainframe computer in the 1960s (see Figure 2.1). However, in terms of computational use for public participation, it is a relatively new phenomenon and focused almost entirely on visualisation using computer-aided design (CAD). As Batty (2001) states, wire-frame flythrough of buildings in downtown Chicago in the 1980's showed what was possible but widespread use of these kinds of three-dimensional technologies did not occur until quite recently. A report by *HACASChapmandHendy* (2002) for the Housing Corporation identifies twenty-six local authorities utilising what it terms 'Virtual Reality' and 'Computer Animation' for public consultation in planning and regeneration. Of all these projects only one was digitally networked, that of Woodberry Down Regeneration which is further explored in Chapter 8. The rest utilised a variety of methods for consultation and visualisation. They define Virtual Reality loosely in that it should have the characteristics of being created on computer, showing moving images and be able to demonstrate something that does not exist at present (HACASChapmandHendy, 2002).

The models developed were displayed either via a computer screen, video or in Virtual Reality Centres. Most of the models were CAD-based animations at various levels of detail showing development options. Principally used to discuss development options, all the projects used the digital models as a visualisation tool in association with public meetings and exhibitions. An example of this is the Hetherlow Towers/Walton Park Gardens digital visualisation developed through the Housing Action Trust in Liverpool. The scheme involved the demolition of one low rise and two high rise housing blocks within the Hetherlow estates and their replacement with low-density homes and community facilities. A CAD model of the development was developed with the aim of displaying a before and after scenario as well as illustrating the internal layout of a sample new build home: the CAD model is illustrated in Figure 3.10.

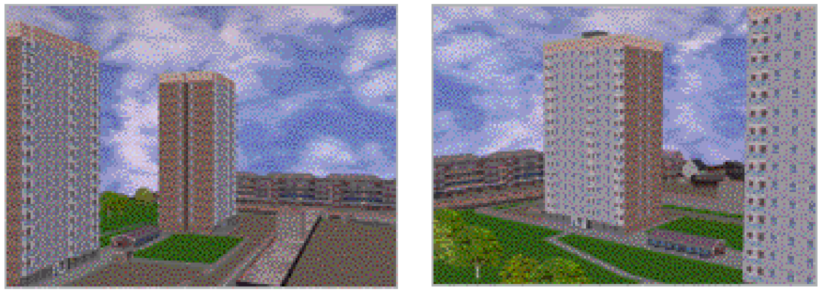


Figure 3.10: Digital Model of Hetherlow Towers/Walton Park Gardens, Liverpool (3D Web Technologies, 2002).

Demonstrated at a public meeting, the model also included a time scale projection, illustrating the period of time between decanting, demolition and redevelopment. The use of CAD in this case provided a clear illustration of the plans with sufficient detail to portray information to the local community groups.

At a higher level of detail and production is the CAD model produced for Cambridge Futures. Cambridge Futures is a group of business leaders, politicians, government officers, professionals and academics working in a spirit of collaboration, rather than confrontation, on possible alternatives for the future of the Cambridge Sub-Region (Cambridge Futures, 2002). The aim is to explore the options for growth in the Cambridge Sub-Region over the next 50 years, and as part of this process, seven options have been produced. Each of these options has been visualized using CAD to display a birds-eye view of the impact on the surrounding area. Figure 3.11 illustrates the 'Before and After Visualization' of the Green 'Swap' policy.

3.11. Cambridge Future's Before and After Visualisation (Cambridge Futures and METAPHORM 3D, 2002).

Figure 3.11 also illustrates the change of use of Cambridge Airport, releasing land for the development of a mixed-use site with retail outlets and high-density housing situated around a central boulevard. The CAD model is used, as in the Hetherlow Towers/Walton Park Gardens example, at public meetings as well as in public exhibitions. Each of the options has been modelled to a high standard and is displayed in the form of a fixed flight path through the area with the various options fading-in to display 'before and after' views. As the options are only detailed in terms of general growth, all the options are displayed from a birds-eye viewpoint and as such, it is debatable if there is a need for a CAD model in terms of public consultation. An artist's view would portray a similar level of detail with considerable savings in terms of time taken to produce the models. The model does however act as a focus point to the exhibition and has attracted local television coverage due its visual nature. As such, it could be seen as more of a marketing tool to attract people to the public meetings rather than a tool that has a valuable use in public consultation.

Moving towards a higher level of detail at street level, CAD can be used to produce realistic models which respond to the unique requirements of planning, engineering and architecture professions (Jepson and Friedman, 1998). Arguably the most advanced examples have been developed by The UCLA Group and the Environmental Simulation Centre (ESC), most notably for Los Angeles and New York. The ESC modelling approach is principally used as a community planning support tool for site selection (locating proposed developments) and design review (Batty et al, 2001). The UCLA model, in contrast, allows the display and evaluation of alternative environments such as neighbourhoods that currently exists, neighbourhoods after new buildings and/or new highway construction, entirely new development, and historic reproduction (Jepson and Friedman, 1998). Figure 3.12 illustrates Downtown Los Angeles from the UCLA group.

Figure 3.12 Downtown Los Angeles (Jepson and Friedman, 1998).

One of the major criticisms of CAD (and its equivalents in GIS) is that it is fixed; if any changes are suggested in a public meeting, it is not possible to implement them without going back to the original model and often re-rendering a pre-defined flight path. The UCLA model however is object orientated, allowing object selection and substitution. By means of a 'switching' node concept, alternative representations for objects in the model can be stored, selected from menus, and switched into the model in *real-time* (Jepson, Liggett and Friedman, 2001). This allows a higher level of flexibility, although it still does not allow modelling changes on-the-fly, only predefined options which have been added to the model before consultation. The model's use for public consultation is limited by the level of hardware required to run it for it is operating on Silicon Graphics hardware which cannot be moved with ease to public meetings or exhibitions. This restriction is common with digital visualisations as such models tend to be limited to operation on single machines running expensive proprietary software, hence also restricting access to related problems arising through planning and design issues (Smith et al, 1998). Such models are often highly detailed, suggesting that the design and layout of the development has already been decided upon, resulting in the model being viewed as merely a marketing tool (Canter et al, 1995). Indeed, the use of highly detailed models as Canter suggests, may indeed not inform the public as intended but adversely alienate them from the decision making process. This could be levelled at the Cambridge Futures application, where the high level of presentation makes it difficult to question the details of each of the options as they cannot be changed on-the-fly by those participating in the process.

3.2.3 Digital-Networked

As Table 3.1 illustrates, our category of digital-networked encompasses a range of communication devices, the simplest being email and moving with increasing complexity to Collaborative Virtual Design Studios which we will examine in both Chapters 6 and 7. A growing number of local authorities are beginning to utilise the Internet for the dissemination of information, although the standards and continuity of such information provision and availability varies considerably from authority to authority. The Association of County Councils Environment Committee (ACCEC, 1996) noted that in some cases, the initiative of placing information on the web is centralised; in others it represents the enthusiasm of one person or department, while it can be authority-wide but informal and exploratory. Although many local authorities are utilising the Internet in experimental and innovative ways, their main use is for displaying information on economic development, tourism services, libraries and information services (ACECC, 1996).

Internet utilisation by planning departments is similar to this wider use by local authorities in general, focusing on innovative and exploitative uses but varying according to expertise and enthusiasm within departments. A study of various planning authorities' web sites does however highlight the range of possibilities that the use of the Internet presents for the planning process.

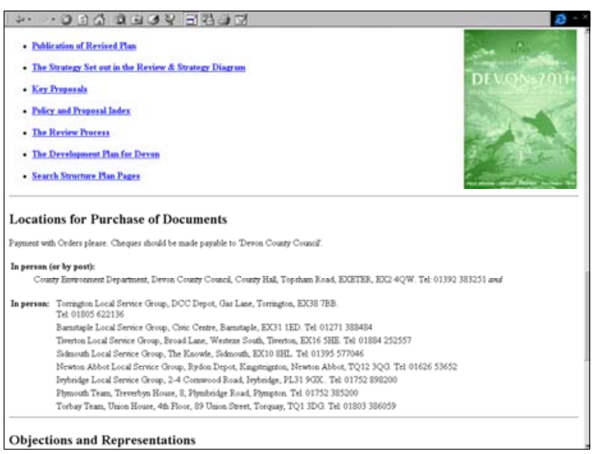


Figure 3.13. The Devon County Structure Plan 2011 Online.

Devon County Council was at the forefront of integrating the Internet into the planning process in 1995 with its placement of a version of Devon 2011, the Devon County Structure Plan (First Draft Review Consultation Document), online. Devon 2011 marked the first utilisation of the Internet in the UK for public consultation in the planning process as we illustrate in Figure 3.13. During the statutory period of consultation for the plan, a comment form was provided, enabling the public to comment on policies directly from the Internet site. The Devon 2011 site was experimental and levels of public participation were limited; during the consultation period, Devon 2011 logged only 11 comments (Taylor, 1996). It did however clearly illustrate how the Internet may be utilised to present planning-based information and promote feedback from the public.

North Wiltshire's Planning Department's Home Page has developed from a site which merely provided information on how to contact the planning department via traditional means of communications, to a site where innovative and informative planning information is made available to the public. North Wiltshire's Home Page provides general information about the local area and information regarding planning applications and permissions, as illustrated in Figure 3.14.

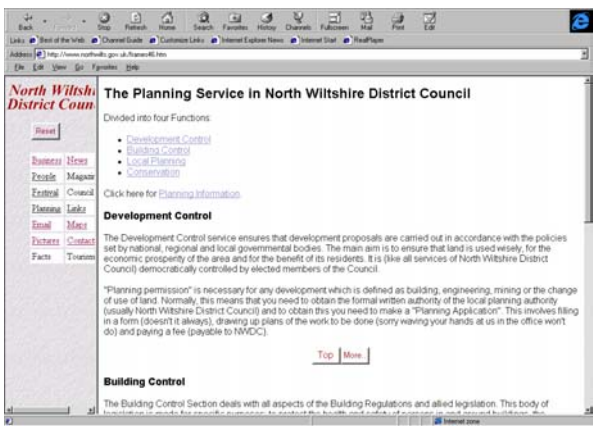


Figure 3.14. North Wiltshire Planning Service.

The site provides information on recently submitted planning applications and planning decisions. The information is provided in a text format, via a search engine, through quoting an application number, decision or location. The ability to search recent planning applications is an illustration of how the Internet can be used to provide planning information. While neither a comment form nor detailed information on planning applications is available, a diary is provided stating the location and times of relevant planning meetings, enabling the public to attend.

Wandsworth Borough Council has developed one of the most technologically advanced planning sites currently available in the United Kingdom. The site, based around a

Planning Register and illustrated in Figure 3.15, allows users to search and display any of Wandsworth Planning Decision notices issued since 1947 as well as more recent Planning Applications.

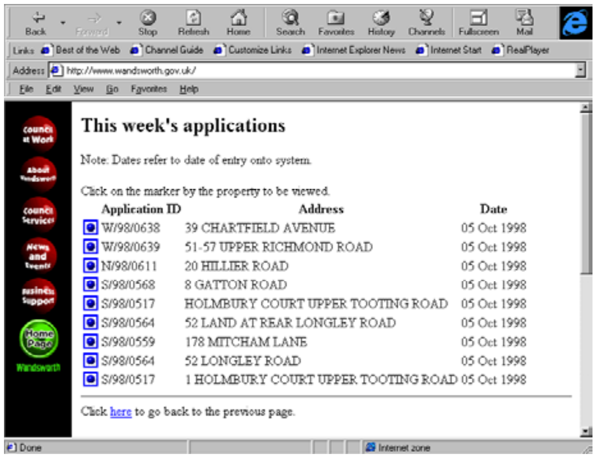


Figure 3.15. Wandsworth Planning Application Notices.

The user is also able to view a complete set of documents for each requested Planning Decision or Application, via an image viewer available for download from the site. The Wandsworth viewer enables users to view documents (scanned in A4 format and saved as .tif files) of any planning decision taken by Wandsworth Borough Council since 1947. The site also enables users to download and print planning application forms, although as yet users are unable to submit applications.

Although Wandsworth and North Wiltshire have used the Internet to provide details on planning applications, the nature of the web as a hypertext system lends itself more readily to the publication of development plans online. Hall (1998) states that the internal structure of the traditional paper-based development plan can be complex to the layperson, and full of jargon, while a multimedia computer-based development plan could largely remove this problem. A World Wide Web-based development plan differs from the paper-based plan in terms of the possibilities for interaction. By placing a development plan online, planning authorities are able to provide a word search system, already widely used on a number of sites notably Wandsworth Borough Council, to enable the public to search for information of specific interest to themselves, and to access relevant local policies. The online development plan opens up the possibility of making local planning policies easily accessible to the public. By integrating word search engines coupled with hyperlinked maps, planning authorities have the opportunity to provide access to local planning information in a freely available, user-friendly way.

Westminster City Council published an Internet enhanced version of their Unitary Development Plan (UDP) online in June 1998, the first of its kind on the Internet. A landmark in the development of digital planning, the online UDP utilises a powerful search engine and facilities to comment on policies, (Slumbers, 1998). The UDP is further supplemented with detailed monitoring reports, committee reports, planning applications and a news page providing a total 'planning policy' package (Slumbers, 1998). However, Westminster's online UDP deviates from the traditional use of the Internet to publish freely available information. Westminster operates a subscription system to its UDP with a range of charging policies ranging from £55 for monthly access to £300 for access on an annual basis. The inclusion of subscription fees to access what is in effect a public document is a cause for concern. Internet usage by local authorities should ideally be aimed at placing information online for the benefit of the local community. In contrast, Westminster has placed their UDP online purely aimed at the professional-user. An opportunity to enhance the use of the Internet to increase levels of public participation and open up the planning process has in effect been lost. Westminster state that they operate an 'access for all' policy with the UDP available freely in selected public libraries, inline with the traditional paper-based plan. Whether Westminster is setting a standard for other online development plans with charging becoming the norm remains to be seen but closed Internet access for publicly available information appears to be an opportunity missed.

The examples reviewed so far have all been aimed at providing information and reach, at best, level 3 on Arnstein's (1969) Ladder of Participation. Using digital networked technologies to allow a further level of feedback, Milton Keynes has utilised an online discussion forum. Notably Milton Keynes has not merely published information but has also included a discussion forum as an additional feature of their website which is central to the drawing up of the development plan on the future of the town. Discussion forums are the first step towards developing a community network. Zemlaiansky (2002) defines discussion forums as virtual spaces where all interested visitors can leave their opinions about the content of the site as well as talk to each other. Essentially they allow multi-way text and image-based communication via the Internet. The addition of this communication moves the level of participation to levels 4 and 5 (see Table 3.1). Forums come in two types, moderated and non-moderated. The majority of forums are moderated, allowing unsuitable messages to be removed from the system by a top-level-user that has password access to the discussion forum system. Moderation can either take place as a filter system, whereby all posts have to be read and approved before going live on the forum or deleted once the messages have gone live. Moderation could be seen as censorship and is an emotive issue as it can lead to the unwanted views being suppressed.

The Milton Keynes board is based on a simple 'post' system; users are not required to register a username or password, and it is simply a matter of filling out a form and making a submission. Over a period of 13 months, the discussion forum has received 121 posts with comments on issues ranging from the town's environment to comparing Milton Keynes with Venice and calling for a more European 'café' culture city. The range of posts is eclectic and the actual contribution it will make to the development plan is questionable due to a lack of focus or follow up on the discussions by officers and members of the local authority. However, in terms of the request for the development of a skate park via the discussion board, this is one subject that may not have been voiced at the traditional public meeting or during the process of consultation. Public participation is usually targeted at adults rather than teenagers and thus the Internet can make the demographic range much broader than can be accomplished by traditional means.

As a place for the expression of views, discussion forums provide a simple and effective route if they are backed up by the relevant parties involved in the decision making process. They can also be used to alert people and attract support for issues that may not be immediately relevant to the local issues in hand. We will explore this further in Chapter 8 with regards to the setting up of a discussion forum for the Woodberry Down project. Discussion forums are global and in the case of Milton Keynes, the views on its future are not limited to local people, but can be accessed by the global online community. As such, posts can be made linking into other relevant sites. An example is the case of a post on the 'Regen-net' discussion forum with the subject 'how regeneration fat cats get rid of people who ask too many questions' by Mike Lane. The post referred to a World Wide Web site Lane has set up to expose his views on the corruption of the regeneration process in Kingston, Liverpool. With the catchy address of http://www.whistleblower.nstemp.com/, he has documented the incidents that led to his exclusion from the citizens' panel set up to aid public participation in the regeneration process. The site is professionally organised, indeed more so than many local authority sites set up for public participation. With low cost hosting packages on the web and easy to use software, it is possible for almost anyone to set up their own net-presence. Whistleblower is a site that offers an alternative view of the regeneration process and as such, is as much a public participation site as any other developed to date, in so far as it provides information and has the ability to receive views on the subject. Views may not be posted via a discussion forum hosted on the main site, but on a site relating to a more general topic. This shows again how such issues can become global, jumping from discussion forum to any web page at the click of a hotlink.

Slaithwaite, a village in West Yorkshire was the setting for arguably the first system to use GIS for public participation in 1998. Running in parallel to a more traditional 'Planning for Real' exercise, the residents also had access to a number of Internet terminals running the Virtual Slaithwaite System. Developed by the Department of Geography at Leeds University, the system was based around a virtual model of the village that allowed the local community to interact with a two-dimensional dynamic map (Kingston, Evans and Carver, 2002). The map provided a level of interactivity allowing members of the public to pan, zoom and ask questions such as 'what is this building' or 'what is this road' (Kingston, Evans and Carver, 2003). We illustrate the interface to Virtual Slaithwaite in Figure 3.16.

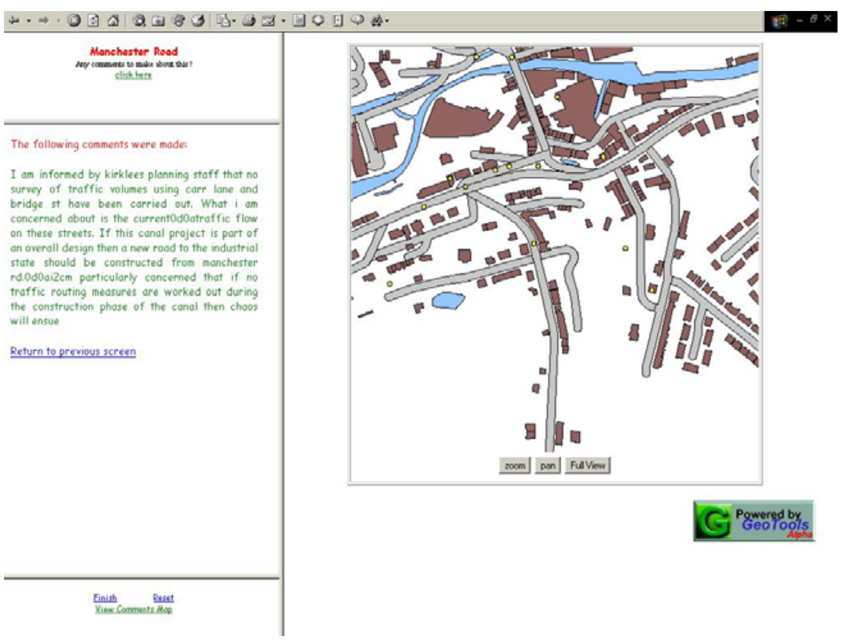


Figure 3.16. The Virtual Slaithwaite Interface (http://www.ccg.leeds.ac.uk/slaithwaite/).

The system is centred around a custom written JAVA applet which allows the simple options of selecting buildings, objects or roads and submitting views via the interface. Working in a similar way to 'Planning for Real', the users are able to see locations which have received comments and place any additional views along side them. All comments are automatically logged as part of the interface and form part of the decision making process for future planning. The system is however only two-dimensional and as such is it difficult to gain a sense of location and place. Kingston, Evans and Carver (2002) in their evaluation of the system were encouraged by the relative ease with which people grasped the concept of GIS and used the system. Indeed the system is easy to use although it is also information sparse. No other information apart from a location's name is provided, leaving the user unsure of further details. The system would have benefited greatly by the user of either photographic, further textual information or the inclusion of the types of digital visualisation which we detail in Chapter 6.

Since the development of Virtual Slaithwaite, the communication of geographical information via the Internet has advanced considerably. We do not intend to carry out a comprehensive review of GIS delivered via the Internet but it is timely to detail a couple of recent examples. Geertman and Stillwell (2002) note that at a local level, a number of local authorities in the UK have begun to develop web-based PSS that enable information about neighbourhoods to be accessed and progress towards meeting targets to be evaluated. It is arguable if these systems are indeed PSS or merely ways to deliver data via the Internet. One such example is the Open Information for Birmingham website (Oi4B). The system has been met with great enthusiasm for its technology and potential as a planning tool for departments and agencies (Birmingham City Pride, 2002). Although not planned as a complete system for all service input and delivery of data, it is viewed as playing a key role in issues such as Neighbourhood Renewal. A series of data sets are available through the site, aimed at providing clear information on the Government's floor targets for Neighbourhood Renewal. These cover indicators on health, education, employment, community safety, and housing. The reduction of inequalities in localities has become an important focus for Government Policy Initiatives (Geertman and Stillwell, 2002). Organised by the former Department of Transport, Local Government and the Regions (DTLR), now the Office of the Deputy Prime Minister (ODM), the Neighbourhood Renewal Unit has been set up to tackle the issues which lead to deprivation as part of a new commitment to neighbourhood renewal and the introduction of a National Strategy Action Plan. This marked the start of a far-reaching programme to reverse the twenty year spiral of decline in the poorest parts of the country (HMSO, 2001).

In the Oi4B application, data has been placed in the public domain via a map-based interface delivering basic GIS functions over the Internet. Users are able to navigate the data either via standard 'pan and zoom' tools or via location-based queries such a postcode and enumeration district. At each level, layers can be switched on or off to display the relevant data required. We illustrate the interface in Figure 3.17.

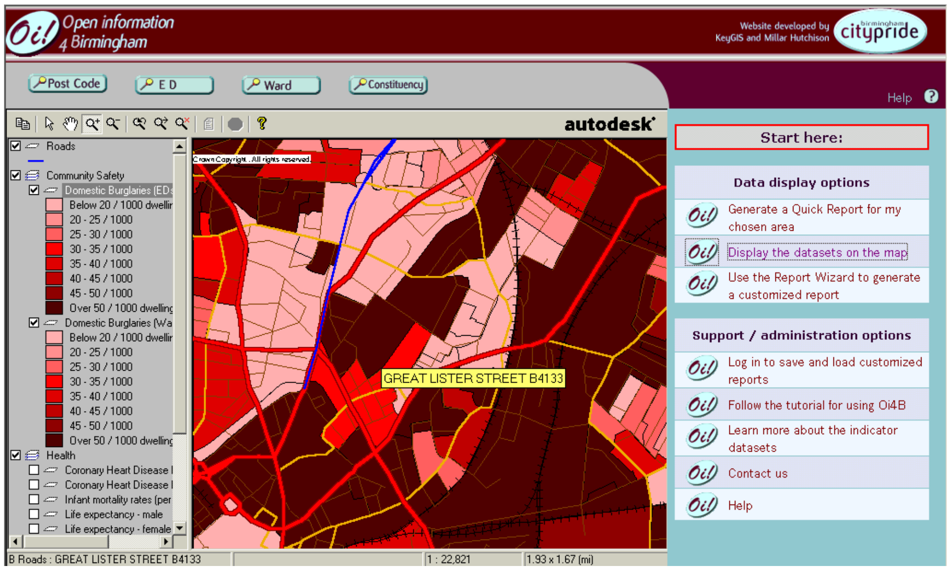


Figure 3.17. Oi4B Map Interface Illustrating Domestic Burglaries According to Enumeration District (http://www.oi4b.com/).

The interface is driven by AutoDesk's Mapguide, providing query-able data within a clear and well-defined interface. One of the main criticisms of GIS is that they are complicated systems which require a high degree of knowledge to be able to use and understand them (Pickles, 1995 in Kingston, Evans and Carver, 2002). Internet-based GIS can attract the same criticisms as although the interface is standard to users aware of desktop GIS software packages, they are notably different to other web-based interfaces. With this in mind the Oi4B system includes a simple 5 step 'wizard' to generate both a map and a report on any data selected. This is a welcome addition to the GIS interface and significantly helps the user gain an understanding of the underlying data. Such systems are of course two-dimensional and represent a simple modification of a desktop GIS towards the network via out-of-the-box packages such as AutoDesk's Mapguide as used in the Oi4B example or ESRI's ARC Internet Map Server to name another example.

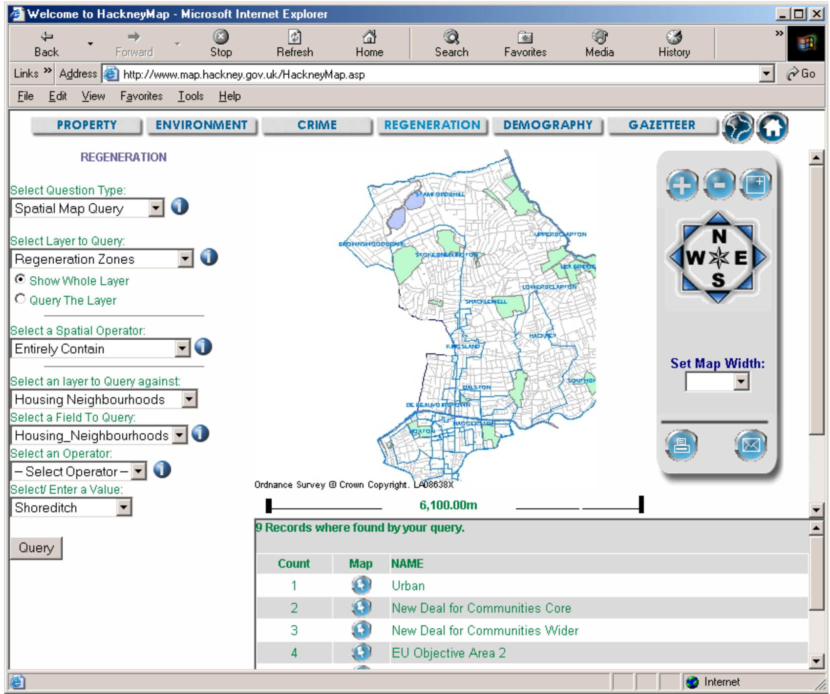


Figure 3.18. Hackney Map (http://www.map.hackney.gov.uk).

The London Borough of Hackney has used a similar system to Birmingham to deliver their Map Hackney over the network. The Map Hackney was developed partly as a response to the *Modernising Government* Initiative to encourage data sharing in support of collaborative working and partly as an aim to deliver best value within a range of council functions. Rather than purchasing expensive desktop license for stand-alone GIS systems, it was decided to move towards a networked service which would also allow access to the data by members of the public. Andrew Bailey, developer of the Map Hackney, views the choice of system as simple: what was needed was a cheap, flexible system that would be quick and easy to get up and running, fit in with existing data and systems and be able to support a diverse set of users to a reasonable level while readily adapting to future, as yet unspecified, requirements for online services (Bailey, 2002). Hackney's system was based around another customisable out-of-the-box GIS package, in this case Intergraph's GeoMedia Webmap. Map Hackney allows a higher level of data analysis that Birmingham's Oi4B. Contained within a single-user interface users, are able to define their own queries and analyses allowing thematic and spatial analysis. We illustrate the interface to Map Hackney in Figure 3.18.

Tools such as the Map Hackney and Oi4B are not specifically aimed at digital planning, yet it would be possible to link planning applications to geographic locations as separate layers linked to the underlying database. By adding the ability to post comments as in the case of Virtual Slaithwaite, it is possible to quickly and simply put online a system to view and comment on planning applications. Although as technology is constantly moving on, it is arguable that there is no longer a need for the two-dimensional map for such data queries. We explore this further in Chapter 9 with regards Virtual London. In order to move away from the two-dimensional information and into the third dimension, a new set of tools are required for digital planning. It is these tools we discuss in Part 2 of this thesis.

Part II

Tools for Digital Space

"At every instant there is more than the eye can see, more than the ear can hear, a setting or view waiting to be explored. Nothing is experienced by itself, but always in relation to its surroundings"

Kevin Lynch, *Image of the City*, 1960, p1

CHAPTER 4

Digital Space – Cyberplace

In our quote that prefaces Part 2, Lynch (1960) states that at every instant, there is more than we can see and hear in terms of the setting or view which might be explored with respect to the urban environment. Nothing is experienced by itself, but always in relation to its surroundings. This is the reality of the city, the built environment. If for the purpose of digital planning, we are to replicate the built environment in digital space, the space itself must convey to the user a sense of location, orientation and identification; in short, it must convey a sense of place. To paraphrase Tuan (1997), geographers study places; planners would like to evoke a 'sense of place'. To gain the essential foothold on place, man has to be able to orientate himself; he has to know where he is. But he also has to identify himself within the environment, that is he has to know he is in a certain place (Groat, 1995 in Bell, 1996). This chapter explores the concept of space and place in relation to the construction of the virtual environment. It explores the concept of building reality out of the digital equivalent of bricks and mortar, 0's and 1's, bits and bytes, and it sets the scene for the creation of the virtual environments explored throughout the rest of this thesis.

4.1 Digital Space

Digital space takes many forms, and it is limited only by our imagination. However, for the purposes of 'Online Planning', we are interested in the digital space that mirrors the real world: space that is grounded in reality. It is this reality that is first explored.

“Knowledge of space is hard wired into each of us…insubstantial and invisible, space is yet somehow there and here, penetrating all around us. Space, for most of us hovers between ordinary, physical existence and something given. Thus it alternates in our minds between the analysable and the absolutely given” (Benedikt, 1996). Our interpretation of space and the resulting sense of location and place, influences our perception of reality. Bell (1996) identifies three different kinds of space: visual, informational and perceptual.

Visual space is all that we can see. It is the array of objects that surround us, creating when viewed collectively, our environment. Each of these objects has a multitude of different attributes, from variations in light and colour to reflectivity. These objects create reality, a fully immersive environment in Cartesian space, space that can be interrupted and explored in three dimensions. If these objects are broken down to singular levels, then each object can be viewed as being made up of a combination of primitives. Primitives are a collection of graphic tokens such as points, lines, and polygons, forming a two-dimensional or three-dimensional arrangement, and we can think of visual space populated by these tokens (Mitchell, 1994). If these points, lines and polygons can be recreated in digital space along with their attributes, then digital space is able to mimic reality, creating a mirror of the real world, a mirror world existing in digital space. Figure 4.1 illustrates the components of perceived reality in real and digital space in relation to Bell's (1996) classification of visual, informational and perceptual space to which we have added social space.

Informational space is an overlay to visual space and it is the space in which we communicate and receive information. From urban signage to oral communication, information is communicated in visual space. In the digital realm, information is not a separate space but an additional attribute. Digital information takes the form of the embedding of data within digital space or the enabling of communication within a digitally generated environment. With the addition of communication to convey informational space, overlaps occur with the third form of space, that of social or perceptual space. Social space defines the user’s identity and role in relation to other users in the visual environment. In digital space, the user’s identity is again an additional attribute which is explored later in terms of embodiment and presence in virtual environments. The combination of visual, informational, and social space influences the individual’s perception of reality, be it in the real or digital environment, and this is what we define as perceptual space. It is this perception that is key to the digital representation of the built environment. Using digital technologies, reality cannot only be modelled and displayed on the computer screen in the form of points, lines and polygons, but it can also be augmented, manipulated or violated.

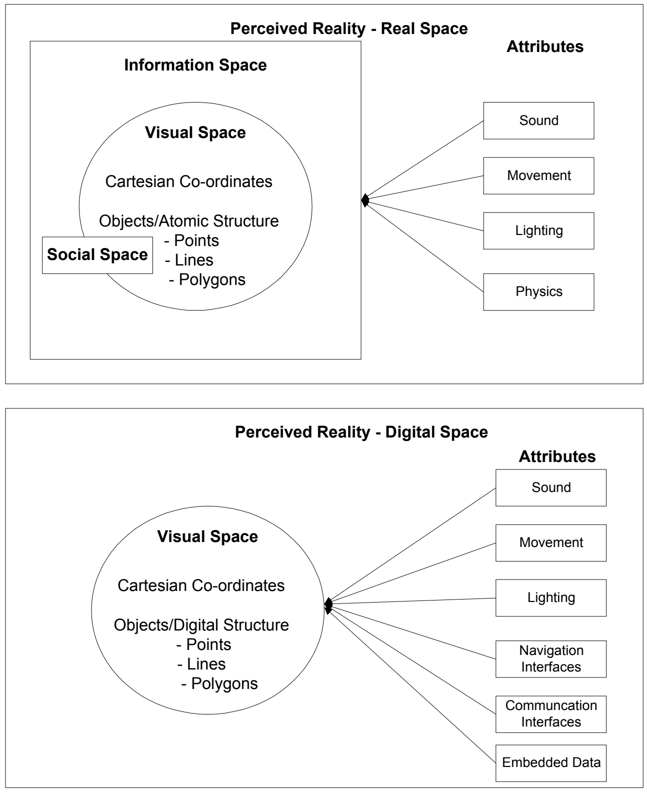


Figure 4.1. Components of Perceived Reality in Real and Digital Space.

As Benedikt (1996) states, because virtual worlds are not real in the material sense, many of the axioms of topology and geometry so compellingly observed to be an integral part of nature can therefore be violated or reinvented as can many of the laws of physics. It is this reinvention that allows attributes to be enhanced and emphasised, and the laws of gravity, density and weight to be excluded, allowing buildings to be moved with the click of a mouse or allowing the user to fly above the environment. Reality can thus be made virtual: Virtual Reality: VR.

4.2 Virtual Reality

At this stage, it should be noted that we are not talking about the populist vision of Virtual Reality, the vision of a headset displayed environment with tactile feedback and input devices. Kitchin (1998) states that Cyberspace can generally be divided into three domains: the Internet, Intranets, and Virtual Reality. Although partly true, this fails to understand completely the nature of Virtual Reality and Cyberspace. Virtual Reality is not a separate section of Cyberspace, it is part of it, another dimension to the network which characterises the dimension of place and presence. When someone enters Virtual Reality, he leaves the computer behind. No longer is the computer screen a window through which the world is observed. Now the user is completely inside the computer. The user can interact with the elements of this world, can move easily through this world, and change it. To describe these phenomena, the term Virtual Reality is used (Pimental et al. 1993, in Kooper, 1995). There are numerous ways to 'enter' the computer, from fully immersive head-mounted displays and Cave Aided Virtual Environments (CAVE's) to semi-immersive projected reality. However, we are concerned with Virtual Reality existing within the Internet, a virtual environment in Cyberspace.

Our definition of Virtual Reality is a virtual environment, an environment in Cyberspace, a place entered via the computer screen and navigated with standard input devices, the mouse and keyboard. This is not to say that this work is outside the realms of fully immersive Virtual Reality. Indeed all the research documented in the following chapters can be ported into a fully immersive system. The semi-immersive monitor screen and standard inputs are used as our defining point as they are the devices most people using the Internet will have access to. The use of the computer monitor to display virtual environments limits the amount of immersion possible. As Tanney (1999) states, computer screens reduce the normal human field of view, so the size and placement of spatial cues become very important. For example, typical computer monitors represent only sixty degrees of our normal one hundred and ten degrees field of vision. Many of the cues in normal peripheral vision are no longer apparent when imaged on a typical computer monitor. In addition, computer monitors only offer a monocular view of the space. Some alternative screens such as those accessed through head-mounted displays, project a much wider field of view in stereo. This more closely approximates our normal field of view. However, for the purposes of digital planning and the need for open access to this technology, the computer screen is adequate and remains our starting point.

4.3 Cyberspace/Cyberplace

The term Cyberspace is one of the most popular terms used to define the size, depth and content of the Internet. It is a term that attempts to visualise the ‘space’, which constitutes the Internet. Cyberspace was first coined by Gibson (1984) in his science fiction novel 'Neuromancer' in which it is defined as not really a place, not really a space but a notional space. Gibson’s widely quoted vision of Cyberspace provides an insight into the concept of networked notional space:

> *"A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts…..A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data, Like city lights, receding…"*
>
> *William* Gibson, **Neuromancer** (1984: p57)

Plewe (1996) in turn develops Gibson's definition to define Cyberspace as a metaphor for the distributional 'space' of information as well as its owners, within computers and networks, to people and places in the real world. Batty (1997) defines this nonspace of the mind – clusters and constellations of data – as 'Virtual Geography', the geography of the digital environment. The four concepts of space, which together constitute reality; visual, informational, perceptual and social space, can be layered onto Batty's (1997) four foci of virtual geography involving place and space:

- **place/space:** the original domain of geography abstracting place into space using traditional methods;
- **cpace:** abstraction of space into c(omputer) space, inside computers and their networks;
- **Cyberspace:** new spaces which emerge from cspace through using computers to communicate; and
- **Cyberplace:** the impact of the infrastructure of Cyberspace on the infrastructure of traditional place.

Batty (1997) charts the inter-relationships of these spaces and their relation to each other in Figure 4.2. Cspace and Cyberspace are digital virtual environments, constructed in Cspace and distributed via the Internet. In Batty's (1997) definition, Cyberplace is a grounded real world location, consisting of the network infrastructure and its impact on location and place in the real world. In terms of digital environments, for planning, and the relationship between digital and real space, the definition needs to be modified. Cyberplace is not a real world location in the digital environment. It is a three-dimensional representation of the real world, a virtual environment that contains enough defining elements to move from a space to portray a sense of place, Cyberplace.

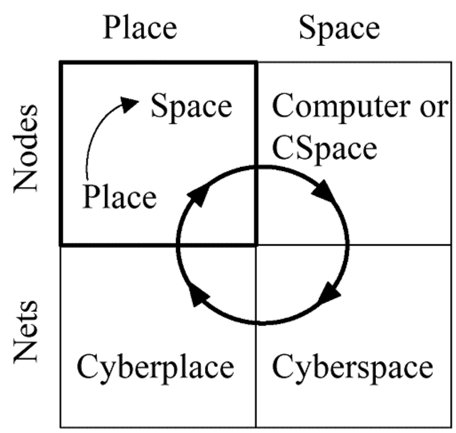


Figure 4.2. Virtual Geography as Place and Space in Nodes and Nets, (Batty, 1997).

Figure 4.3 adapts Batty's (1997) image of Virtual Geography, defining boundaries between Cyberplace and Cyberspace and the resulting impacts on the physical space, in relation to asynchronous and synchronous virtual environments.

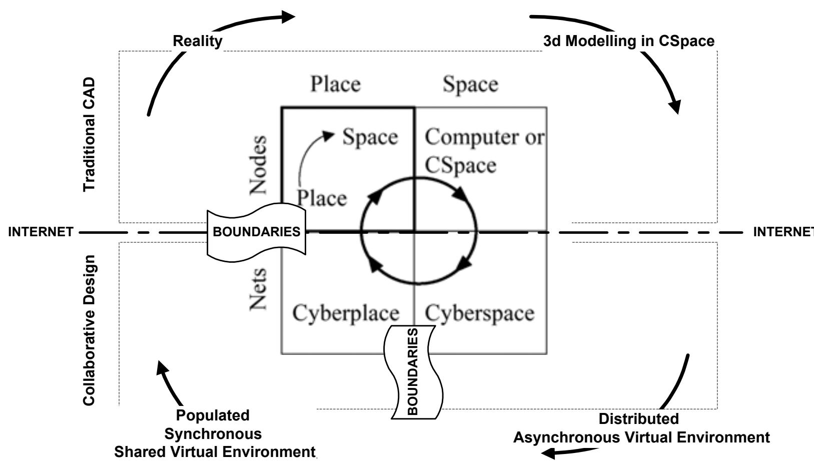


Figure 4.3. Cyberplace in Cyberspace, Asynchronous and Synchronous Virtual Environments.

The boundaries between Cyberspace and Cyberplace, as well as the boundaries between Cyberplace and the real world, are blurred. In our definition, Cyberspace becomes Cyberplace when distributed virtual environments become populated, when they embrace the all-important social space. Limits of technology make the boundary between real world place/space and Cyberspace less blurred. The limitations on the construction of Cyberplace are explored in Chapter 5 in terms of modelling virtual environments and further in Chapter 7 on virtual cities. Cyberspace becomes Cyberplace when additional attributes are added to the digital space (see Figure 4.2).

Attributes of communication and navigation interject social space into the virtual environment, allowing synchronous communication, manipulation and navigation. This creates a sense of place and moves closer to mirroring the real world. It is this boundary in Cyberplace that allows networked virtual environments to be used for the purpose of digital planning.

4.4 Digital Embodiment

Cyberspace provides a revolution in the way we obtain, distribute and react to information as it is an informational, not a spatial medium. Many commentators relate Cyberspace to a spatial metaphor whereby people can occupy the space. Typical is Barlow (1991) who states that Cyberspace is the homeland of the Information Age **-** the place where the citizens of the future are destined to dwell. Is it not, however, Cyberspace where the citizens of the future are set to dwell, but Cyberplace. Cyberplace is an environment whereas Cyberspace is a shelter for information. As Norberg-Schulz (1980) expresses in Violich (1983), man dwells where he can orientate and identify himself with an environment in meaningful ways. Dwelling…. implies something more that 'shelter'. It implies that the spaces where life occurs are places. In Cyberplace, life does not occur, but it can have presence in digital space. As Damer (2000) implies, another revolution is waiting just over the horizon. This is the arrival of a "true Cyberspace" and it will change the very face of software and our use of computers. This revolution is about the direct representation of people on the Internet. Cyberplace is closer to Stephenson's "Metaverse" in the science fiction novel, **Snow Crash**, than to Gibson's Cyberspace. Here is an example:

> *"As Hiro approaches the Street, he sees two young couples, probably using their parents' computers for a double date in the Metaverse, climbing down out of Port Zero, which is the local port of entry and monorail stop. He is not seeing real people, of course. This is all a part of the moving illustration drawn by his computer according to the specifications coming down the fiber-optic cable. The people are pieces of software called avatars."*
>
> Neal Stephenson, **Snow Crash** (1992 p. 35)

Avatars are an individual's visual embodiment in Cyberplace. They provide an all-important visual and social presence in the digital environment. They are the citizens, the occupants, and the commuters of the digital realm. As such they are also the citizens that can occupy and manipulate the digital built environment. The term avatar – for use in terms of digital environments, that is – was first coined by Chip Morningstar, the creator of Habitat, the first networked graphical virtual environment developed on the Internet in 1985. The term 'Avatar' originates from the Hindu religion as an incarnation of a deity; hence, an embodiment or manifestation of an idea or greater reality. Avatars take many shapes and forms, and in the digital realm, they are limited only by the bounds of our imagination. However the most common Avatar is the human form. Figure 4.4 illustrates typical designs for avatars in a three-dimensional virtual world, and presents two views of the avatar, firstly through the eyes of the user in the digital environment, and secondly in 'God' view, i.e. looking down on the user.

Figure 4.4. Avatars in Digital Space, Part of 30 Days in ActiveWorlds.

These images are taken from 30 Days in ActiveWorlds, an exploration of virtual space which is fully documented in Chapter 7. The level of interaction possible while 'inhabiting' an avatar varies according to the virtual environment system utilised. More advanced systems allow the use of gestures to portray emotions. An example of this is the use of gestures within ActiveWorlds, a system which is explored later in this chapter. Avatars in ActiveWorlds are capable of basic gestures such as 'wave' and 'jump' and gestures to indicate emotions such as 'happy' or 'angry'. Figure 4.4 illustrates an avatar using the 'wave' gesture. Each avatar is linked to the individual-user with the user name displayed over the avatar head.

Avatars inhabit virtual environments defined as Shared Virtual Environments (SVEs). SVEs are not new innovations. The first synchronous graphical virtual environment, known as Habitat, was developed by Lucas Film Games, a division of Lucus Arts Entertainment Company in 1985. Habitat was unique as a multi-participant online virtual environment, a Cyberspace. Each participant ("player") used a home computer as an intelligent, interactive client, communicating via modem and telephone over a commercial packet-switching data network to a centralised, mainframe host system (Farmer, 1997). Habitat, as already noted, introduced the concept of avatars within the virtual environment, a concept that is the basis of today's three-dimensional systems. Figure 4.5 illustrates a screen shot from the original software Habitat.

Figure 4.5. Habitat, the First Graphical SVE.

Habitat was 'habitable' in that when the user signs on, he or she has a window into the ongoing social life of the Cyberspace -- the community "inside" the computer (Stone, 1991). The avatars in Habitat were able to move around, pick up, put down and manipulate objects, talk to each other, and gesture, each under the control of an individual player (Morningstar and Farmer, 1991). Communication was achieved via the keyboard with players typing in text. Text was displayed over the avatars' heads in the form of speech bubbles. The prototype Habitat consisted of approximately 20,000 separate locations each displayed in two-dimensions and accessed via standard real world metaphors such as doors and corridors. So did Habitat achieve a sense of place in its two dimensional environment? The answer is without doubt yes. Although the visual space is two-dimensional, the provision of landmarks, non-fixed objects and communication creates a semi-immersive environment and thus Habitat was the first graphical Cyberplace.

4.5 Text Space

Habitat was not however the first SVE. That accolade goes to a Multi-User Dimension (MUD) written at Essex University in 1978. MUD stands for Multi-User Dimension also known as, Multiple-User Dungeon, or Multiple-User Dialogue general terms for a text-based virtual environment in which users can interact in real-time (Outka, 1994). MUDs are virtual spaces created solely by written words and their space unfolds on the computer screen as scrolling text: text space. They are also social spaces shared by many players who are able to interact with each other and with the environment around them. The experience of MUDding (playing on / in a MUD) is often described as like being inside a literary novel but not just as a reader. The MUD is a living novel, being written in real-time by its players (Dodge, 2000). They provide examples of how cognitive space and motion engage us. MUDs on the Internet number in the thousands. Though originally just role-playing games, they are increasingly used in collaborative work and research environments (Anders, 1999). They are space and place described as text and they leave the fine detail of visual space to the imagination, existing in the description of locations. Indeed as Mitchell (1995) states, the first impression a user has of a MUD is the space itself. Dodge (2000) documents a typical description of location from DungenMud:

> *Narthat Street*
> *You stand surrounded by ornate buildings of gothic design. Carriages rush by you, carrying elders and townsfolk through the fog. Above you staring out into the mist are gargoyles perched on rooftops, and the barely visible glow from TinyBen's luminous clockface.*
> *[Exits: South to the town square, NorthEast into the Lawyer's Guild, cab, West into the builders guild, East into the Town Hall, North along the street]*
> *Contents: a window box of daisies The Town Hall*

MUDs exist in non-space. They do not portray space and place in the same way as graphical SVEs or the real world and as such they are in the no-man's land between Cyberspace and the user's imagination. Their space is not collective, it is shared in the coarse detail of text and individually at the fine detail of the imagination. A MUD is not sensory, it is imaginary. The user builds his or her own world in their mind.

If a user enters a new location in a MUD, they are announced: for example '*Smithee enters Narthat Street*'. If a user wants more information on Smithee, they can type a command such as 'look Smithee' and the user's resulting description will be listed on the screen. As much of a MUD's location is in the mind of the user, they do emit a stronger sense of place than graphical SVEs. This has resulted in many commentators inhabiting MUDs and undertaking a MUD-based social life (see Dibbell, 1999 and Turkle, 1995). A hybrid of the MUD is a MOO, a 'MUD Object Orientated' and one of the most well-known MOOs' is LambdaMOO. This is described by Curtis (1997) as a network-accessible, multi-user, programmable interactive system well suited to the construction of text-based adventure games, conferencing systems, and other collaborative software. Its most common use, however, is as a multi-participant, low-bandwidth Virtual Reality. MOOs allow the user to create their own rooms and objects within a MUD, i.e. they can create their own environment. Dibbell (1999) describes LamdaMOO as a modern utopia, a virtual island, a place of lawlessness and an uncharted moral landscape; it becomes lived in by real people and coloured by their imaginations.

MUDs and MOOs are text space but it should also be noted that other text-based environments exist. Systems such as JAVA-based chat rooms, bulletin boards or text talkers are examples of text non-space. They allow networked text-based communication but the conversation takes place in a non-descriptive environment. A popular text non-space is Internet Relay Chat (IRC), originally designed by Jarkko Oikarinen in Finland in 1988 with the aim of letting more than one person connected to the same machine talk to others (Randall, 1997). IRC was not the first *real-time* communications tool on the Internet, for the first was the Unix-based application 'Talk'. Although 'Talk' allowed *real-time* text-based communication, it was limited to two simultaneous users, whereas IRC enables multiple users communicating across various discussion forums. Crispen (1996) describes IRC as being like a CB radio, with a series of channels for topics of conversation and 'handles' or nicknames to identify users. Nevertheless a non-space IRC is important as its text nature forms the basis of communication in the three-dimensional virtual environments explored later.

MOOs, MUDs and other text-based systems represent the lowest common denominator of virtual space. Before we explore graphical SVEs which lead to the development of virtual environments for digital planning, it is timely to explore high-end virtual environments - computer games.

4.6 Game Space

Gaming has become part of popular culture. In the UK, the gaming industry is worth more than £1bn with global revenues overtaking that of cinema (Thompson, 1998). Gaming is no longer merely the pastime of children. As technology and levels of graphical realism have improved, it has moved into the 20 something age group. The gaming medium is often overlooked in systems development beyond the gaming realm, yet gaming is at the forefront of computing, often pushing hardware to its very limits (Gifford, 1996). An examination of the gaming medium provides an insight into virtual environments in terms of modelling environments and system design. Indeed as Anders (1999) states, we can see in computer games characteristics underlying many other multi-user environments.

Mass market computer gaming came into being in 1972 with the release of Pong. Pong consisted of a black screen with short, thick white lines on each side (the paddles) which could be manipulated vertically by the player or players, in an attempt to control a bouncing 10-pixel square (ball) that beeped when struck (Ogden, 1999), as we illustrated in Figure 4.6.

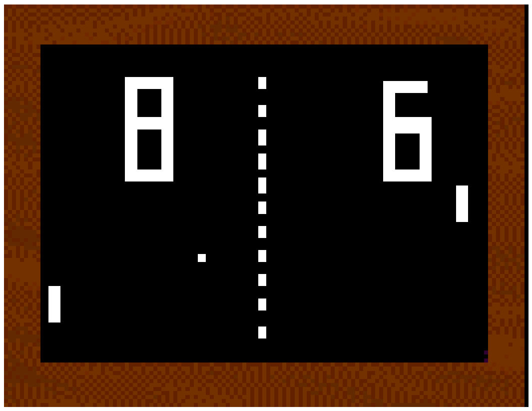


Figure 4.6: Minimal Graphics Representing a Ping-Pong like game, in 1972, Pong.

Ogden (1999) states that Pong was not a ping-pong game; it was a series of icons that stood in for a ping-pong game. The conversion took place in the player's head. Pong was a series of icons, yet it revolutionised the concept of using computers as a gaming medium and introduced computers dedicated to gaming into the home environment in the form of 'consoles'. As gaming consoles have increased in power from 8-bit (1986), through 16-bit (1991), 32-bit (1994), 64-bit (1996), to 128-bit (1998-2002), the complexity of the graphics has increased and with it a number of gaming genres have developed. It is in these genres in which digital space and place is created and manipulated by the player in the form of a game.

4.5.1 The God 'Simulation'

A god-simulation or 'god-sim' as it is more widely known, is essentially a strategic game in which the player has control over an entire world - or at least has significant macro management of a portion of that world. In other words, the player has been afforded divine status (or a close approximation) and is able to manipulate the mechanics of a world and see the effects gradually unfold before them (Stevens, 1997). SimCity, currently in version 'SimCity 3000' developed by Maxis, is one of the most popular god-sims. Figure 4.7 illustrates the gaming environment and a section of a developed city.

Figure 4.7. SimCity 3000 Gaming Environment.

SimCity uses an isometric viewpoint and the player navigates the environment by scrolling left, right, up, or down. Isometric games first developed in the 1980's, consist of an environment made up of multiple squares turned sideways and projected to be seen from above to resemble diamonds. Arranged along the x- and y-axes, the diamond-shaped tiles create a sense of depth without requiring a z-axis (Krikke, 2000). The use of an isometric viewpoint is common in god-sims as it allows a deity camera angle, adding to the player's sense of space and place and feeling of overall control. Due to its simulation of city growth, SimCity 3000 and its previous incarnation SimCity 2000, is one of the few games which has been directly utilised for planning education.

The game sets out to model the processes by which cities grow and expand. The gaming simulation utilises some quite sophisticated underlying theoretical concepts such as positive and negative externalities, spill-over effects, public choice, land values, accessibility, closed and open cities, spatial interaction, and spatial equilibrium, (Yewlett and Webster, 1997). SimCity revolves around the player's role as mayor of a city, and as such the player is directly responsible for:

- planning - zoning, long- and short-range;
- city infrastructure - water, power, transportation;
- government services - fire, police, hospitals, prisons;
- education - schools, colleges, libraries, museums;
- recreation and open spaces - parks, zoos, stadiums, marinas;

- city budget and taxes;
- major and minor land manipulation; and
- the health, wealth and happiness of the Sims (the population) that live in the city.

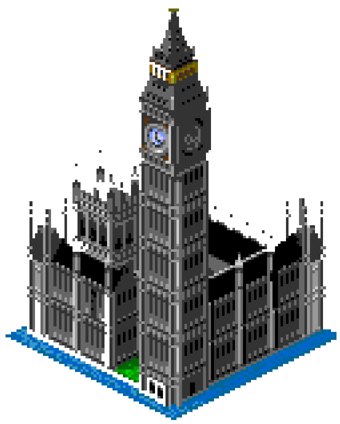


Figure 4.8 Houses of Parliament, London, Modelled in the SCURK for SimCity 2000.

As mayor, the player is required to set a budget from which they have to create and manage a successful city, installing infrastructure and generally creating a pleasant living environment for the 'Sims'. Yewlett and Webster (1997) have used SimCity 2000 for teaching under-graduate planners. They state that SimCity has provided a valuable and entertaining introduction to economic theories of urban form-ation and planning. It has also introduced the whole concept of using computers for simulation purposes. SimCity can also be used, albeit to a limited extent, to explore issues of urban design. Maxis has developed a SimCity Urban Renewal Kit (SCURK), allowing users to develop their own buildings which can be integrated into the SimCity gaming environment. This allows SimCity design scenarios to be developed based in real city locations. Figure 4.8 illustrates an example of the Houses of Parliament, London, developed in the SCURK. Although a basic architectural representation, the Houses of Parliament example illustrates how games such as SimCity could, in principle, be used for planning and design applications.

Transport Tycoon, developed by Micropose, follows a similar theme to SimCity both in terms of gameplay and graphics. The goal of the game is to run a transport company and construct train, road, ship and air routes to transport good and passengers from place to place (Baughn, 1998). Routes are constructed between various local authorities and ratings given on the quality of service provided. Competition is introduced in the form of computer-controlled transport companies which compete for transport routes and passengers. Figure 4.9 illustrates the Transport Tycoon gaming environment.

Figure 4.9. The Transport Tycoon Gaming Environment.

Like SimCity, Transport Tycoon has also been used by Yewlett and Webster (1997) for teaching. An addition to the original Transport Tycoon software is a World Editor (similar to the SCURK in SimCity) which allows local authorities and geographical locations to be constructed using real world data. Figure 4.8 illustrates Norwich in East Anglia, an example of a scenario in Southeastern England produced by the World Editor.

4.6.2 Three Dimensional 'Shoot em Ups'

In 1993 'Doom' was released by ID Software for the personal computer. A landmark in computing graphics, it introduced a new genre – the three-dimensional 'shoot em up'. The ideology behind Doom, pictured in Figure 4.10, is simple. The user must navigate through a maze populated by demons, solve a few basic puzzles and reach the end of on of the preset level.

Figure 4.10. Doom from ID Software.

Although the concept is simple, the games overriding success is the sense of space and place that the game's graphics engine portrays to the player. The atmosphere created by innovative lighting techniques and enclosed spaces is such that playing the game can be a truly terrifying experience to the end-user. The game is not however truly three-dimensional. The player is unable to look up or down or indeed interact with any of the objects around him/her. As Frost (2000) states, in Doom the various objects are made up of a series of bitmaps that represent different views and if the object is animated, movements. This allows you to view a monster front and back and from either side and with a couple of different postures, but this does not make it three-dimensional. The monster does not have an actual three-dimensional form. You cannot see the object from all angles but only from the limited viewpoints that are provided. This limits the sense of reality of the game and limits the complexity of detail available. However, Doom demonstrates how it was possible to generate a sense of location and atmosphere with 1993 desktop technology which has now been surpassed in 2002 on the Internet. Its most significant aspect is that fact that it can be connected to the Internet for multi-user gaming known as a 'deathmatch'. The addition of a network option, although secondary to the main single player game, enabled multi-players to occupy the gaming environment. In this sense, Doom can be regarded as the first gaming Cyberplace.

Since the release of Doom, the games market has been flooded with games copying this genre. As console and computing technology has increased in power and graphics quality so has the sense of location and atmosphere accredited to these games. Duke Nukem, developed by 3DRealms, was the first of these games to be based on an essentially urban environment created in an enhanced version of the Doom graphics engine. The concept of the game is similar to that of Doom but the sense of the location portrayed to the user differs. The user obtains a unique sense of space and place when emerging into a public square and equally a sense of unease when wandering through a dark alleyway. These aspects of location and place can easily be related to the modelling of urban space from a planning perspective. The impact of true three-dimensional graphic engines in gaming has been immense. Graphic engines exist where each room, object or creature is three-dimensional, and the character is allowed to travel along an x, y and z axis. As Fisher (1998) states, it is difficult to ignore the excitement in the computer gaming industry concerning *real-time* three-dimensional graphics. Everywhere, the talk seems to be of faster three-dimensional engines, of hardware acceleration, texture-mapping and advanced real-time lighting effects. Every year, we see progressively more realistic "virtual worlds" packaged in game form.

Quake, and its sequels Quake 2 and Quake Arena, developed by the original team behind Doom, brings the three-dimensional 'shoot em up' to the current level of computing technology. Quake Arena's gaming environment, illustrated in Figure 4.11, utilises advances in three-dimensional graphics cards to increase the level of realism in the gaming environment.

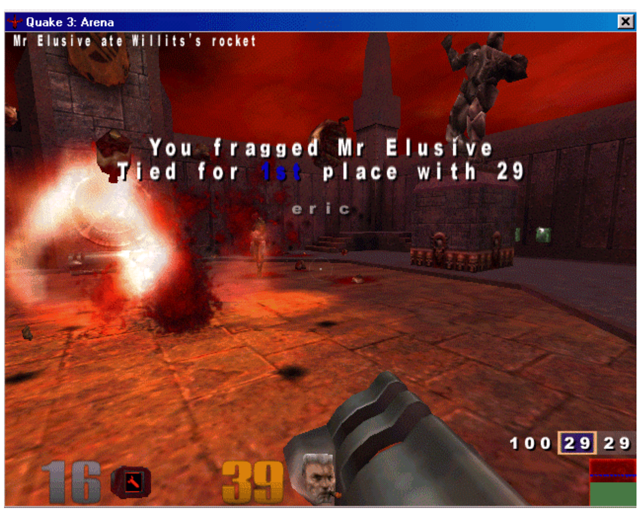


Figure 4.11. Networked Quake Arena, Developed by ID Software.

While the increase in realism of graphics is important to the user's sense of location and atmosphere, it is the introduction of three-dimensional sound which is most significant. In simulations of space, whether they are of the built environment or fantasy location as in Quake and Doom, sound is an often overlooked attribute. Yet sound is imperative if we are to gain a true sense of space and place in an environment, be it real or virtual. An environment with three-dimensional sound is based on the ability to create the sensation that the sound source appears to get louder or softer according to the user's distance from it, portraying a sense of depth and reality. Such sound techniques are now becoming available in Virtual Reality technologies available on the Internet, allowing a new dimension to be added to networked planning simulation. Of note is the move of Quake Arena away from traditional single player gaming towards increasing dependency on the network environment. Quake Arena is, albeit from a single player training mode, network dependent. The game takes place almost exclusively in networked digital space, pioneering the move towards online gaming.

4.6.3 Online Gaming

Networked Quake and the like are only one aspect of online gaming. Damer (1998) classifies 5 separate genres in Table 4.1:

Type of Gaming World	***Description and some examples***
Social Gaming Worlds	These games give you plenty of reason and time to communicate with your fellow players. Meridian 59, The Realm, and Ultima Online are just a few of these socially-oriented quest and action adventure games. Guilds are often formed in these worlds.
Non-social Competitive Gaming Worlds	Good representatives of these games like Quake or Duke Nukem 3D do not give much emphasis to social interaction during the game. Face it, if your goal is to kill your opponent's character, you are not going to stop and talk to them. On the other hand, users often form off-game associations such as Clans.
Multi-Player Sim Worlds	These worlds, War Birds and race car driving games, being two examples, place you in a well crafted competitive simulation. In the cockpit of a World War II Spitfire or an Indy race car, you can converse with your team or squadron members and race or battle other players.
Constructivist Sim Worlds	These worlds, like ActiveWorlds, allow you to create shared spaces and define rules about them. Sim City 2000 is a good example of this kind of world, in which you design a whole city and deal with its economy.
Board, Card and Strategy Game Worlds	Good old favourites like backgammon, bridge, scrabble, chess, Monopoly, and Risk are easily transposed to the Internet and sites like the Internet Gaming Zone give you plenty of choices.

Table 4.1. Classification of Networked Gaming Worlds (Damer, 1998)

An important point to note is that online games can be divided into two separate categories: firstly 'enclosed' whereby the software is either purchased on CD Rom or downloaded in its entirety from the Internet, and secondly 'dynamic' whereby only the basic browser is downloaded. Enclosed software such as Quake runs software and graphics held on a user's computer, enabling intricate levels and graphics to be incorporated into online games. Dynamic games are updated according to user interaction and as such are dependent on bandwidth capacity for graphics rendering, restricting the intricacies of level design and graphics.

4.7 Digital Geography

An important feature in the formation of digital geography is the ability of individual users to construct their own space. This capability creates a new geographic system, allowing ordinary users to become the architects, planners and landscapers of digital space. The ability of the user to construct virtual space and therefore digital geography varies according to the virtual world system. As already noted, ActiveWorlds is one of a number of internet-based systems which allows users to interact with each other in virtual environments as avatars. ActiveWorlds also allows users to build in the environment and this is central to the system. ActiveWorlds consists of hundreds of worlds (more than 500 at the time of writing) including AlphaWorld which is the largest, most highly developed, and most populated and it is this world that we will focus on for our exploration of digital geography. AlphaWorld was the first world in the ActiveWorlds universe and thus the first constructionist Cyberspace environment, (Contact Consortium, 1998). Figure 4.12 illustrates the ActiveWorlds browser with avatars in AlphaWorld.

The ActiveWorlds browser consists of four sections, first on the left in Figure 4.12 is the list of worlds that make up the ActiveWorlds universe. Worlds listed in green can be double clicked and entered, worlds listed in red are private (locked) worlds that can only be entered if the world owner allows. This creates two distinct spaces in the ActiveWorlds environment, private and public space. Second is the world window itself which displays the world and the avatars in the local proximity. Third, communication in ActiveWorlds is via text, similar to IRC. Text, typed in the window below the virtual environment, is displayed both in a scrolling box and above the avatars' heads. Finally, on the right is an HTML browser window which displays relevant web pages that can be triggered to load from within the environment. The main focus of ActiveWorlds itself is the virtual environment window and the text box.

Figure 4.12. ActiveWorlds Browser, Avatars in AlphaWorld.

Before we describe the dimensions of ActiveWorlds and its resulting geography, it is timely to explore the central feature of the ActiveWorlds system, that of building. All structures in ActiveWorlds are constructed from a series of separate objects that make up the ActiveWorlds database. There are a total of 6,591 separate objects in the database, each divided into separate categories such as windows, doors, trees and furniture, to name but a few. Each object is identified by its own unique name, viewable by right clicking the mouse while the cursor is over an object. It is this database of objects that allows building in ActiveWorlds. Available objects can be browsed in a number of building yards within ActiveWorlds. Figure 4.12 illustrates Laras NW Builders Supply Yard where we illustrate a sample of the range of objects available for construction.

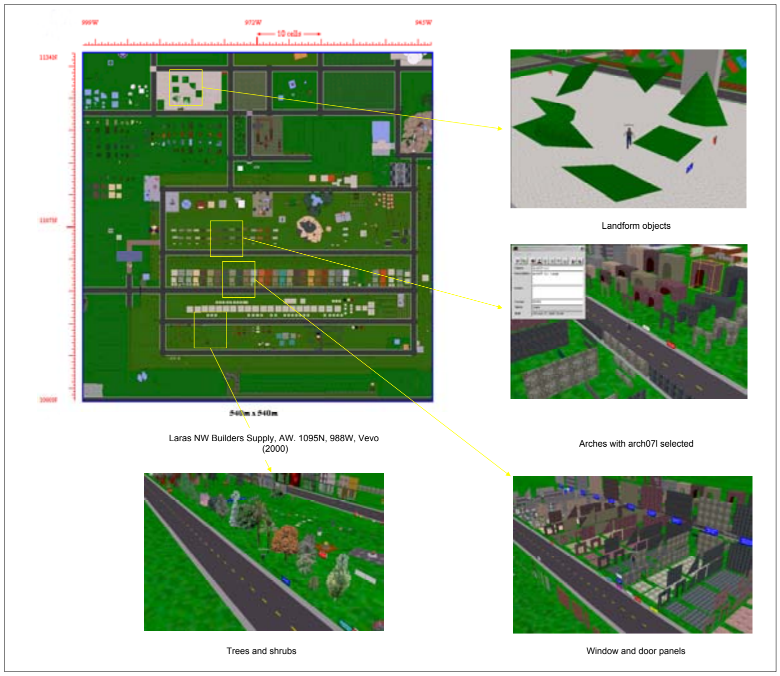


Figure 4.13. Laras NW Builders Supply Yard, AlphaWorld.

As can be seen in Figure 4.13, the objects are arranged in categories, allowing easy selection. Each category is reached via a series of teleports, the details of which are discussed later in this section. Right clicking on an object brings up the 'Object Property' box illustrated in Figure 4.12 for Arch071. This provides the object's unique name which can be noted for future use. Figure 4.14 provides a step by step guide to construction in the ActiveWorlds environment.

The first step to building in ActiveWorlds is to find a plot of available land near another object. Available land is represented as light coloured grass. The free land must be near another object as the building process works by a system of 'cloning and renaming'. Once a plot of land is located, the adjacent object is 'cloned' using the object property box and moved with the arrow keys to the available area of land. To place the required object, in this case the Arch noted in Figure 4.12, the new object's name is entered into the property box. As Figure 4.13 illustrates, the arch is now in place. Once an object has been placed, it becomes the user's specific property and cannot be deleted or moved by another user. This process is repeated for each object to be placed, allowing complex structures to be built from the object database. In August 2000, AlphaWorld was made up of 58.5 million objects, each cloned and renamed and creating a unique digital geography.

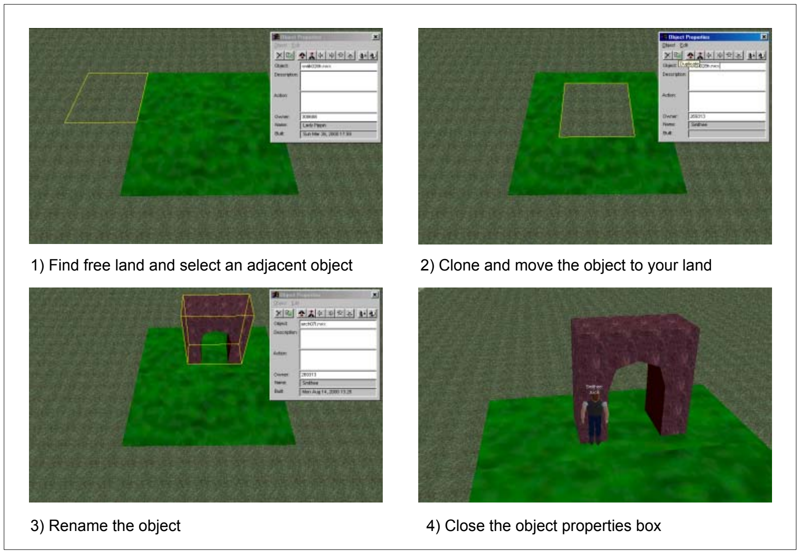


Figure 4.14. Construction in ActiveWorlds.

4.7.1 Dimensions of ActiveWorlds

The geography of ActiveWorlds can be traced back to 28th June 1995 when the first ActiveWorlds server, AlphaWorld, was opened to the Internet. Its physical geography is relatively simple, a vast flat plain of virtual land 429,038 x 429,038 kilometres in size, more than four times larger than California (Vevo, 1998). ActiveWorlds is based on a Cartesian co-ordinate system whereby the x and y axis co-ordinates relate to points of intersection at the origin (0,0). The centre of AlphaWorld, and of all worlds in the ActiveWorlds system, is at 0,0 - also known as Ground Zero. Locations from Ground Zero are represented as a series of cells with each cell measuring 10m x 10m. The traditional Cartesian referencing system is used in ActiveWorlds to represent a location in terms of cells, for example 100N 100W relates to 1000 meters North, 1000M West. An addition to the system is a Z co-ordinate to represent heights, for example 100N 100W 0.5 represents the same location but 5 meters above the ground. Note that these indicators are all based on a unit size of 10 meters.

The first 3 maps in Figure 4.14 illustrate the growth of the central region of AlphaWorld between December 1996 and August 1999. The maps cover an area between 1000n, 1000s, 1000e and 1000w with ground zero (0n, 0e) in the centre. These three maps, produced by Roland Vilett of ActiveWorlds, represent a mere 0.3% of the total area of ActiveWorlds.

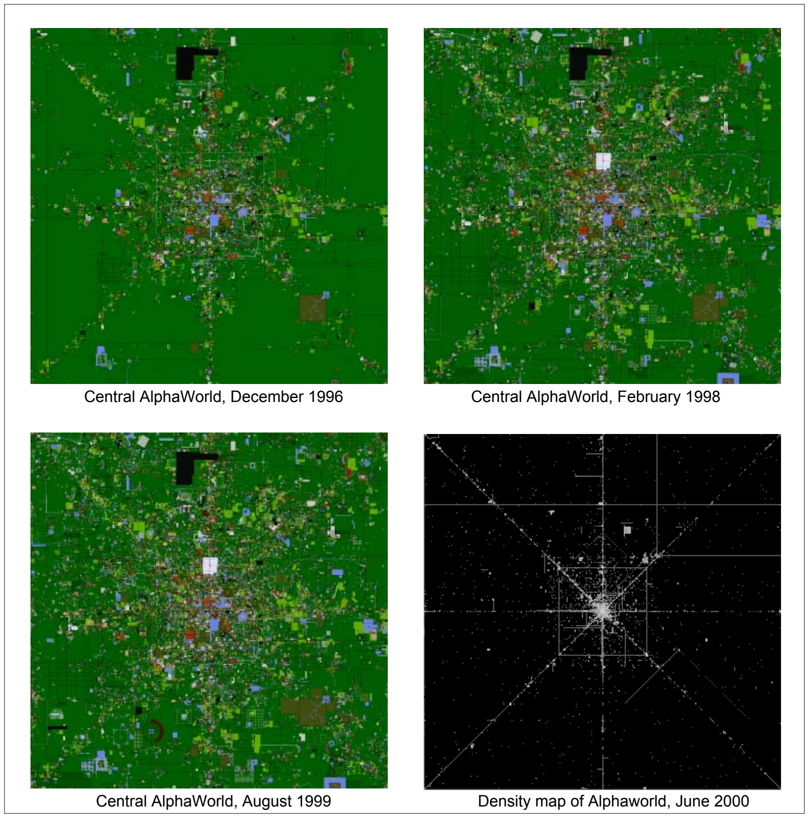


Figure 4.15. Central AlphaWorld Over Time (Vilett, 2000) and AlphaWorld Density map (Vevo, 2000).

AlphaWorld is a world of mixed virtual geography, ranging from complex landforms and physical features to sprawling urban areas and suburbia. Figure 4.15 centres on Ground Zero which to all intents and purposes acts as a Central Business District. Growth away from the centre is on distinct axes, focused on the 8 compass quadrants, which is clearly illustrated by the density map in Figure 4.14. The density map showing growth along distinct paths is a result of a number of factors, ranging from aspects of agglomeration, natural clustering and building restrictions. Vilett (2000) notes that you can see the 'Starfish' shape of the building as people crowd their buildings along a north-south axis and 'equator' of AlphaWorld, and as they build along the co-ordinates with matching numbers (i.e. 220n, 220w, 450s, 450e etc.). Some do this so that their co-ordinates are easy to remember, and others simply by building onto what others have built.

The growth of AlphaWorld to August 2000 has been remarkable with 58.5 million objects (Vevo, 2000) placed by 315,825 citizens (Mauz, 2000). However most of this growth occurred pre-October 1997 before a two-tier structure of citizenship was introduced into ActiveWorlds. Citizens were divided into 'tourists' and fee-paying 'citizens', with citizenship costing $19.95 per year. Tourists are allowed access to all public spaces just as fee-paying citizens do, but they do not have the same range of choice of avatars and they can only build in certain areas (Schroeder, Huxor, and Smith, 2000). In addition to restrictions on building, tourist buildings are not permanent, meaning that any object or building made by a tourist can be deleted by any other user. The introduction of these changes resulted in a decrease in the number of users. A recent estimate is that there are 28,500 registered citizens in total (Eep, 2000) but this does not include lapsed citizens who have not renewed their citizenship.

4.7.2 Communication Space of ActiveWorlds

As already noted, communication in ActiveWorlds is text-based. Communication is divided into four tiers; open conversation, whispered communication, telegrams, and file transfer. Figure 4.16 provides an illustration of the topology of communication in ActiveWorlds with open multi-nodal and optional single party links.

In Figure 4.16, section 'A' represents an undefined area of a highly populated virtual world, for example AlphaWorld, while 'B' and 'C' represent other worlds in the ActiveWorlds Universe. All users have the ability to hold open conversation, conversation typed in the main text window in the ActiveWorlds browser. Conversation can only be 'heard' over a limited distance, and that distance set to 40 metres by default, although it can be increased by the user to a maximum distance of 120 metres. As the user moves around the world, other users come into conversation range and this is represented by the overlapping conversation circles. In addition to open conversation, all users have the ability to whisper to other users. Whispering is a recent addition to the ActiveWorlds browser, introduced in early 1999 and it is only possible between two users, not between groups of people. Whispering was introduced to allow private conversations while in populated regions in ActiveWorlds, essentially creating a private communication space in a public area.

Only registered citizens have the ability to telegram and transfer files between other users. While whispering and open conversation is limited to the world the user currently inhabits, telegrams and file transfer operate both between the current and other worlds. In order to transfer files, both users need to be logged into the ActiveWorlds Universe. Telegrams, on the other hand, can be sent even if the other user is logged off. Telegrams are automatically received when the end-user logs into the

ActiveWorlds system and in this sense, they are the equivalent to email in ActiveWorlds.

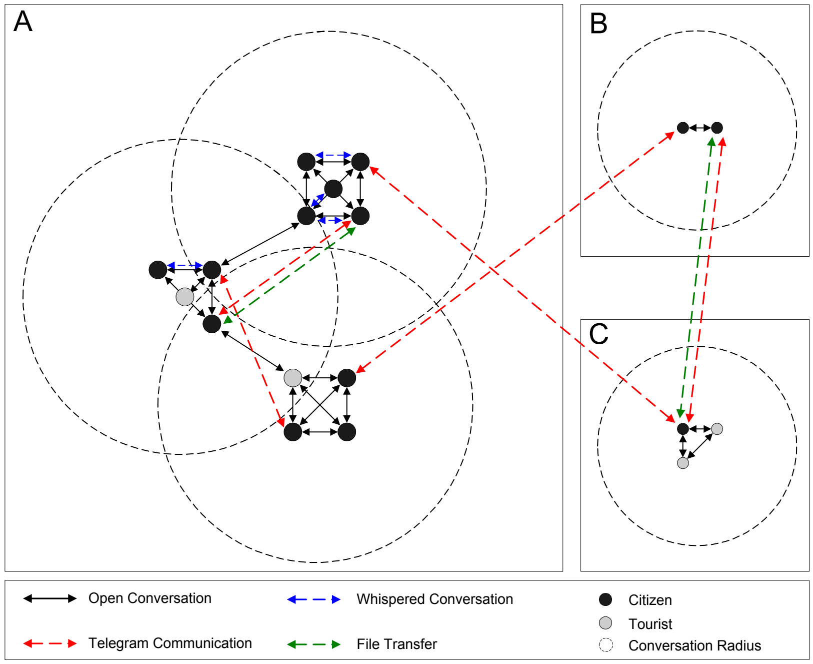


Figure 4.16. ActiveWorlds Communication Space.

Figure 4.16 can been compared to the analogy of the Virtual Café by Adams (1998) where he compares text-based conversation in Cyberspace to that of a café in the real world. To be like a real café, a 'virtual café' must consist of: (a) groups of two or more nodes highly interconnected among themselves to form clusters (as around tables), (b) nodes which are loosely associated to form a larger network (the café), (c) nodes which support a certain amount of one-way communication between customers as well as (d) the possibility of forming intercluster links (encountering friends), and (e) the opportunity to switch clusters (move from one table to another) (Adams, 1998). In Figure 4.15, the customers are the users represented as avatars where clusters are the natural social grouping, for example around the world entry points such as Ground Zero and the one-way communication is the open entry text. In addition in ActiveWorlds, registered users are linked to other worlds, or in Adams analogy, 'cafes' through the use of telegrams.

4.7.3 The Visual Space of ActiveWorlds

As we have noted, visual space is all that we can see. It is the array of objects that surround us which when viewed collectively create our environment. In digital space, the number of objects that surround a user's avatar is often restricted due to technical limitations, Chapter 5 examines these limitations in detail. As such, digital virtual environment systems need to limit the number of objects displayed to the user at one time. ActiveWorlds achieves this by imposing a restrictive viewing distance in its three-dimensional browser and by default, the viewing distance is limited to 40 metres around the avatar in any direction. As the user explores the world, the browser loads up additional objects within the avatar's view and deletes the objects which fall out of the 40 metre radius. Figure 4.16 illustrates the visual space in ActiveWorlds and links it to Hopi space and time in subjective and objective realms.

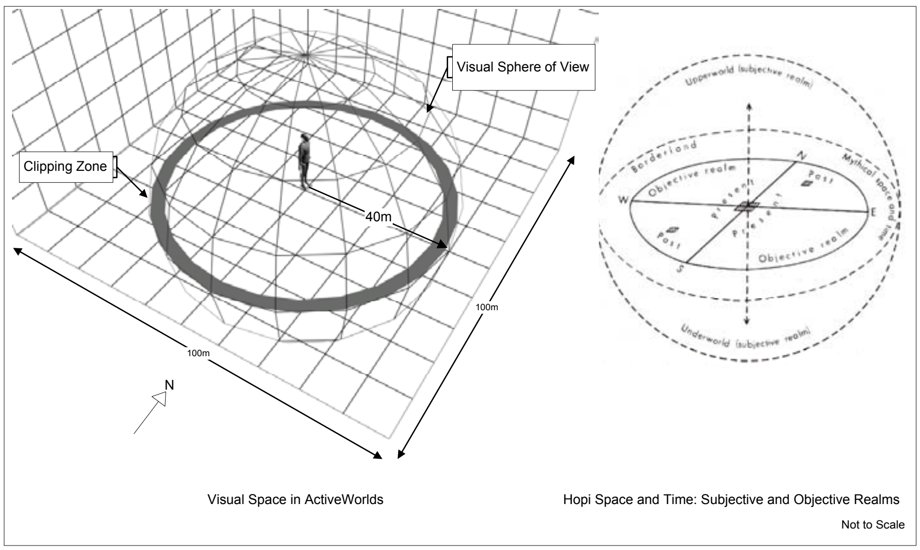


Figure 4.17. Visual space in ActiveWorlds and Hopi, Space and Time: Subjective and Objective Realms (Tuan, 1977).

The visual space in Figure 4.17 can be linked to the realms of reality portrayed by the Hopi Indians of the American Southwest. The Hopi Indians occupy land where it is possible to view long distances, unlike ActiveWorlds where distance is restricted. Despite this, comparisons can be drawn in the Hopis' perception of two realms of reality; manifested (objective) and manifesting (subjective) (Whorf, 1952, in Tuan, 1977). Tuan (1977) describes these two realms of reality as manifested reality, the historical physical universe. It includes all that is or has been accessible to the senses, the present as well as the past, but excludes everything we call the future. Manifesting, or subjective reality as Tuan (1997) states, is the future and the mental. It lies in the realm of expectancy and of desire. It is that which is about to manifest, but which is not fully operating. In terms of ActiveWorlds, manifested reality is within the displayed viewpoint and regions already explored which is the historical digital space. Manifesting reality is the region on the edge of the default 40 metre view and in this area, objects appear to be clipped as if emerging from fog. The clipped or manifesting zone provides a glimpse of the future; it is the hint of digital space to come. AlphaWorld exists on a horizontal plain, four times the size of California and it can never all be seen at once but the user subjectively knows it is there. Tuan's (1977) illustration of Hopi space also includes the dimension of time. Distance is not abstracted from time and thus the greater the distance, the greater the lapse of time. This results in events taking place in other places becoming recalled in a timeless past, the realm of mythical space and time. Within ActiveWorlds, distance is also abstracted from time in that distance is irrelevant. Any area of ActiveWorlds can be reached by teleportation and thus distance is not a barrier to place.

4.8 Navigation of Space

Methods of travel differ within the virtual world system. The ActiveWorlds system is based on a system of teleports, teleporting users to new locations according to a Cartesian co-ordinate system. Teleports are located throughout ActiveWorlds and act as a convenient means of travel; indeed teleporting is now an integral part of the ActiveWorlds' interface. However, the ability to teleport was not part of the original ActiveWorlds system, for it evolved through the influence of Neal Stephenson's science fiction novel **Snow Crash**. In **Snow Crash**, the ability to teleport was blocked;

> *You can't just materialise anywhere in the Metaverse… this would be confusing and irritating to the people around you. It would break the metaphor.*
>
> Neal Stephenson, **Snow Crash** (1992: p42)

Pressure from users resulted in teleportation stations being introduced at select points in and around ground zero, but it caused concern among the developers. The New World Times (1998), an AlphaWorld newspaper, reported that "there is still some concern that teleportation will ruin the simulation of reality in AlphaWorld". Teleportation is now fully implemented and an integral part of travel in ActiveWorlds. However, in a bid to regain the original vision of transportation, world owners now have the ability to disable a user's ability to teleport.

4.9 Utopianism

AlphaWorld is an emerging digital space, a space in which users can claim land and create place. As an emerging space, it has a frontier like philosophy, creating a pioneering spirit in the inhabitation of a new land. King and Lamb (1996) note that visionaries like Howard Rheingold (1993), Nicholas Negroponte (1994) and William Mitchell (1994) identify Cyberspace as the new social frontier. Virtual environments such as AlphaWorld are at the edge of this frontier. If systems such as ActiveWorlds had been around in the last decades of the nineteenth century would the then utopian movement founders such as Ebenezer Howard, have first their idealised cities – Garden Cities – in ActiveWorlds? The answer is probably yes. An example of this cyberutopianism mentality is Sherwood Village in AlphaWorld.

Sherwood was developed by the Contact Consortium (an interest group developed around multi-user virtual worlds, see http://www.ccon.org) as a community project, aimed at developing a community space for the purpose of beauty, function and personal expression (Damer, 1998). Sherwood is reminiscent of both the utopian and anarchist movements of the late 19th century where the aim was to build an idealistic community, a natural living and working environment. However whereas the utopians of the 19th century experimented with the development of real world space, the utopians of the present day build in virtual space. The aim of Sherwood was to create a viable community within the new medium of human interaction. To observe how this community is to be built, grow, and function, it was organised as a planned colonisation of Cyberspace (Contact Consortium, 1998). Figure 4.16 illustrates two maps of Sherwood, firstly a map of the local region by Vevo (2000) and secondly a hand drawn map of Sherwood, illustrating its planned nature by Hanly (1996). Linking these maps are two images of the entrance to Sherwood.

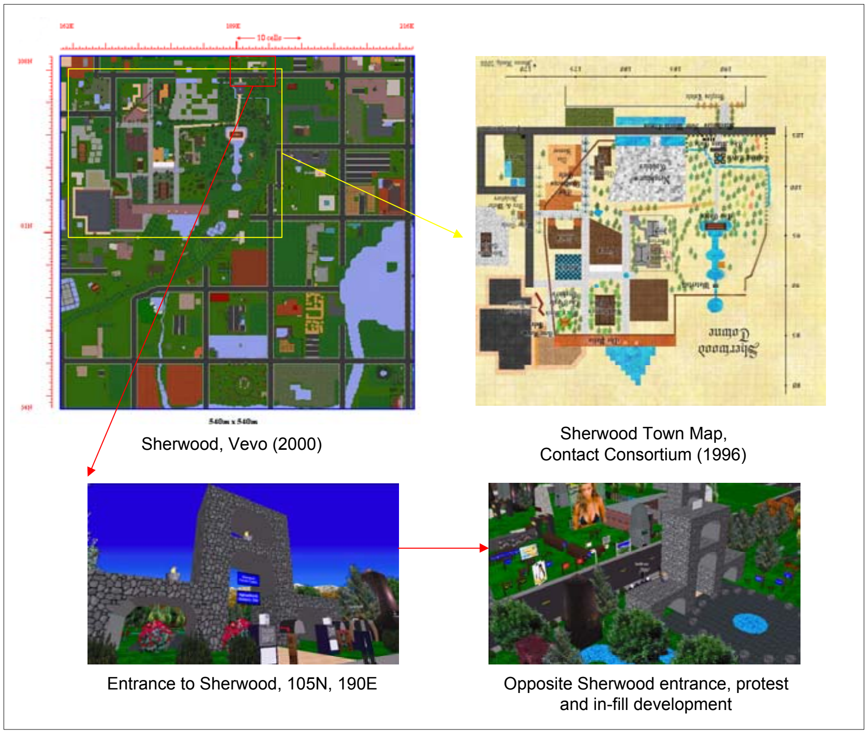


Figure 4.18. Sherwood, AlphaWorld.

The foundations of Sherwood were laid in January 1996. Damer (1996) states that a site was selected and carpeted with a large forest, consisting of many species of trees, shrubs and flowers, all interspersed with lakes and streams. This was aimed at creating a natural setting in which to situate the new human community. The town was defined by a boundary wall in effect sealing the community off from the rest of AlphaWorld. Sherwood operated an 'apply and build policy' and therefore users could not just turn up and build. They had to apply to the community leaders for a plot of land, who then decided whether or not plots of land would be allocated and the area of the 'town' to be planned. As such Sherwood is a gated community, entry is via application and it is isolated from the rest of AlphaWorld. Damer (2000) documents the gated philosophy, stating that contrarians complained and opted to build in more free form development dubbed 'New Towne' outside the walls. Within the community they sought only 'Olde English' designs. This 'cell wall' effect was designed to create more of a texture to the space.

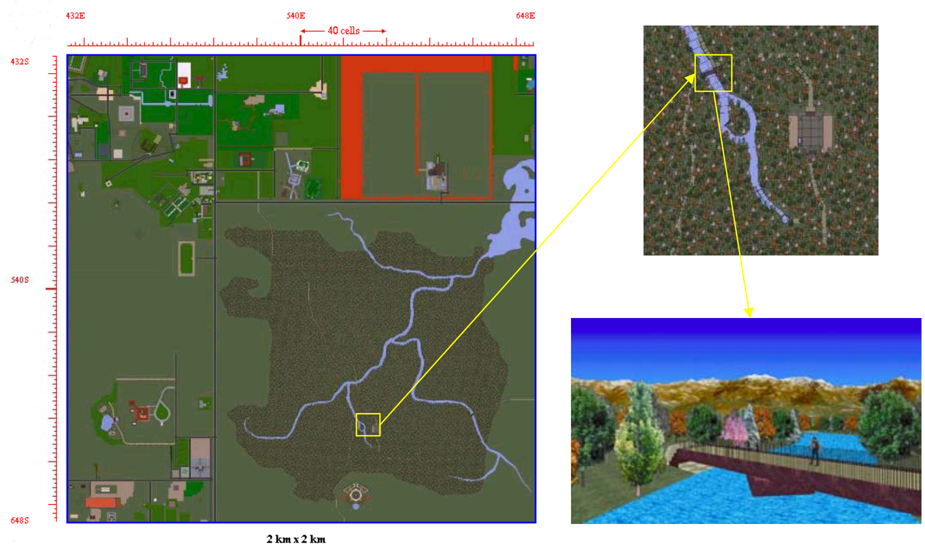
A total of 60 people contributed to the development of Sherwood. The community featured areas for education, contemplation, public and private space, and a weekly newspaper, and as such, it became a social focus in AlphaWorld. The land around Sherwood has attracted a large number of builders, constructing objects ranging from virtual advertising boards to virtual bars, providing entertainment for the occupants. Indeed, Damer (1998) compares the construction around Sherwood to the development of low calibre commercial space around Disneyland in the 1950's. It also attracted what Damer (1998) terms the 'darkside of ActiveWorlds' in the form of vandalism and verbal harassment (avabuse) of members of the Sherwood community. Indeed the incidence of avabuse became such that a policy of installing call boxes to the AlphaWorld Police Department and Help Patrols was considered (Damer, 1998). The Police Department was set up to deal with such crime, having the rights to delete any object in the world. However, proof must be provided that such acts of vandalism are not creative acts. The Police Department has since been superseded by 'peacekeepers' - citizens that have the power to eject people from worlds if they abuse the ActiveWorlds terms of use. Damer (2000) states in relation to vandalism, that across from Sherwood many 'suggestive' signs and teleporters popped up on the free land while infill building filled up most of the area. The worst incident of vandalism was a 'teleporter bomb', a tiny object placed by a shrub at the entrance to Sherwood that warped visitors to a new location when they tried to come into the front gate. A further insight into vandalism in these virtual worlds is explored in Chapter 7 when we recount our own experiences in '*30 Days in ActiveWorlds*'.

Whilst Sherwood was developed for many social and geographic reasons pertaining to the real world, it was also a response to the geography of the virtual world. Sherwood was an attempt to depart from the 'build and abandon' philosophy that is prevalent in virtual world construction. Although precise figures are not available, vast tracts of AlphaWorld are in reality virtual ghost towns. Users have claimed a space, built a home, office or other structure, and then abandoned it, either to build elsewhere or to move to another virtual worlds system. The problem of abandoned areas partly relates to the introduction of an annual charge to become a citizen of ActiveWorlds with world-building rights. The annual fee has also had the result that many areas built by users while the system was free of charge, have become ghost towns overnight. This relates in some respects to the real world phenomenon of urban sprawl. Batty et al. (1999) in defining sprawl, state that often when development comes to the end of its life, it is abandoned and waves of new growth, building on the old do not take place. Central cities are depopulated and abandoned while suburbs keep on growing. This is typical of the ActiveWorlds environment, which consists of waves of new growth and abandonment. However unlike the real world, the old areas are not re-inhabited and reoccupied as they remain the property of the initial builder and thus are left abandoned in the virtual space. Despite Sherwood being set up to avoid the build and abandon philosophy, it is currently an abandoned community. The town was built up with occasional building over two years but currently it has become, ironically, simply a tourist attraction in digital space. The town is still used but mainly for guided tours or one off reunion events.

Figure 4.19. PippinVille in AlphaWorld.

Sherwood is but one example of cyberutopianism in AlphaWorld. Whereas Sherwood was a group-build project, other developed areas are attempts at utopianism by individuals. One such example is PippinVille, a small town developed by Lady Pippin over a period of 18 months. We illustrate areas of PippinVille in Figure 4.19.

Pippinville contains a number of urban and rural features, including an art gallery, museum, restaurant and areas of hills and streams. The development of physical features are of note as AlphaWorld started life as a flat plain of land, devoid of any physical features but since it was opened, these features have been built by the users of ActiveWorlds and a physical landscape has developed. A further example of this virtual landscape is a forest 'built' by LittleBull, a citizen of ActiveWorlds, between November 1995 and April 1996 which we illustrate in Figure 4.20. The forest consists of over 1 million separate objects, a river meanders through the centre and bridges have been placed to allow easy crossing points.



Forest and river features in AW, Vevo (2000)

Bridge over a river in the midst of the forest, 582S 568E

Figure 4.20. LittleBull's Forest in AlphaWorld.

4.10 Cyberplace

As Lynch's (1960) quote at the beginning of this chapter is as relevant to the digital, virtual world as to the real. Digital environments hold the ability to create a sense of place, and thus they are able to mimic the real world for the purpose of digital planning. Leading the field are developments in computer gaming followed by SVEs such as ActiveWorlds. The growth of AlphaWorld with its millions of objects, marks the first colonisation of Cyberspace. Areas displaying the real world characteristics of urban areas are an everyday part of life in ActiveWorlds. These worlds represent an emerging Metaverse, where space is colonised and built, and place is created. If these places can be built to mirror the real world, then they can be used for digital planning. Thus the basic premise of visual, social, informational and perceptual place have already been met, albeit to a limited extent in the digital environment.

It is, however, early days in the development of Cyberplace. There are many problems and issues which need to be explored and confronted before we can truly inhabit digital space. These issues, in relation to the modelling of the built environment, will now be explored in Chapter 5.

CHAPTER 5

Tools and Requirements: Modelling and Distributing Virtual Environments.

As we argued in Chapter 4, the creation of virtual environments to represent built form has traditionally been through the medium of Computer Aided Design (CAD). The nature of CAD and its development as a high-end architectural rendering tool has meant that it is normally limited to computer-intensive graphics workstations running proprietary architectural or modelling-based software. Such packages provide high quality animations or single frame renderings of proposed changes or additions to the built environment, but they cannot communicate these presentations effectively over remote networks. These problems begin when a model needs to be shown interactively to a client or user for CAD is not a low-bandwidth real-time rendering tool. If models are to be distributed and interactively manipulated remotely, they need to run over a network and within an interface that operates effectively on a low-end, home or office-based machine.

This chapter explores and demonstrates how such models can be rapidly prototyped and distributed online. It is divided into three distinct, although overlapping, sections: components of networked three-dimensional graphics, modelling virtual environments, and distributing virtual environments. All the models illustrated throughout this chapter are aimed at the local scale, i.e. streetscapes and clusters of buildings and are therefore also applicable to the communication of single buildings or urban designs. Aimed at gaining a sense of location and place online, the convergence of multi-player computer games, chat rooms, and streaming graphics and audio over the Internet is enabling us to use these networked virtual environments for digital planning. These environments require a new set of tools and distribution techniques which we will examine here.

5.1 Components of Networked Three-Dimensional Graphics.

Brutzman (1997) defines six components of Internet distributed three-dimensional graphics as follows: connectivity, content, interaction, economics, applications, and personal impacts. The combination of these six components is central to our understanding of how networked three-dimensional graphics and the resulting virtual environments are produced by the modeller, distributed over the Internet, and browsed by the end-user. Figure 5.1 illustrates the interlinking features of Brutzmans' six components with an additional seventh, that of file size. Each of these features and components will be examined in turn in relation to virtual environments.

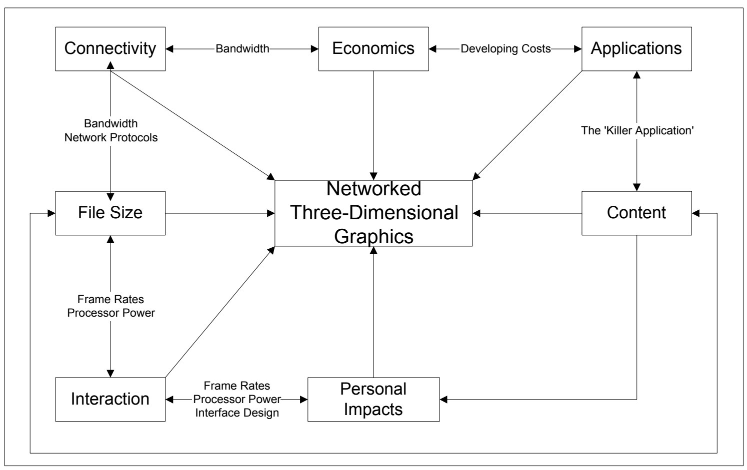


Figure 5.1. Interpretation of Brutzman's (1997) Six Components of Graphics Internetworking with the Addition of File Size.

The first and perhaps most important component is connectivity. Connectivity refers to the capacity, bandwidth, protocols and multicasting capabilities of networking infrastructure (Rhyne, 2000). Although networking is considered to be quite different from computer graphics, network considerations are integral to the production and distribution of large-scale interactive three-dimensional graphics. Graphics and networks are two interlocking halves of a greater whole: distributed virtual environments (Brutzman, 1997). Connectivity however, in terms of available bandwidth, is a decreasing problem. At the start of this research, the average home-user connection speed was 28.8bps with many users connecting via slower 14.4bps analogue modems. At present average connection speeds for home users are 56Kps or above (Graphics, Visualisation and Usability, 1998). The increase in available bandwidth has allowed an increase in file size for the virtual environments produced during this thesis. Table 5.1 lists theoretical download times, based on a perfect connection, for a typical 1.5mb file in a virtual environment. Download time is listed in relation to connection speeds and increasing bandwidth availability.

33.6Kbps	56 Kbps	128KBps ISDN	784 Kbps xDSL	5Mpbs Cable
7.5 minutes	4 minutes	1.5 minutes	16 seconds	2.5 seconds

Table 5.1 Download times According to Connection, Adapted from Telegraphy (2000).

Download times are representative of distribution mediums using a client/server architecture, whereby the entire file is required to be downloaded before the virtual environment can be rendered. Alternatives to the client/server model are discussed later. There is a direct relationship between connectivity and file size in the client/server model. This relationship represents a bottleneck in our ability to distribute three-dimensional models online.

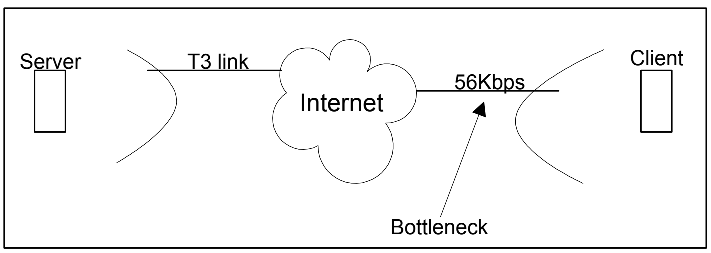


Figure 5.2. Bottlenecks in Access Speed, Adapted from Halabi, (1997).

As Figure 5.2 illustrates, even if a model is hosted via a T3 link (44Mbps), the fastest connection the client can obtain is 56Kbps connected by a 56Kbps standard modem. Online three-dimensional environments therefore need to be tailored to the current average connection rate of 56Kbps. As already stated, bandwidth is a diminishing problem: capacity is increasing as cable modem and Digital Subscriber Line (DSL) technologies are beginning to enter the home. However at the time of writing, the successful distribution of virtual environments is inexorably tied to the ability to distribute content within available bandwidth with file size being all-important.

Connectivity and file size are linked through issues about interaction. Interaction involves a sense of presence and the ability to both access and modify content. It also defines the level of location and place in a three-dimensional scene. The level of interaction is a key aspect to consider in the modelling of the built environment. Despite the ability of networked three-dimensional graphics to create imaginative and complex environments, they are too often limited by low levels of interactivity, either due to system limitations or interface design.

The level of interaction is tied in with content and application. E-commerce requires a lower level of interaction than, for instance, collaborative design. In e-commerce applications, the user normally only requires the ability to view the product from a limited range of angles. Collaborative design requires a more sophisticated level of interaction with the ability to walk and fly-through the environment in addition to the ability to move, add and subtract objects. E-commerce, however, is a recurring theme in the development of three-dimensional graphics and the ability to model and distribute virtual environments online. We will return to this later.

Personal experiences are linked to both the level of interaction and the content of the environment. This can be seen in the sense of wonder and/or frustration when interacting and navigating a virtual environment. Interlinking these components is interface design. How the user navigates and explores the environment is crucial to the level of wonder and/or frustration experienced. Content can be seen as any information, dataset or stream that is transported via a networking protocol which in our case, are models of the built environment. Content is an emotive issue in the modelling and distribution of three-dimensional models as despite all the hype, there is yet to be a killer application for online three-dimensional graphics. Currently three main content driven applications exist: multi-user gaming, shared virtual environments, and e-commerce. These three applications are shaping the delivery of virtual environments which we will examine later in terms of their distribution.

Economics is all-important. If three-dimensional graphics are to become commonplace on the Internet, entry requirements need to be at a cost the basic consumer can afford. This has to include the cost of the whole package, from cost of connection and hardware to the cost of viewing and development software. In order to communicate a sense of location and place online, three-dimensional communication of the built environment is dependent on Brutzman's (1997) six factors and our seventh, file size. For effective communication utilising networked three-dimensional graphics, a rethink of traditional modelling and distribution techniques is required. We will turn to this next.

5.2 Tools for Modelling Virtual Environments

Tools for producing virtual environments are many and varied. It is not proposed to examine tools in terms of a systematic review of software packages *per se*, but instead to review increasing levels of technical complexity and connectivity relating to the specific research examples we have developed. We show these with respect to these variations in Figure 5.3.

This section explores a range of methods to model existing urban scenes. The modelling of such scenes as a portrayal of the existing environment is crucial to view any proposed development in context. It is however the modelling of the existing environment which poses the most difficulty (Kjems, 1999). It is much more difficult to build a three-dimensional model of an existing environment than a new development. With this in mind, methods are examined based on four levels of detail and abstraction, namely panoramic visualisation, prismatic primitive, prismatic with roof detail, and full architectural rendering. Firstly we will examine panoramic visualisation.

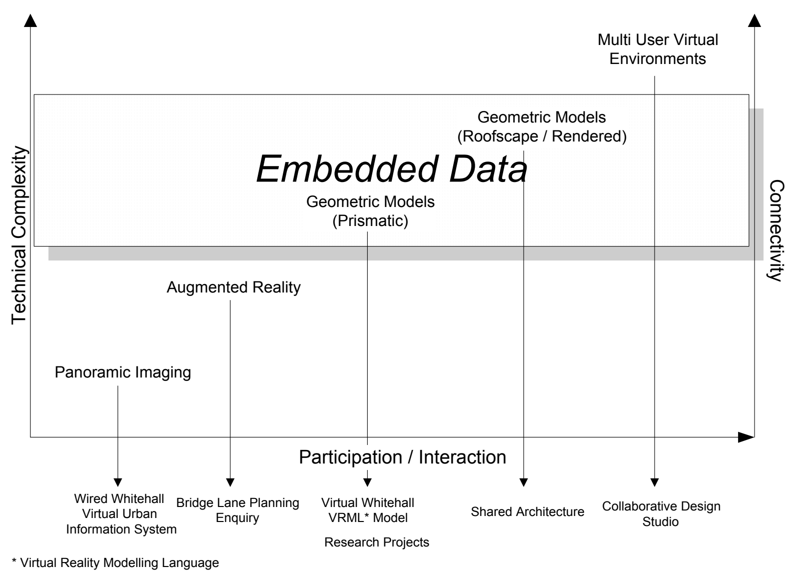


Figure 5.3. Technical Complexity and Connectivity in Relation to Participation and Interaction, Linked to Specific Research Examples.

Panoramic visualisation is not three-dimensional *per se*, in that it consists of a series of photographs or computer rendered views stitched together to create a seamless image. Rigg (1998) defines a panorama as an unusually wide picture that shows at least as much width-ways as the eye is capable of seeing. As such it provides a greater left-to-right view than we can see (i.e. it shows content behind you as well as in front). Figure 5.4 illustrates a sample for Canary Wharf Square in the London Docklands.

Figure 5.4. Panoramic Image of Canary Wharf Square, London Docklands.

Although panoramic images are two-dimensional as they are constructed from a series of photographs, the effect is considerable realism (Cohen, 2000). Panoramic images have not been brought about by the rise of the digital age; indeed they have been in existence since the 1840's with the introduction of the first dedicated panoramic cameras. However it was not until 1994 and the introduction of QuickTime Virtual Reality (QTVR) for the Apple Macintosh that panoramic production, based on the stitching of a number of photographs, became available on home computers for the first time. QTVR works by taking a sequence of overlapping images and automatically aligning and blending them together to create a seamless panorama. The resulting picture is a photorealistic capture of a scene taken over the time required to capture the images, typically between 30 seconds and two minutes. Panoramas are viewed online via either a plugin or JAVA applet. The viewer renders a section of scene allowing the user to pan and zoom the panorama using a combination of the mouse and keyboard. Each single panorama can be defined as a node on the desktop or the net while hotlinking between a series of panoramas creates a multi-nodal tour.

Since the introduction of QTVR in 1994, a number of rivals have emerged, providing similar stitching and viewing abilities. These rival products compete on various aspects, such as progressive downloading, node jumping efficiency, full up and down viewing, support for sound and foreground animations, and scrolling speed/image quality/file size balance (Merlin, 1998). In particular there is *Photovista* from Livepicture which is available for both the Windows and Macintosh platforms. This has capitalised on the market by providing a powerful stitching algorithm within an easy-to-use interface and it has been used for the creation of the majority of the panoramas featured in this thesis.

The image of Canary Wharf Square in Figure 5.5 displays a considerable amount of distortion when projected on a flat plane. Distortion is a result of the images 360-degree field of view, i.e. the image shows both in front of and behind the viewer. Removing distortion requires the image to be mapped onto a shape corresponding to the field of view of the camera. For example, if the camera has a standard 35mm lens, the field of view in portrait position (i.e. with the camera on its side) is 54.42 degrees, making the equivalent of a 'cone' when the resulting panorama is stitched. If the camera uses a wide-angle lens, such as a 8mm fisheye, the subsequent field of view increases to 180 degrees and the resulting image represents a spherical viewpoint as in Figure 5.5.

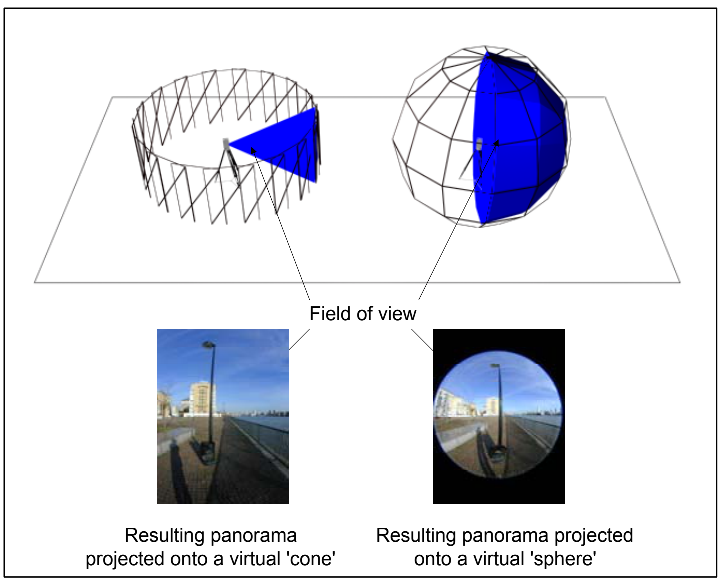


Figure 5.5. Projection of Panorama According to Field of View.

Figure 5.5 also acts to illustrate that the number of images required to make a panorama is dependent on lens type and the resulting horizontal field of view (HFOV). To successfully stitch and blend a series of images creating a seamless panorama, an overlap of between 30-50% is required between each image.

The number of images required can be calculated using the following rule of thumb (Rigg, 2000):

Number of images required = 36000 / (50xHFOV)
For portrait capture HFOV = 2xtan-1(18/focal length)
For landscape capture HFOV = 2xtan-1 (12 / focal length)

Figure 5.6 illustrates a series of images captured, as part of *Hackney Building Exploratory Interactive*. Images were taken using a Kodak DC220 digital camera with a 29.00mm lens, resulting in a 63.55 degree field of view. A total of 16 images were captured, to ensure a seamless panorama. As Figure 5.7 illustrates, a panoramic tripod mount was used to ensure that all images were captured from a single nodal point. The nodal point is defined as the focal point of the camera lens. The panoramic mount ensures the camera is kept level throughout the capturing process and it also provides precision rotation, allowing the camera to be rotated the required number of increments through 360 degrees.

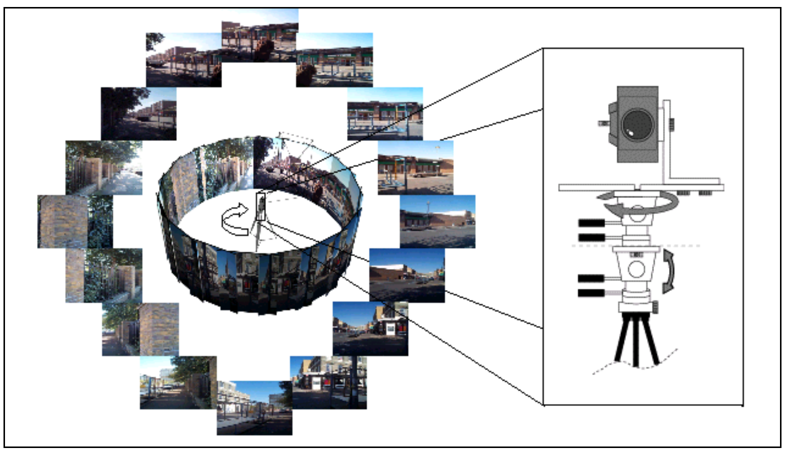


Figure 5.6. Creating a Panoramic Image.

Once captured, the images were loaded into the stitching software, in this case *PhotoVista*, as in Figure 5.7. The images are aligned, warped and blended to create the final panorama. The panorama can be saved in a range of formats, including the option of JAVA-based viewing for cut and paste insertion into an HTML document.

Figure 5.7. Stitching Images in PhotoVista.

During the capturing process, it is important to bear in mind two factors. Firstly, the exposure of each image needs to be fixed after the first image is captured. This ensures that all images are captured at the same level of exposure, evening out any changes in light conditions between photographs and ensuring seamless blending of the resulting panorama. Secondly, it is important to take into account any moving objects in the scene such as people or vehicles.

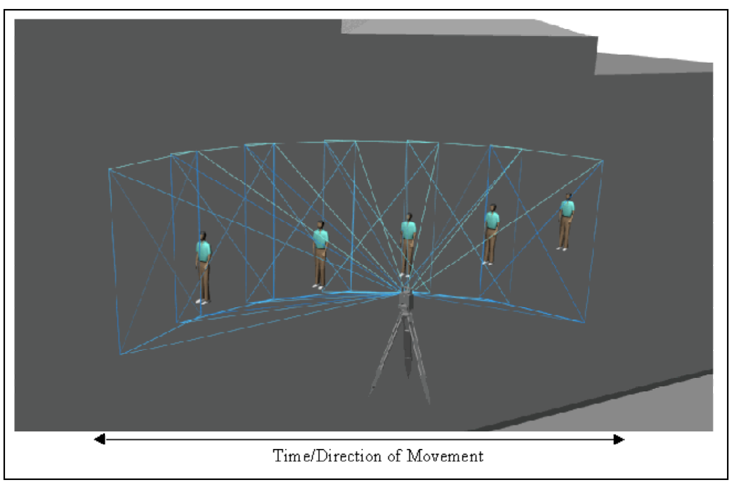


Figure 5.8. Pedestrian Movement During a Panoramic Capture.

Figure 5.8 illustrates a series of images captured over time as a pedestrian walks towards the camera. If the images are captured in sequence with the pedestrian, the sequence will include the pedestrian in multiple photographs. When the resulting panorama is stitched, depending on the pedestrians' position relative to each frame, the pedestrian will feature in varying locations. If the pedestrian is captured in the overlapping sectors of the images, the resulting panorama will contain ghostly figures. This is a result of the stitching software attempting to blend out objects which are not in both overlapping regions. For this reason, pedestrians need to be captured in the centre, i.e. non-over lapping section of a single image. This ensures that human presence is included in the scene while ruling out multiple instances and ghostly figures. Moving vehicles are more problematic to capture. It is often not possible to capture them in the centre of a single image. Vehicles therefore either have to be captured while stationary, for example at traffic lights, or from a distance ensuring they can be aligned in the central region of the image. Capturing people and moving vehicles is a problematic and time-consuming process but nevertheless it is essential if a scene is to look realistic. Techniques for obtaining populated scenes in busy urban areas are explored further in relation to the *Wired Whitehall* application in Chapter 6.

As previously stated, a panoramic image is two-dimensional and the user is able to pan and zoom within the scene. But as the scene is composed of single viewpoint, it cannot convey true spatial perception (Waack, 1998). A person views the real world in three dimensions, viewing the world from left and right eyes which thus create two slightly different viewpoints. These in turn embody our spatial perception. Figure 5.9 illustrates such left and right eye views for Canary Wharf, in London's Docklands. Note the differences with respect to the central line.

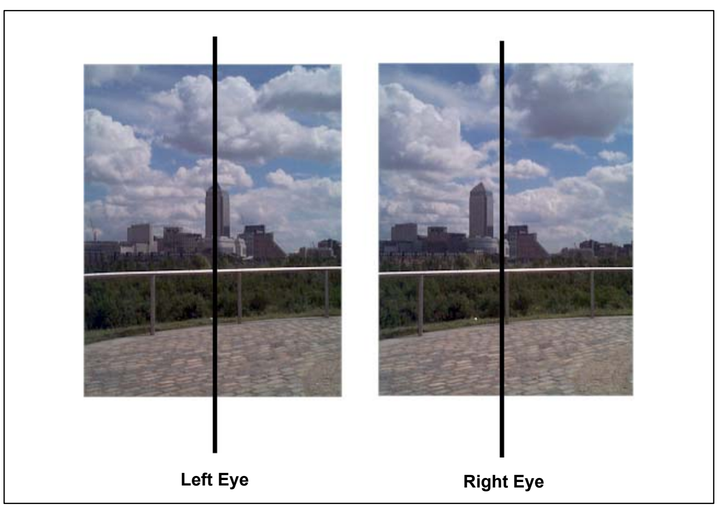


Figure 5.9. Left and Right Eye Views of Canary Wharf, London Docklands.

In order to create the illusion of depth either in a photograph or rendered scene, the scene needs to contain both left and right eye views that can be successfully conveyed, but separately to the brain. This can be achieved by creating an anaglyph representation of the scene. An anaglyph consists of two separate images merged to create a left and right eye view. In order to convey this to the brain, the images are split into their separate red, blue and green colour channels. The left eye view consists solely of the red channel and the right eye of only the blue and green channels (see Figure 5.10). The channels are merged using a standard image manipulation package.

Using a pair of anaglyph viewing glasses, with a red colour lens for the left eye and blue for the right eye, an illusion of depth can be obtained. The red filter on the left eye extracts only the information of the left view, thus left and right eyes see slightly different images, allowing the perception of depth. Using the concept of anaglyphs, panoramas can thus be produced which include both left and right eye views of the captured scene but in order to achieve this, two separate panoramas need to be photographed, each approximately 7 centimetres apart (eye width) as we show in Figure 5.11.

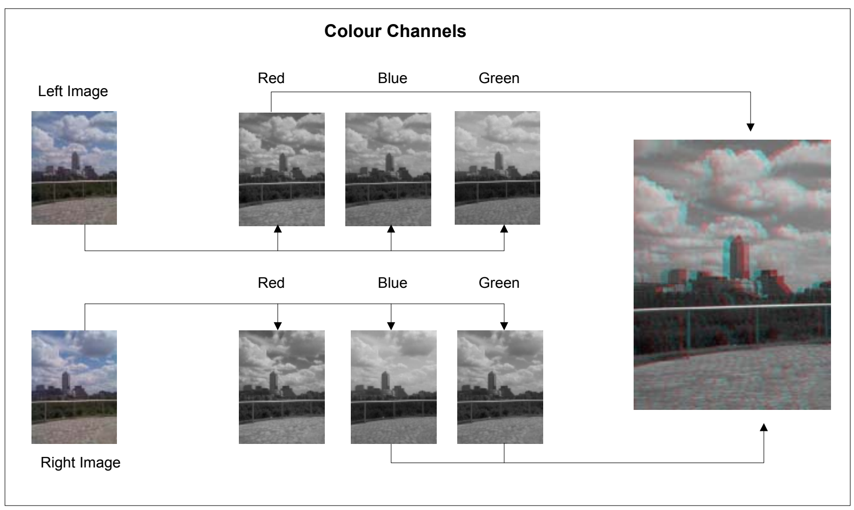


Figure 5.10. Merged Left and Right Images Split Into Colour Channels and the Resulting Anaglyph Image.

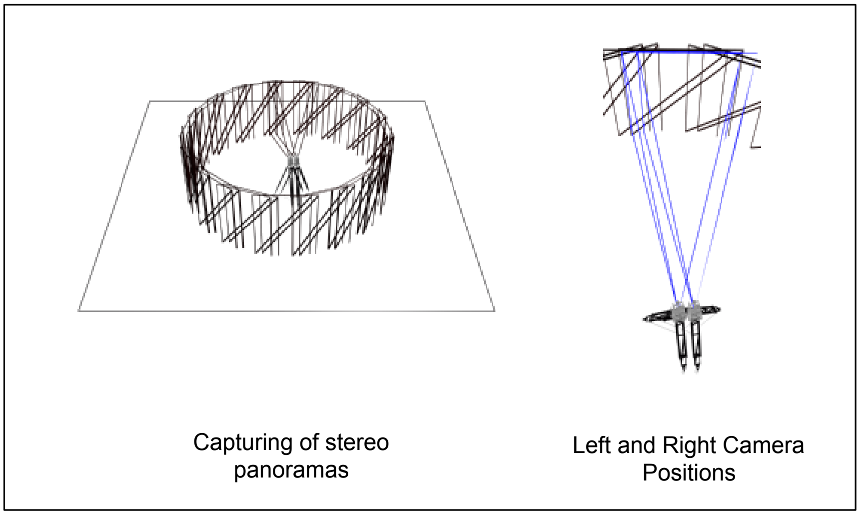


Figure 5.11. Creation of Stereoscopic Panoramas.

The need for two separate images means that the capture of moving objects is more problematic. Solutions are discussed in Chapter 10.

Panoramas operate by placing the user in the centre of the photograph and rotating the viewpoint around a central axis. A hybrid is the panoramic object movie which effectively places the user to the side of the scene looking inwards, towards the central axis, rather than outwards. A panoramic object is essentially the digital equivalent of a flickbook animation with a series of frames captured during which the object is rotated a full 360 degrees.

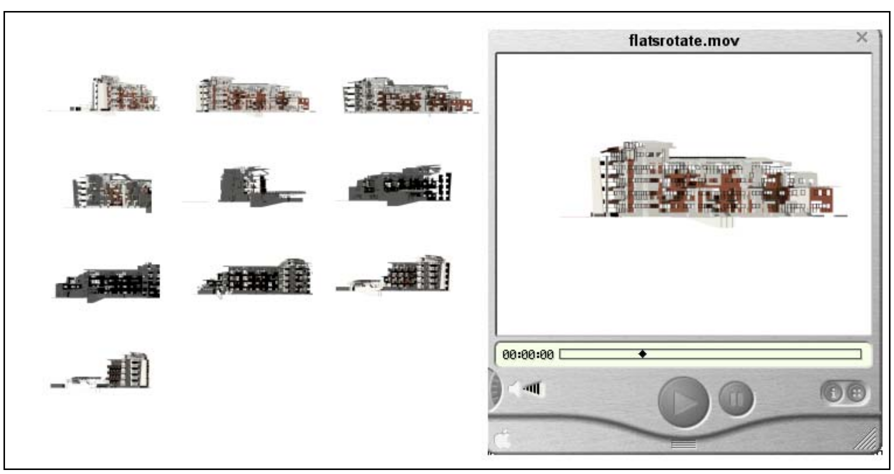


Figure 5.12. QTVR frames and the Resulting Object Movie.

Figure 5.12 illustrates a QTVR rendering of a block of flats used for the digital visualisation of the Bridge Lane Planning Inquiry which we detail in Chapter 6. The figure shows the frames rendered to create a QTVR scene and the resulting movie. A total of 10 frames were rendered and each is played back as the user moves the mouse over the scene, creating the illusion of rotating the object.

In terms of Brutzman's (1997) components, panoramas score highly with respect to the use of available bandwidth and file size. To view and navigate a panoramic image, all that is required is the plugin or JAVA applet and the image file. Based on a medium level of compression, image file size for a typical panoramic scene can be as little as 150k or 200k including the JAVA viewing applet. Capture techniques are both rapid and low cost with stitching software typically available for under £100. Panoramic images are thus well suited for the communication of existing locations via the Internet, allowing photorealistic representations with low file size. Interaction is however limited for all users can do is pan and zoom or link to HTML documents. As the image is two-dimensional, no higher level of interaction is possible. The use of panoramas thus becomes more problematic if new developments are to be visualised. This involves integrating a three-dimensional object with an existing panorama or creating a rendered photomontage, essentially augmenting reality. Augmented reality is explored further in our example of the Bridge Lane Planning Inquiry in Chapter 6.

For the production of full three-dimensional models of the existing built environment, there are three critical factors - building footprints, roof morphology, and height data. It is the combination of these factors that allows the creation of realistic models. Building footprints are widely available in the UK, most commonly in the form of vector-based streets and parcel data, such as 'Landline' or the more recent 'MasterMap' data from the Ordnance Survey. The data is however both prohibitably expensive and rather detailed for online usage.

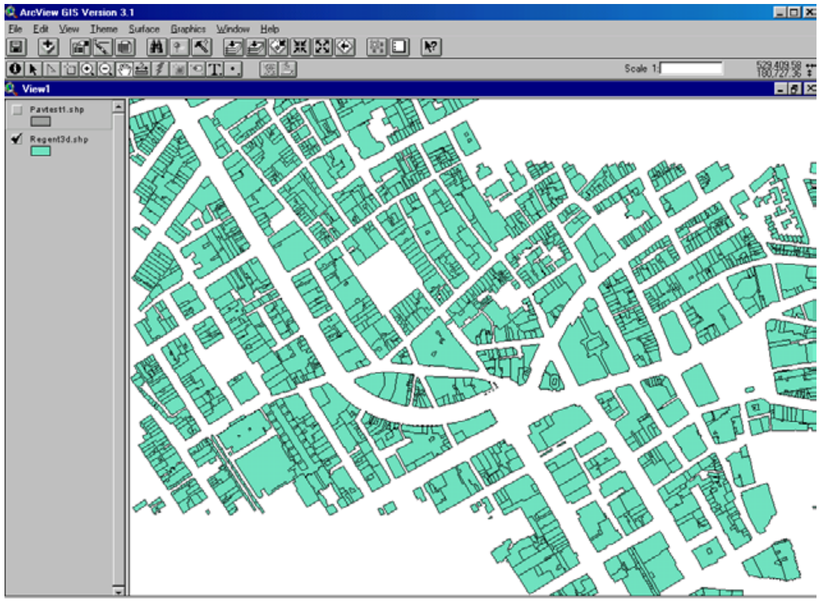


Figure 5.13. LandLine Derived Building Outlines in ArcView.

Figure 5.13 illustrates building outlines derived from Ordnance Survey Landline data for a section of Central London. At a cost, Landline data can of course be obtained but the main problem is the acquisition of suitable height data and roof morphology; most derived map data is confined to two dimensions.

Average height data can be purchased off-the-shelf from mapping companies such as the Cities Revealed data set. This data provides the average height according to building footprints. Comprehensive data can be obtained from range imaging methods, the most widely used being Light Detection and Ranging (LIDAR). LIDAR provides a high-resolution three-dimensional surface which can be imported into a GIS and draped with an aerial photograph as we show in Figure 5.14.

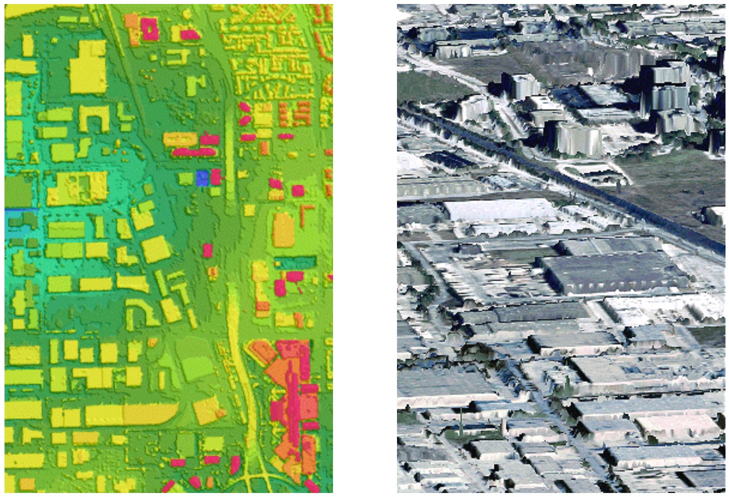


Figure 5.14. LIDAR-Based City Models (http://www.globalgeodata.com/bldgdata.html).

LIDAR is at the high end of the data range scale and as such is not suitable for the production of models aimed at online distribution, although combined with building footprints, average height can be extracted.

Figure 5.15 illustrates a section of Central London extruded from building footprints up to an average height derived from LIDAR data. The resulting model is a prismatic representation of Central London but it is both crude and unwieldy in terms of required processing power and file size. Manageability of the model can be improved but considerable generalisation of the base data is required. This is problematic, as we illustrate further in Chapter 9 when we introduce the *Virtual London* application.

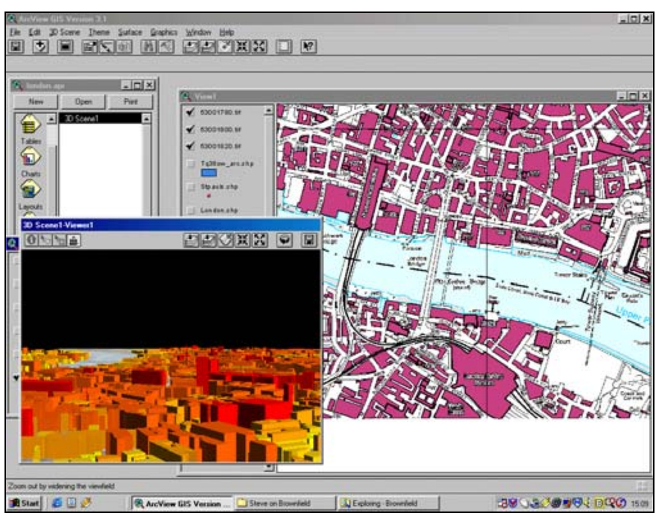


Figure 5.15. Extrusion by Average Height Derived from LIDAR in ArcView.

Prismatic models lack any significant architectural detail and thus do not convey any compelling sense of the nature of the environment (Batty, Smith et al., 2000). Roof morphology can be added either within a GIS or via a standard modelling package such as Microstation or 3D Studio. There has been considerable research effort over recent years into developing the capabilities of GIS to handle three-dimensional information of the built environment (Faust, 1995). This has often been achieved through the linkage of CAD technologies to a GIS database (Liggett, Friedman and Jepson, 1995) but such linking of GIS to CAD is a tentative and cumbersome process. Figure 5.16 illustrates the output of PAVAN, a three-dimensional modelling package for the MapInfo GIS package.

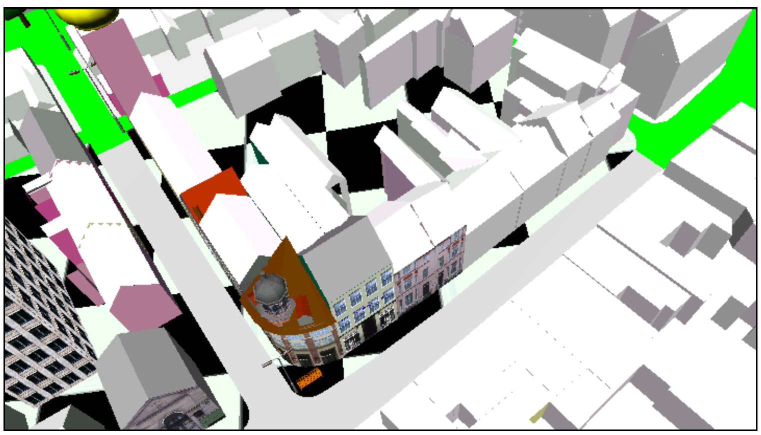


Figure 5.16. PAVAN Output from MapInfo ,Illustrating Roof Morphology.

PAVAN enables roof morphology and texture maps to be added to height extrusion up to eye level. While this is adequate for basic modelling, the level of realism is low and it relies on knowledge of the modelled area's roof structure data which is not commonly available without a comprehensive area survey. Where roofing morphology is not known, new methods for modelling are required.

Methods to rapidly extract and texture map both building outlines and roof morphology have become readily available in the last 18 months. A result of the increase in personal computing power and the demand for realism, predominantly in gaming environments, packages such as *Canoma* from Metacreations, *GeoMetra* from AEA Technologies and *Image Modeler* from RealViz have been developed. These packages are aimed at creating models which are optimised in terms of file size while retaining a high degree of realism and are directly suited to the production of models aimed for distribution online.

The following sections provide an illustrative walk-through of the process of creating texture mapped three-dimensional model of a typical new build development in the UK using *Canoma*. *Canoma* is typical of the new range of low cost photogrammetric modelling packages.

The model was constructed from two photographs, taken with a Nikon CoolPix 850 digital camera and these are shown in the top line of Figure 5.17. The photographs were framed to ensure that all four corners and any shared geometric features of the building were in view. The first stage to constructing the model is an intuitive division of the building into a series of primitives, these primitives then being aligned, joined and stacked to create a wire-frame version of the building. Once the building has been divided into basic shapes, the first primitive can be placed - in this case a box which constitutes the main area of the building, shown in the second line of Figure 5.18. The correct placement of the first primitive is all-important. From the first primitive, *Canoma* calculates the position of the ground plane and the camera position. Pinning the corners to the corresponding points in each photograph anchors the box, the pins being represented as red triangles which we show below in Figure 5.19. Where a corner is not visible as the case in the bottom right photograph, a bead or a round red dot, is placed to guide the primitive to approximately the correct position.

Figure 5.17. Canoma Modelling Stage 1.

Figure 5.18. Canoma Modelling Stage 2.

Stage 2 creates the central roof structure. By using a 'stack' command the selected roof shape primitive can be placed directly on top of the first box. A combination of pins and beads are then used to align the primitive with the actual photographs as we show in Figure 5.18.

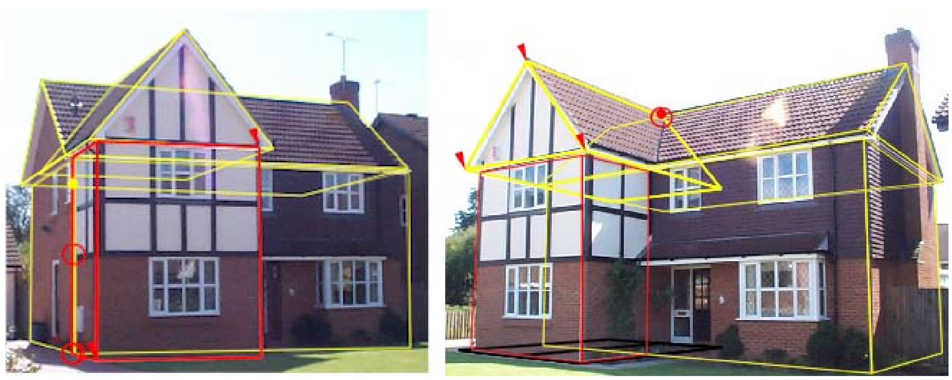


Figure 5.19. Canoma Modelling Stage 3.

The third stage repeats the procedure of creating the first box primitive and stacking to generate the front section of the house. To ensure the new section of the model is correctly aligned, it is 'glued' to the first box primitive where the ‘glue’ is now represented as the red circle in Figure 5.19.

Figure 5.20. Canoma Modelling Stage 4.

The wireframe is now taking shape. Matching the two photographs, the front porch section and chimney are added in the same manner as in stages 2 and 3, using a combination of pins, beads and glue as illustrated in Figure 5.20. The model can now be automatically texture-mapped and exported in the desired distribution file format. The example provided is for a single building where two images are sufficient to create the three-dimensional model. Two images are sufficient for the wire frame as there are a number of linked geometric reference points in each image and thus the model can be made up of basic standard primitives. For more complicated, larger-scale urban areas, the addition of oblique aerial photography is required to provide an overview of the entire scene. Combined with street level views, urban scenes can be constructed as in Figure 5.21 which illustrates a model of Canary Wharf modelled in *Canoma*.

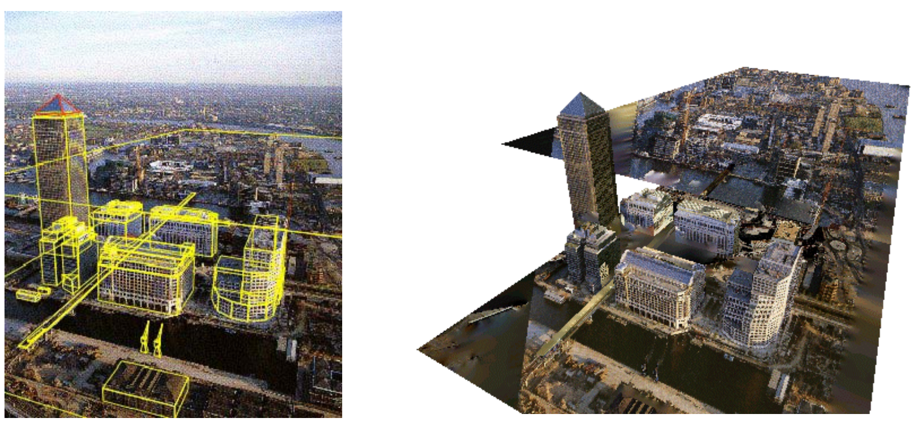


Figure 5.21. Canary Wharf Modelled in Canoma.

This model was produced using a combination of aerial photography and street level photographs taken from the Canary Wharf Square panoramic example in Figure 5.4. Once a scene is constructed, all-important to its successful placement online is the file format it is saved in and the resulting format used for distribution. This format chosen is a critical factor in the balance of Brutzman's (1997) components for networked three-dimensional graphics.

5.3 Distributing Virtual Environments

As we have developed these ideas and made them operational, new tools have emerged for the production of three-dimensional models aimed at online distribution. Modelling packages traditionally export in a number of formats which are usually interchangeable between software packages, as we illustrate in Figure 5.23.

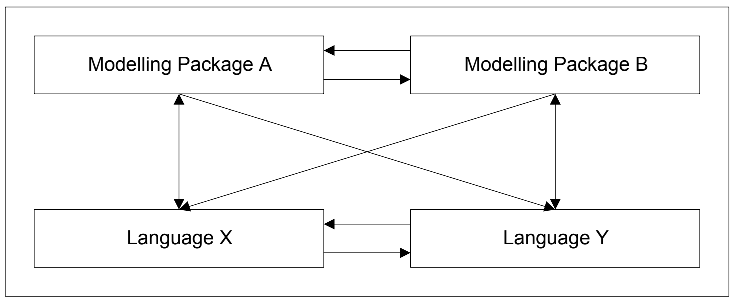


Figure 5.23. Conversion Between Modelling Packages and Languages, Adapted From Costello and Bee (1997).

Format interchangeability allows models created in one package, for example *Canoma,* to be imported into *3DStudioMax* for additional modelling and subsequent export in a range of formats optimised for online distribution. There are currently in excess of twenty distribution formats which enable three-dimensional models to be viewed and manipulated online. These formats vary considerably in their ability to effectively display models in a low bandwidth environment and therefore in their suitability for the distribution of virtual environments Online. Tables 5.2 and 5.3 compare the current formats openly available on the Internet against a range of criteria applicable to the communication of virtual urban scenes.

	Active worlds	Alice	Anyfy3d	Atomic3d	B3D	Blaxxun	Cult3d	Eon	3DML	Hyper cosom
Open Standard	X	X	X	X	X	X	X		√	X
Streaming	√	X	X	√	√	X	√		X	X
Plugin	√	√	√	√	√	√	√		√	√
JAVA	X	X	X	√	X	√	X		X	X
Platform	Win	Win	Win/Mac/ Unix	Win	Win	Win	Win/Mac/ Unix		Win	Win/Mac
Scriptable Behaviours	√	X	√	X	X	√	X		√	√
File Import	.RWX	Standard	3Dstudio		3Dstudio	VRML			.3DML	
Suitable for Urban Scenes	√	X	X	X	X	√	X		√	X

Table 5.2. Comparison of Internet 3D Modelling Distribution Technologies.

	Java3D	Metastream	NEMO	Octree	Pulse	Shout3D	Superscape	Vecta3D	VRML	Zap3D
Open Standard	√	?	X	X	X	X	X	X	√	X
Streaming	X	√	X	X	√	X	√	√	X	X
Plugin	X	√	√	√	√	√	√	√	√	√
JAVA	√	X	X	√	X	√	X	√	X	X
Platform	Win/Mac/ Unix	Win/Mac	Win	Win	Win/Mac	Win	Win/Mac/ Unix	Win/Mac	Win/Mac/ Unix	Win/Mac
Scriptable Behaviours	√	√	√	X	√	√	X	√	√	√
File Import		3Dstudio	3Dstudio	3Dstudio	3Dstudio/. DXF	3Dstudio		3Dstudio	Standard	
VRML Support	X	X	X	X	√	√	X	X	√	X
Multi-user	X	X	X	X	X	X	X	X	√	X
Suitable for Urban Scenes	X	√	X	X	X	X	X	√	√	X

Table 5. 3. Comparison of Internet 3D Modelling Distribution Technologies (2).

Essentially the criteria for effectively distributing virtual environments over the Internet requires a format to be both an open standard or compatible with an open standard, viewable on a range of operating platforms, with multi-user access and the ability to script behaviours. From Tables 5.2 and 5.3, six formats meet the basic specification and demand further explanation. These formats will be divided into single and shared virtual environments and examined in terms of Brutzman's (1997) components of networked three-dimensional graphics.

The majority of formats are based on single, asynchronous viewing of such models. This section explores and evaluates the Virtual Reality Modelling Language (VRML), Metastream, 3DML, and Vecta3D. VRML (version 1.0), was conceived in 1993, integrating web extensions to the Silicon Graphics Open Inventor file format (Martin and Higgs, 1997). It provides the only open standard language for the communication of three-dimensional information on the World Wide Web and as such, is the singly most important format for the distribution of three-dimensional models. VRML is summarised in the introduction to VRML1.0 specification as a language for describing interactive simulations - virtual worlds networked *via* the global Internet and hyper-linked within the World Wide Web (Bell et al, 1993). VRML is both a 'tools' and a 'distribution medium'; a 'tool' in that it is an open language which can be coded in a standard text editor, and a 'medium' for distribution in that other formats openly support VRML.

In this sense, VRML is both a synchronous and asynchronous medium although for this section, we will concentrate on its single-user nature. VRML is essentially a scene description language that describes the geometry and behaviour of a 3D scene or "world" . VRML "worlds" got their name from an original goal of VRML: shared virtual worlds on the Internet. VRML worlds can be single files or groups of files that load at the same time. They can range from simple objects to very complex scenes (Crispen, 1998). Initially static worlds, VRML1.0 was superseded in 1996 by VRML2.0. VRML2.0 included a number of modifications to allow actions and events to be embedded within worlds. VRML2.0 allowed non-passive, synchronous worlds distributed via the Internet. VRML was specifically designed to operate over the Internet, meeting three criteria (McNamara, 1997): platform independence, extensibility and the ability to work over low-bandwidth (56K modem) connections.

It is useful at this stage to illustrate some basic VRML coding, as this illustrates the open nature of the language and the ability to interact with objects within a VRML world. Figure 5.23 illustrates a cube within a VRML browser and a plane-sensor has been added to the code, enabling the user to move the cube along the x and y axis.

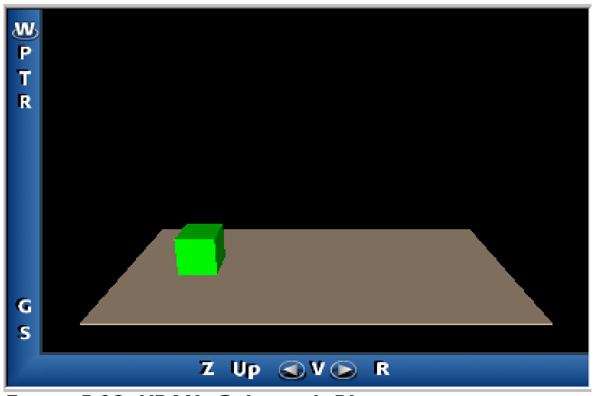


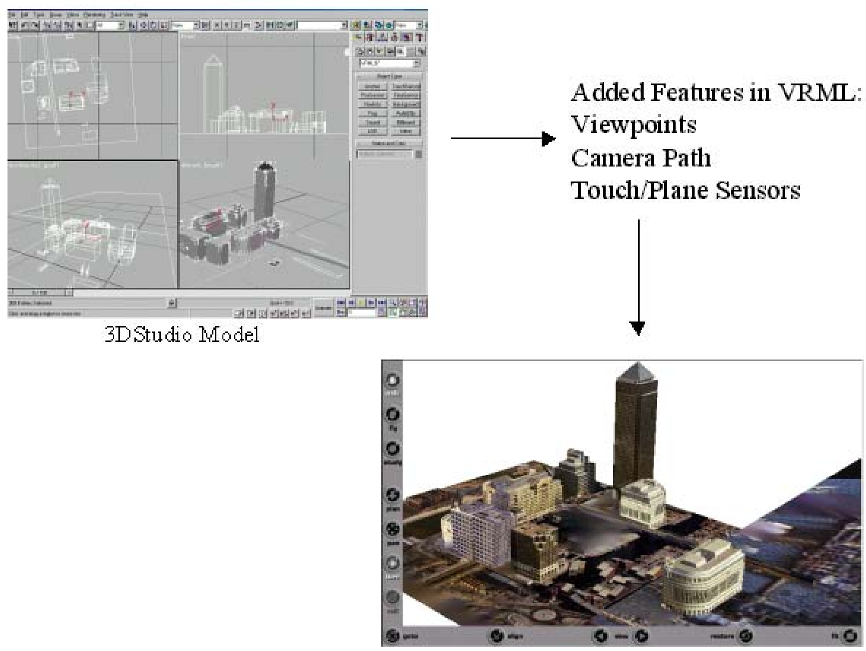
Figure 5.23. VRML Cube with Planesensor.

```
#VRML V2.0 utf8

# Demonstrate a PlaneSensor node.
#http://www.iup.edu/~jacross/graphics/c8.htmlx
# Group the Sensor with its object.
Group {
children [
# DEF provides a name for the sensor to connect to.
DEF Cube Transform {
children Shape {
appearance Appearance {
material Material { diffuseColor 0 1 0 }
}
geometry Box { }
}
},
DEF Drag  PlaneSensor { },
]
}
# Place a surface under the object.
Transform {
children Shape {
appearance Appearance {
material Material { diffuseColor .86 .76 .65 }
}
geometry Box { size 20 .06 10 }
}
translation 0 -1.03 0
},
# Add a starting viewpoint.
Viewpoint {
position 0 10 20
orientation 1 0 0 -.3
description "At 0 10 20 looking down"
}
ROUTE Drag.translation_changed TO Cube.set_translation
```

Table 5.4, Illustrates the Code Required to Firstly Build the Cube and Secondly add the Interaction.

The ability to modify VRML code from scratch is a distinct advantage over other closed three-dimensional modelling systems. It is however only of use to add manual actions as in adding a planersensor to allow interaction. It is not practical to construct an entire urban scene in hard VRML code. As an answer to this, in recent years a range of standard CAD packages have included a VRML export option allowing, in theory, model distribution via the Internet.



Model exported to VRML (buildings can be moved on x/y plane)

Figure 5.24.* 3DStudioMax *export to VRML.

Figure 5.24 illustrates an example developed to explore the use of interactivity in VRML97 as well as illustrating some of the more important features of VRML for interaction and visualisation. The example was developed using *Canoma* and subsequently imported into *3DstudioMax* for additional interaction and modelling. The important features to note here are the navigation, behaviour, and interaction ability which are included in the scene.

Within the scene, a series of viewpoints have been embedded. Viewpoints act like a set of cameras placed within a three-dimensional scene. Users are able to move between the various viewpoints allowing model developers to ensure that the end-user is able to view the model from a desired position in the three-dimensional space. Viewpoints were part of VRML1.0 and are an important aspect of navigation within a VRML world. As Bourdakis (1997) states, by using viewpoints it is possible to experience the data from different perspectives, locations, camera angles and heights, thus creating a more inclusive map of the information involved. The use of viewpoints also aids the end-user who may not be familiar with the interface of the VRML viewer used. By merely clicking on the viewpoints icon, a clear and coherent virtual tour may be obtained. In addition to static viewpoints, a 'tour' viewpoint can be added to the scene. Tour viewpoints were introduced with VRML2.0 adding the ability to set up predetermined camera paths. Basically the Tour mode follows a camera on a predetermined path through the scene, essentially creating a fly-through of the environment. The use of both tours and viewpoints were included to aid navigation which is an emotive issue in VRML browsers. There are three main VRML browsers for the Windows and Macintosh operating platforms; these are *Cosmo Player* from Cosmo Worlds, *WorldView* from Intervista, and *Cortona* from Paragraph. The most widely adopted browser has been *Cosmo Player*, where in Figure 5.25 we illustrate its navigation interface.

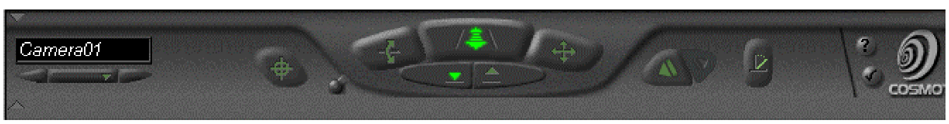


Figure 5.25. Navigation Interface in Cosmo Player.

Navigation in three dimensions using a two-dimensional interface is notoriously difficult. Cosmo has however complicated matters by providing 7 different ways to navigate and this gives a somewhat non-intuitive interface. To explore VRML worlds successfully in Cosmo requires experience in three-dimensional navigation, often leading to the inexperienced-user becoming disorientated within the scene. Compounding this issue of navigation is the fact that the display is dependent on the raw VRML code. Despite the fact that VRML97 is an open standard language, the three main browsers do not interrupt some VRML nodes in the same way. This breaks down the open standard and often means developers need to provide varying versions of the VRML file available for download, according to the browser used.

To illustrate the use of behaviours, each building in the scene from Figure 5.24 has been attached to a touch and plane sensor. This allows each building to be moved by clicking and dragging the mouse along the X and Y plane. The ability to move aspects of the built environment independently of one another, allows each user to create their own interpretation of any given urban scene. The addition of interaction within a three-dimensional scene, although currently time consuming due to software limitations, is immensely important in the communication of design information. The developed model provides an insight into how information relevant to the planning system can be effectively communicated on the World Wide Web. The ability to move individual components of the model is especially relevant to urban issues such as the placement of street furniture or the implementation of a new building. The user is able to view the scene and then move the planned object to a preferable location within the scene, thus effectively communicating information and allowing users to have a constructive input into the design process.

VRML arrived on a wave of hype, typical of new technology. It promised the ability to distribute and view three-dimensional models via the Internet. As such it was and is a logical language to use to distribute three-dimensional representations of the built environment. However, the reality has proved to be otherwise with VRML based distribution of models being almost impossible, except for small urban areas with a low level of detail. This is clearly illustrated by the experience of the Centre for Advanced Studies in Architecture at the University of Bath during the development of their model of Bath from 1991 onwards. The model, constructed from aerial photographs using photogrammetry, is accurate to less than half a metre and covers the whole historic city centre, an approximate area of 2.5x2.0 km (Bourdakis et al, 1997). Bath City Council supported the project and since its completion, the model has been used by the city planners to test the visual impact of a number of proposed developments in the city. The model is the most comprehensive in the United Kingdom, but it is not however suitable for viewing over the Internet.

Developed as separate units based on city blocks, each unit was modelled using a PC-based CAD package. Depending on size and complexity, each block took between three and ten days for a skilled operator to construct. The whole model is composed of 150 urban blocks occupying over 60MB of disk space (Day, 1994). The Bath model was converted into VRML with four versions developed to take into account varying technological and design requirements;

- Standard VRML 1.0 version 255Kbytes: building geometry only, no other landscaping information (all platforms, 32MB RAM min)

- VRML 2.0 version A 240Kbytes (to be phased out): Streets and pavements on most roads in the centre of the city, no textures (Pentium PCs with hardware accelerated graphics, low end SGIs, 32MB RAM absolute minimum)

- Optimised VRML 2.0 version B 330Kbytes Similar to version A, but with texture mapped trees. (Pentium PCs with hardware accelerated graphics, low end SGIs, 40MB RAM)

- Texture Mapped VRML2.0 version T 550Kbytes geometry plus 270Kbytes textures. This version includes texture mapped terrain of 10 km x 10 km around the city and the Bath Abbey in full detail. (High end Silicon Graphics (SGI) or PCs with high end Glint cards, 64MB RAM).

The textured mapped VRML 2.0 model of Bath, running on a high end SGI, is illustrated in Figure 5.26.

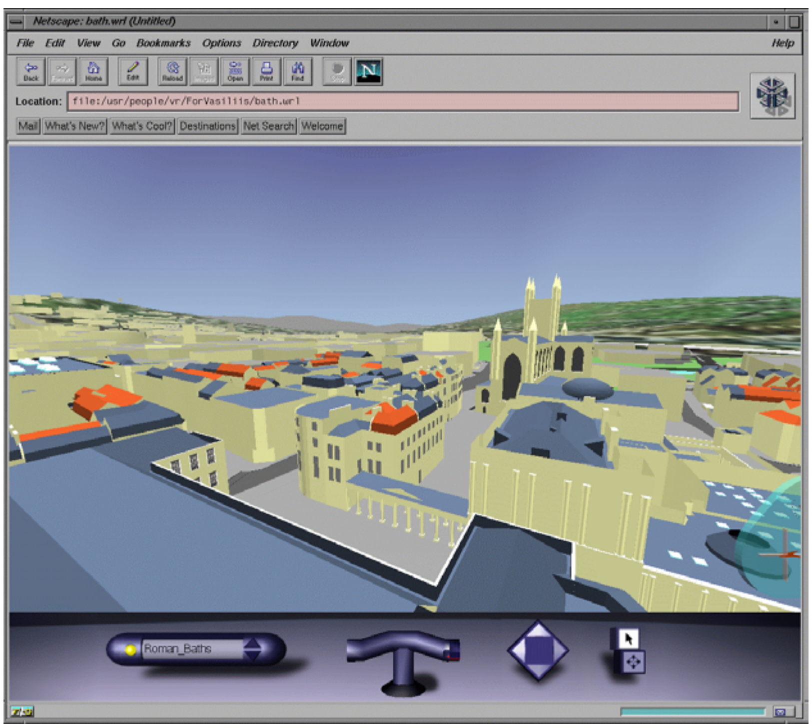


Figure 5.26. VRML2.0 Bath Model: Screen Grab from SGI Version.

The model is impressive and provides an interesting insight into how the urban environment can be modelled and the models distributed on the World Wide Web. However at the present time, it is not possible to view such detailed models on an entry level home-based Personal Computer due to a number of factors. Firstly, any increase in complexity of a model results in an increase in file size, placing a limit on the level of possible complexity which can currently be delivered over the web. One important feature of a model designated for real-time visualisation has to be its efficiency in defining a space as detailed as needed with as few polygons and textures as possible (Kruse, 1998) and this is especially true if distribution is envisaged on the web. Thus VRML is suited to the distribution of models with low geometry requirements and simplified repetitive textures. However this approach can only be successfully implemented in certain types of models such as skyscraper-filled city centres, high rise office developments, and generally widely repetitive environments (Bourdakis, 1998).

Figure 5.27 illustrates the use of texture mapping on polygons in order to add realism to a model of Tokyo developed by Planet9 Studios (http://www.plannet9.com/)**.** The model is constructed using simple polygons to keep file size to a minimum and realism is achieved using textures.

Figure 5.27. Repetitive Textures in VRML Version of Tokyo.

In models of scenes where repetitive texturing of geometry is not applicable, file sizes and the number of polygons displayed on screen quickly increase, resulting in slower download times and lower frame-rates on standard machines. The number of polygons displayed on screen at any one time however can be reduced using the Level of Detail (LOD) node in VRML 2.0. LOD allows basic geometry to be displayed at a distance with detail increasing as the user navigates towards a subject. The use of LOD is essential in a large urban model to increase frame-rates but only serves to reduce the level of reality and therefore the sense of location and place achieved by a model. LOD cannot however be used to effectively reduce file sizes and the resulting download time for the user. Complex models can often exceed 2-3 MB with 500K not being unusual. The scene of Canary Wharf shown earlier in Figure 5.22 already is 588K. Download time is exacerbated by the way in which VRML handles and displays the resulting file. In VRML for a scene to load, the browser downloads the entire world file, as VRML operates on client/server architecture. The requirement to effectively jump from scene to scene is both disorientating and bandwidth intensive as whole scenes are loaded before being navigable. Competing distribution mediums use 'streaming' technologies, allowing models to be loaded as required, therefore removing the client/server system. These will be explored later.

File size, as stated, is dependent on the complexity of the model and the nature of the modelling program's VRML export option. CAD-based models are typically complex and thus result in large file sizes. However with web access growing faster and cheaper and broadband technology moving into the home environment, file size is not necessarily a concern. The main concern of VRML is the processing power required to navigate complex scenes at an acceptable frame rate. Bourdakis (1997) states that the Bath model is un-viewable on 224MB Max Impact SGI if half of the full VRML Bath model is loaded, and the VRML version contains only a quarter of the information of the full CAD version.

The problems of using VRML to view urban scenes can be summed up as:

- poor navigation interfaces make viewing and manipulation difficult, reducing personal impacts and interactivity;
- complex scenes require high-end graphic workstations for viewing, thus reducing interaction;
- resulting file sizes can be large, making models unsuitable for online distribution; and
- VRML browsers have different ways of interpreting the code, breaking down the open standard.

Metastream is a partially open source file format enabling streaming of three-dimensional objects over the Internet. Streaming allows a wire-frame version of the model to be displayed on the user computer within approximately 5K of download. Texture maps and additional structure are added as the download proceeds. Streaming allows models to be viewed and navigated before the whole download is complete. The format is open source but is not editable in ASCII format and all editing and interaction is coded via the modelling software. In the case of Metastream, this currently includes Metacreations *Cararra*, *Poser*, *Bryce* and Kinetix *3DStudio*. Using streaming and compression technologies allows users with networking connection speeds ranging from a 56K modem to a T1 (or higher) line to examine 3d content in *real-time* (Rhyne, 2000). Metastream's compression is based on the scalability of its models. Exported Metastream files contain a multi-resolution mesh representation, allowing automatic determination of the importance of geometric and material features in the model. This ensures that a high polygon count model can be placed online in the knowledge that it will be automatically scaled to the client machine based on available performance. Metastream is indicative of a move towards using three-dimensional graphics for e-commerce. As Metacreations states, Metastream allows consumers to interact with a virtual product on an e-commerce site, much as they might in a store. At the time of writing, Metastream currently in version 2.0, is fast becoming the industry standard for the distribution of three-dimensional models across the Internet and is taking the place of VRML. Metastream compares well with VRML in terms of file size and thus connectivity; it also allows *real-time* lighting, reflections, and shadowing to increase realism. It does not however compare in terms of interaction. Metastream does not provide features such as viewpoints or camerapaths, illustrating its focus on e-commerce products where models of such products only need to be rotated and zoomed, rather than explored.

As such, it is only of use for small urban scenes or specific buildings, as we illustrate in Figure 5.28 in an example taken from *Shared Architecture* application which we explore further in the next Chapter. The user can zoom and rotate the building but no higher level of interaction is possible.

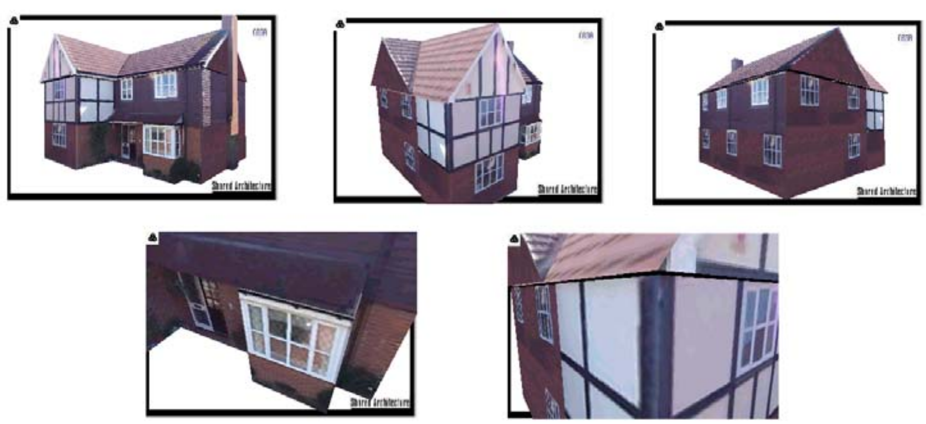


Figure 5.28. Building from 'Shared Architecture' Viewed in Metastream.

Currently in Beta release is Metastream 3.0. Version 3.0 introduces enhanced interactivity with the possibility of including animation and click events within objects. It does not as yet allow the use of viewpoints or camera paths.

The only other ASCII based file format, apart from VRML, is the Three-Dimensional Markup Language (3DML) from Flatlands. A beta version was released in December 1998, with a full release in March 1999 to coincide with the release of the 'Rover' plugin for Netscape and Internet Explorer. Rover displays 'spots' created in 3DML, which is the 3DML equivalent to a world in VRML. Running on Windows 95/98/NT, Rover supports spatial sound, standard web graphics, animation, translucency, and dynamic lighting. 3DML is similar to HTML in that it is a markup language. In this sense, 3DML spots can be created without any modelling software, for all that is required is a text editor. Aimed at the non three-dimensional software-user, a spot is made up of a series of blocks. The tutorial on 3DML from Flatlands demonstrates this, stating that "building a 3DML space for the web is actually very similar to building in the real world using familiar pieces such as simple wooden blocks or even 2" x 4"s from the local lumberyard" (Flatlands, 1999). In 3DML, there is a set of blocks which you put together to build a house, a waterfall, or anything you desire. In the basic 3DML construction set, there are blocks which act as shape ramps, columns, signs and more. The village 3DML block set has blocks shaped like trees, houses, and sidewalks. Each of these blocks is represented by a character on the keyboard. The number of blocksets, and therefore the objects you can place in a spot is limited, and currently there are only two blocksets. The tutorial provides comprehensive details on the creation of spots, and the following section taken from the tutorial demonstrates how to create a simple spot. It sets out to illustrate the language of 3DML.

Like an HTML file, a 3DML file has 2 major sections: the <HEAD> and the <BODY>. The <HEAD> is the section where you set parameters that are true for the entire SPOT, such as the map dimensions, ambient light and sound, the sky texture, etc. The <BODY> is the section where you can customise your Blocks, and where you create your actual map. The map is the heart of a 3DML file, where you use different kinds of Blocks (represented by ASCII characters) to build a 3D space. Each block occupies a space of 256 x 256 x 256 (pixels). Blocks are arranged into a grid pattern to create each horizontal level of a SPOT. Levels are stacked on top of each other to create multi-story spots. Figure 5.29 illustrates a basic one level building constructed in 3DML.

```
<LEVEL
NUMBER="1">
###...###
#.......#
#.......#
#.......#
#.......#
#.......#
#.......#
#.......#
##########
</LEVEL>
```

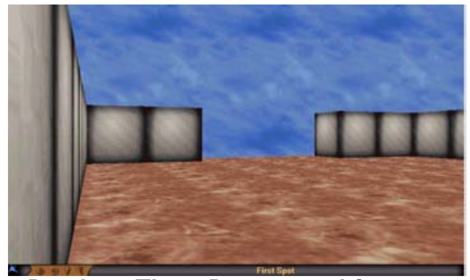


Figure 5.29. ASCII 3DML Code and the Resulting Three-Dimensional Spot.

In Figure 5.29 the character "#"represents a full block, occupying the full 256x256x256 space. The "." character represents an open space, thus the layout in Figure 30 creates an enclosed room with an entrance. To add another level, for example a roof, the code is repeated with the level number 2 and all the spaces made up of "#" characters. Using the available blocksets, virtual environments can be created.

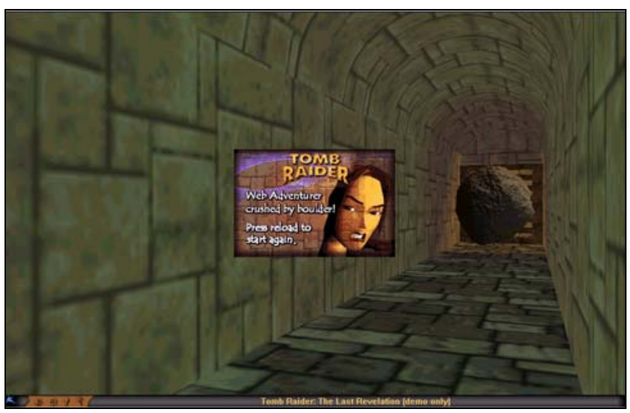


Figure 5.30. Tomb Raider Last Revelation Spot, Edios Interactive.

The main 3DML spots created are aimed at gaming, e-commerce or promotional environments. For, example one of the most popular spots is the Tomb Raider Last Revelation spot from Edios Interactive which we show in Figure 5.30.

The Tomb Raider spot was built using a customised blockset, and this blockset has been released allowing users of 3DML to construct their own levels for Tomb Raider, navigable in the Flatlands browser.

As 3DML is a closed format, scenes can only be constructed via a text editor or Flatlands web site. As such, the format is not interchangeable and thus it cannot be loaded into a file conversion program. No software program currently exports 3DML format. Despite this, 3DML has been used for the construction of urban scenes, notably Virtual Kyoto in Japan. It is useful to examine the model in terms of Brutzman's (1997) components and Figure 5.31 illustrates a screen grab from the Shijo district of Virtual Kyoto.

Figure 5.31. Shijo District in Virtual Kyoto.

Flatlands operates as VRML on a client/server model. The low resolution version is 1Mb, providing a single street scene, the full version is 15Mb. File size is therefore an issue and this is mainly due to the dependence on textures when defining the sense of location and place. Using the Flatlands blockset, only limited shapes are possible, ruling out the construction of realistic roof morphology or even building outlines in the model. Thus file sizes increase considerably if any level of realism is required in a scene. Navigation is similar to VRML 'walk' mode with the ability to navigate using either the mouse or keyboard. No viewpoints are included and this restricts the use of 3DML in the navigation of geographically large regions. Interaction is limited to the ability to hotlink HTML documents from sections of the three-dimensional model.

The client/server model can be expanded to populate models, all of which examined so far have been asynchronous. Figure 5.32 illustrates how using two-way communication between the server and the client, virtual worlds can be populated, creating Shared Virtual Environments (SVEs) which we discussed in Chapter 4.

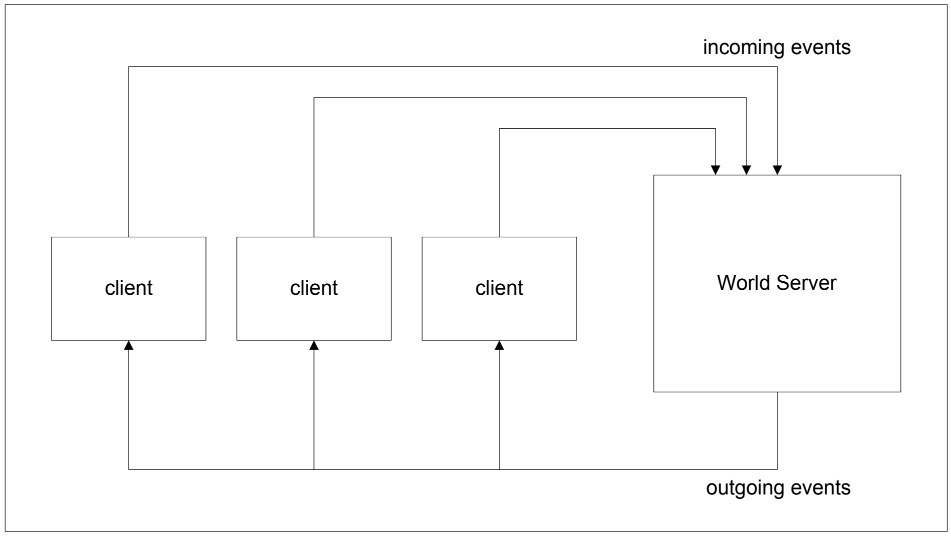


Figure 5.32. Communication Between the Client and Server in SVEs (Blaxxun, 1999).

The diagram is based on the Blaxxun Community Server, but essentially the basic process of populating a virtual environment is similar throughout the SVE system. The client downloads the environment from the server, either in its entirety or within the bounds of a viewpoint, depending on the system, from which the server acts as a position tracker and message forwarder. Each client's browser as they navigate the virtual environment, sends positional information regarding their avatar back to the server. The server then uses various areas of interest algorithms depending on the system used, to decide which browsers need to be aware of these positional changes. The server subsequently sends an outgoing event to update the position of the clients' avatar, thus enabling users to view avatars navigating the environment. A similar system is utilised for communication, be it text or audio. We will examine five SVEs distribution clients, each displaying differing features and therefore levels of interaction and immersion for the user. Firstly we examine VRML-based SVEs in the form of *Blaxxun, Community Place, Onlive* and *Holodesk*.

VRML-based SVEs by nature of their use of VRML, suffer the same positive and negative aspects which plaque VRML-based distribution. Navigation is poorly executed, scene size is limited by download times and frame-rate is determined by processor speed. They do however add the ability to populate urban three-dimensional models. *Blaxxun* named after the Bar in Neal Stephensons' (1992) science fiction novel **Snowcrash** provided the first online SVE in 1996 with avatars and the environment based on VRML1.0. Their first world called PointWorld, was accessible through a standalone program named

CyberGate (Damer, 1998). *Blaxxun* world currently support VRML97 and up until recently *Superscapes* .SVR format. Worlds are viewable via the Blaxxun client called Contact, currently in version 4.3. Figure 5.33 illustrates the Fleamarket in *Blaxxuns*' CyberTown, an environment based on VRML97.

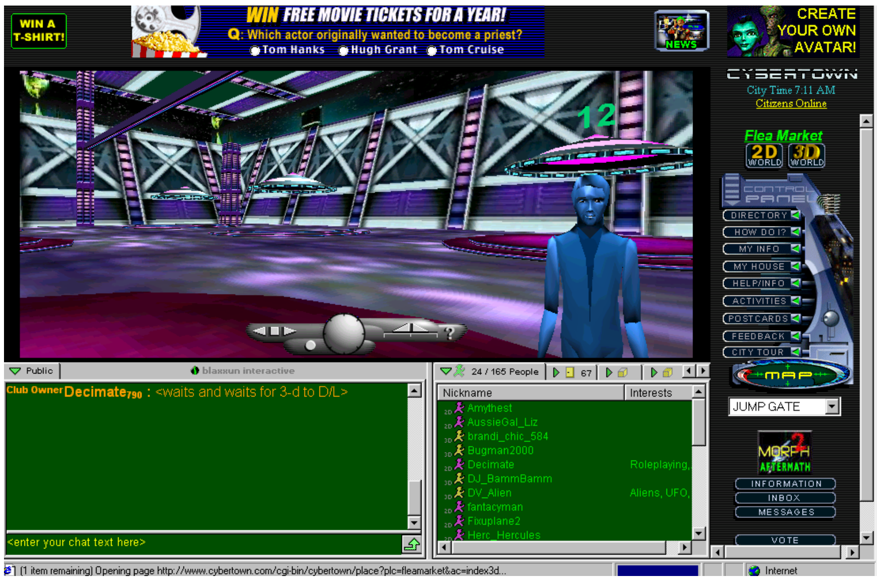


Figure 5.33. Blaxxuns VRML97 CyberTown.

Operating within the Windows environment, the client comprises three main elements: the display of the three-dimensional environment, a chat window, and a control panel. The client is composed of a series of frames running both the Blaxxun VRML viewer and a JAVA chat client. Communication is constrained to the chat client. When text is not visible via the VRML environment, it is only seen in the separate JAVA applet. This tends to alienate the three-dimensional aspect of the environment, most of the user's time being spent using the chat client rather than navigating the environment. Other systems display the text typed above the avatar's head, thus maintaining interest in the virtual environment. This is compounded by the ability of users in *Blaxxuns*' Cybertown to choose either two or three-dimensional chat. The majority of users choose to use the two-dimensional chat client, resulting in a crowded chat client but a sparsely populated avatar environment. Navigation in the virtual environment is typically problematic. It is complicated by possibly the worst navigation interface for online virtual environments. Poor navigation makes the use of *Blaxxun* a frustrating experience, thus lowering interactivity and personal impact. The *Blaxxun* browser and its applications is documented further in Chapter 7 on Virtual Cities and its use for an asynchronous panoramic system is described in Chapter 6.

As stated, *Blaxxun* until recently supported worlds created in the *Superscapes* .SVR language. Using a combination of a JAVA chat client and the Superscape Viscape plugin, users could view virtual environments. Figure 5.34 illustrates an example of the Superscape's SuperCity University, part of their Virtual World Wide Web.

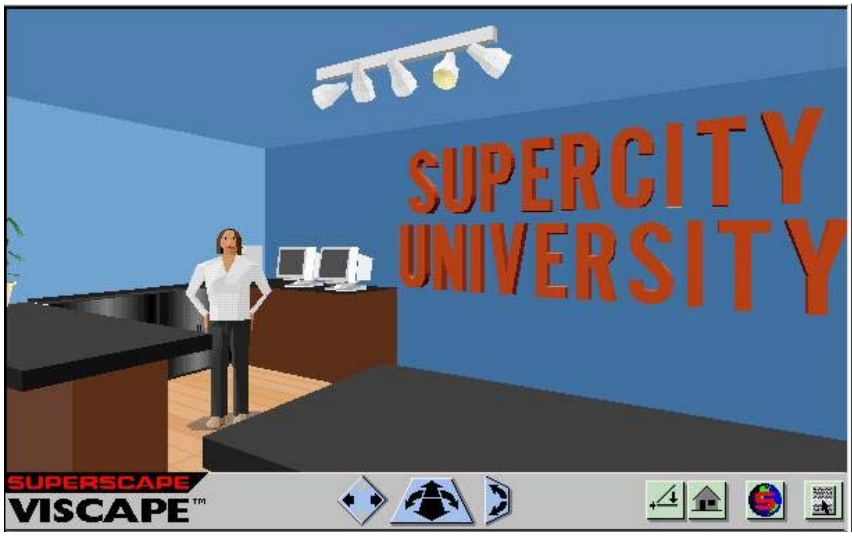


Figure 5.34. Superscapes Viscape SVE Browser.

As of April 7th 2000, *Superscape* closed down its Virtual World Wide Web of SVEs with the statement that *Superscape* had been re-launched with a new business strategy. The company's focus is now on project-based work and associated activities, primarily targeted towards the e-business and e-commerce sector (Superscape press release, 2000). Superscape has also launched a competitor to the single-user Metastream format. This indicates that providers of three-dimensional environments are moving away from SVEs to concentrate on e-commerce which is now the main application of three-dimensional models on the Internet. With this comes the possibility of loss of interactivity as browsers become mainly targeted at the rotation and panning of consumer products.

Sony's Community Place browser may be operated either as a stand-alone application or a browser plug-in on the Windows 95/NT platform. The client comprises two windows - the 3D view and the "chat" window, although the interface can be designed according to application. An example of the use of Sony's' Community Place for collaborative design is the Virtual Ryoanji Project, a joint development project between the Department of Urban Engineering at the University of Tokyo, Sony Corporation, and the Centre for Advanced Spatial Analysis (UCL) from which selected screen shots are shown in Figure 5.35.

Figure 5.35. Avatars in Sony's Community Place VRML97 Browser.

Community Place suffers similar problems to Blaxxun, although the interface is more user-friendly. Navigation and interaction can still however be a frustrating experience.

Blaxxun and Sony utilise text-based communication, similar to IRC. *Onlive* shown in Figure 5.36, differs by offering full voice support for its SVEs.

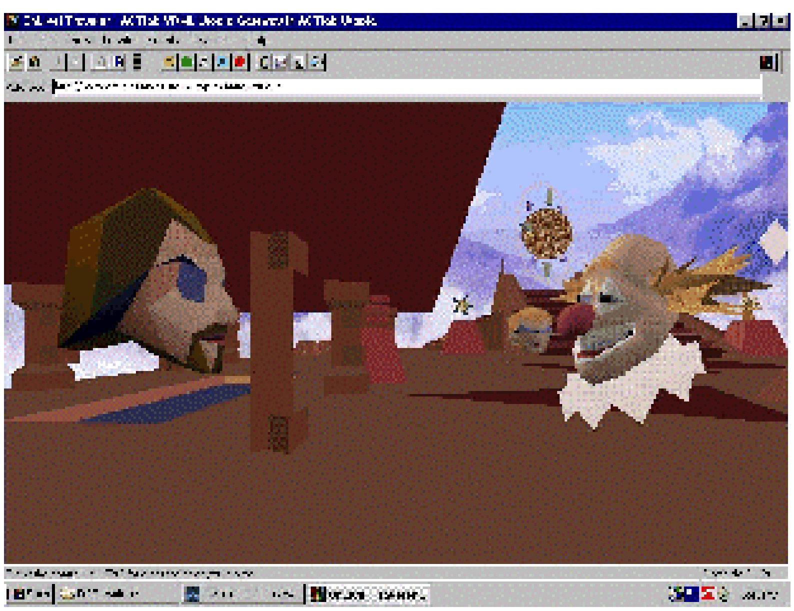


Figure 5.36. Onlive VRML97 SVE.

The integration of voice support allows *real-time* voice-based communication in VRML environments, eliminating the need for text-based communication. Communication is achieved using a set of speakers and a microphone connected to each user's personal computer. To communicate, the user presses the control key on the keyboard and talks into the microphone. The user's voice is then encoded and transmitted into the virtual world using automatic voice synthesis and three-dimensional audio. The result is *real-time* conversation with lip synchronised avatars. With emphasis on lip synchronisation, avatars consist only of single heads. While this focuses on the use of audio, it limits the amount of interaction in the environment. The three-dimensional scenes are merely backgrounds with the user unable to move or interact with objects. The quality of the transmitted audio is often poor, resulting in dropouts and confused conversations. Indeed the most widely used phase in Onlive is 'pardon'! While the technology used in Onlive will undoubtedly become common place with interactive *real-time* audio support, its usage is currently limited.

Holodesk is a VRML 2.0-based SVE from Pittsburgh-based Telepresence. *Holodesk* is a hybrid of Onlive and Blaxxun with *real-time* voice-based communication in a standard avatar-based VRML environment with the additional option of text chat. Both the client and server are available free of charge, with no additional coding required to share a VRML world. The user is only required to place a VRML world in a specific folder and then click the 'share' option which enables other users to download and inhabit the VRML world. Figure 5.37 illustrates a VRML scene built from photographs taken from the viewing platform of St Pauls' Cathedral, London. The resulting VRML file has been placed into Holodesk and shared between two users.

Figure 5.37 Avatars in Part of Virtual London.

Voice communication is full duplex but limited to two users at a time, compared to the multiple-user voice communication of Onlive. Telepresence plans to add additional voice communication facilities later in 2000. Notable additional features to the Holodesk environment compared to other VRML SVEs is the ability to use whiteboards and view prepared graphic slide-based presentations within the virtual environment.

The main benefit of VRML is its ability to add behaviours, i.e. the movement of buildings in the Canary Wharf application, for example. These interactions can be ported to the multi-user world systems with varying levels of effectiveness. SVEs typically require additional coding to ensure that if, for example, one user moves a building, all the other users receive a position update. A key limitation to this is the inability of any of these positional changes to be saved. If the users log out of a world and re-enter, the changes will not have been saved due to the nature of the VRML client/server system. It therefore limits the interactivity of VRML-based SVEs and thus their use for collaborative design.

Finally we explore the *ActiveWorlds* browser for the communication and distribution of SVEs. *ActiveWorlds* differs considerably in its use of Internet-based technology compared to the other systems so far examined. An Active World Server, allowing you to run your own world, can be operated under a Unix or Windows operating system. An ActiveWorld can be run free of charge for 30 days with permission from ActiveWorlds.com. Permission is required as all worlds are linked to a Universe Server. Figure 5.38 illustrates the communication between the *ActiveWorlds* Client, the World Server, and the Universe Server.

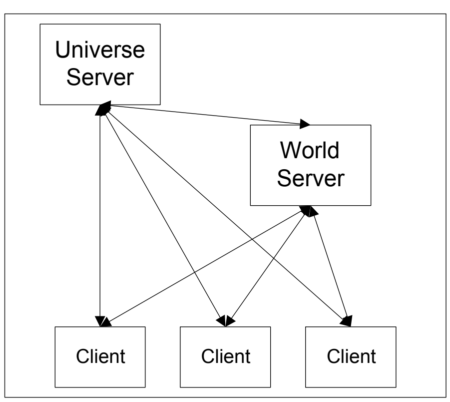


Figure 5.38. ActiveWorlds Universe/World/Client server system (ActiveWorlds, 2000).

The role of the Universe Server is two-fold, firstly to authorise the start up of the World Server, thus ensuring only trial worlds or worlds purchased from ActiveWorlds.com can run; secondly, to authorise the clients' level of interaction within the *ActiveWorlds* environment. The main aspects to consider when examining Brutzman's (1997) components are connectivity and interactivity. *ActiveWorlds* uses streaming technologies to download sections of the virtual environment according to the user's viewpoint. The viewpoint is set to 40 metres by default although higher settings may be chosen. Viewpoints are not used in the same context as in VRML but to define how far the user can see in front of themselves. As the user walks around the world, the server streams in three-dimensional models to update the surroundings within the user's 40 metre viewpoint. Therefore only a 40 metre section within the users' field of view is ever displayed. The use of streaming and the limitation on viewpoint is beneficial for three reasons. Firstly it allows large scale virtual environments to be downloaded as new objects only download when required, maximising connectivity. Secondly it reduces the load on the processor, enabling low-end systems to effectively display environments within acceptable frame-rates. Thirdly it allows changes to be made to the environment. As already explored in Chapter 4, *ActiveWorlds* is the only SVE that allows the user to build using a range of predefined or imported objects. Using streaming, the client is constantly communicating with the world server, enabling objects to be added or deleted from the environment. This enables the ActiveWorlds to be used for issues such as collaborative design. ActiveWorlds models are imported into the system using *Criterions* RenderWare format (.rwx). Previous versions of *ActiveWorlds* (the system is currently on version 3.2), supported VRML-based models but this ability to import VRML was removed in the latest update.

By way of conclusion, the successful distribution of three-dimensional networked graphics and the resulting virtual environments, represents a balance between Brutzman's (1997) components both in terms of building virtual models and their distribution between users. Photogrammetric modelling tools are becoming commonplace, allowing the rapid development and prototyping of three-dimensional models derived from photographs. These models can be exported in a range of interchangeable formats, allowing varying distribution formats and techniques to be used. The important fact is that the construction of existing environments is no longer the most complicated part of visualising developments in context. Indeed, by using streaming technologies and a distribution format that allows multi-user interaction such as

ActiveWorlds, models can be rapidly constructed, distributed, and populated. These three criteria form the basis for model visualisation in digital planning. The development of prototypes and real-world examples taking into consideration all these factors, are examined in the chapters that follow.

Part III

Applications of Digital Planning

"I have never seen anything so sophisticated as the site anywhere…even in government. All we ever see when debating planning issues are paper plans and maps".

Lord Rooker (2002) Minister for Housing and Planning launching The-Glasshouse World Wide Web at http://www.theglasshouse.org.uk.

"Well worth a visit as you can manipulate buildings on display and even take on the role of town planner in the wonderful 'drag-and-drop town' feature, the sites complexity is disguised by good design so that it appears very simple to the end-user".

Site of the Month, PC Pro Magazine (2000, p.214)

CHAPTER 6

Digital Planning and Visualisation: Examples and Applications.

We have undertaken many applications in developing this approach to digital planning. All these embody the goals of participation and the tools of multi-media which we have elaborated in previous chapters. The methodology and analysis is detailed through a series of projects which illustrate digital visualisation and the proposed public planning support system (PPSS) as we have illustrated in Figure 2.3. In this chapter, each project is detailed and research outcomes discussed. The projects which we developed in chronological order include:

- *Wired Whitehall Urban Information System*
- *Digital Visualisation – The Battersea Bridge Road Planning Inquiry*
- *The Collaborative Virtual Design Studio*
- *Shared Architecture*
- *Digital Dounreay Site Planning*
- *Hackney Building Exploratory*
- *London Bridges Interactive*
- *Technology Transfer*

The projects follow on in sequence in terms of development, and various aspects of each are utilised in the fully operational PPSS developed for the Hackney Regeneration Team which is discussed more fully in Chapter 8. Our starting point for any PPSS is basic visualisation and how to represent the built environment online. With this in mind, we first developed the application which we call *Wired Whitehall*.

6.1 Wired Whitehall Urban Interface System

Wired Whitehall was placed online in February 1997, representing the first web site in the UK which involved a virtual tour. The aims were three fold:

- to demonstrate how the emerging panoramic technologies could be used to create an online urban information system;
- to explore how online visualisation could enhance the standard World Wide Web page to aid the communication of information; and
- to explore how Augmented Reality could be used to communicate design information within a low bandwidth environment.

The system was developed around the 'Jutvision' plugin for Windows 95. Jutvision enabled panoramic imaging to be embedded in a standard HTML page, while each panoramic image could subsequently be overlaid with additional information and hotlinked to other web sites. The Jutvison plugin is no longer freely available online and panoramic imaging is currently predominately JAVA-based.

6.1.1 Data Capture and Information Communication

Wired Whitehall consisted of 8 panoramic scenes featuring the main 'tourist' locations of London within the Whitehall area. Figures 6.1 and 6.2 provide examples of the panoramic images used for the site visualisation. The panoramic images were captured using a standard tripod and a digital camera operating at 640 x 480 resolution. Each panoramic scene consisted of 14 photographs, digitally stitched together using the shareware package 'Photovista' from Live Picture Software. To enable the embedding of information into the panoramic scenes, each image was opened as an ImageMap within the Jutvision Developer software, and information on the urban scene and design encoded. Information was limited to 50 characters of text for each 'mouse-over' event within the scene. To create a 'Virtual Tour', each image was subsequently hotlinked, depending on location and placed with the World Wide Web page as a '.Jut' file. The scenes were additionally linked to a clickable map interface of the Whitehall district as illustrated in Figure 6.3.

Figure 6.1. Panoramic Imaging: Wired Whitehall (1).

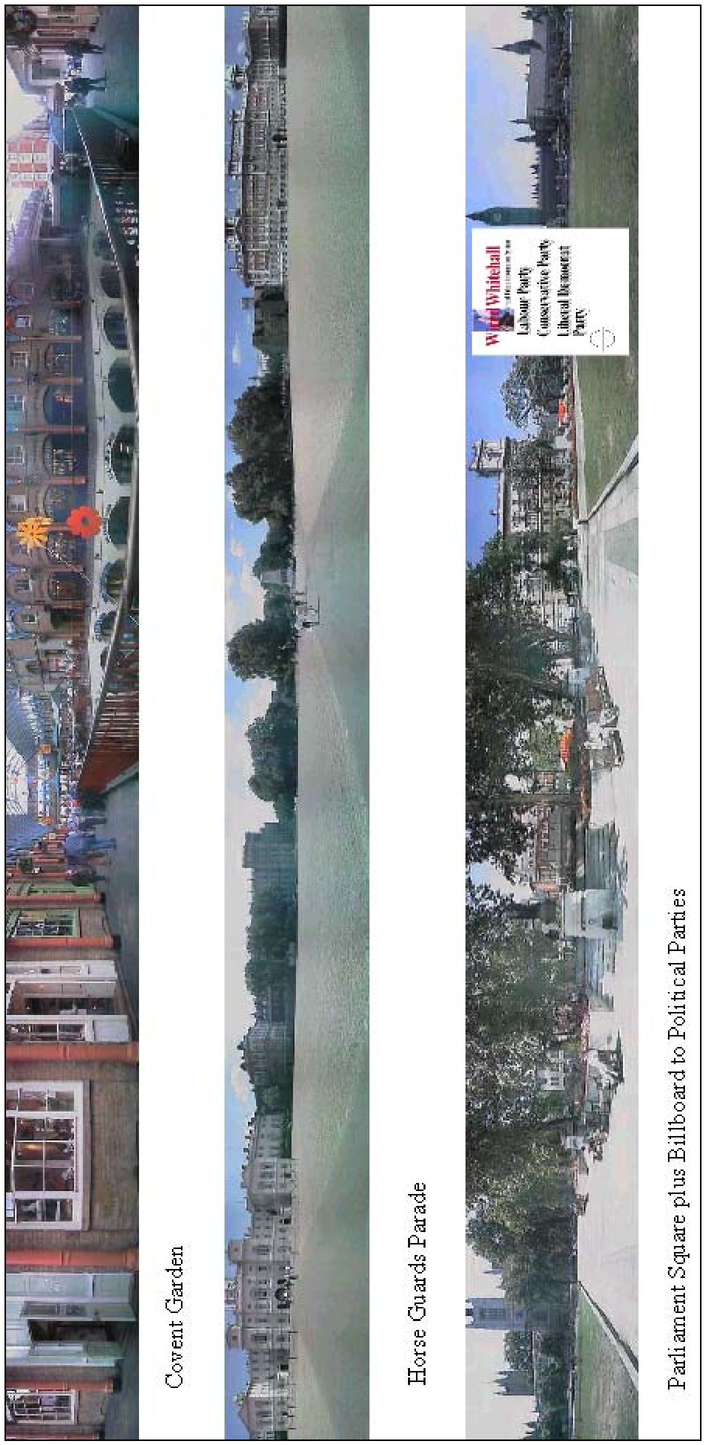


Figure 6.2. Panoramic Imaging: Wired Whitehall (2).

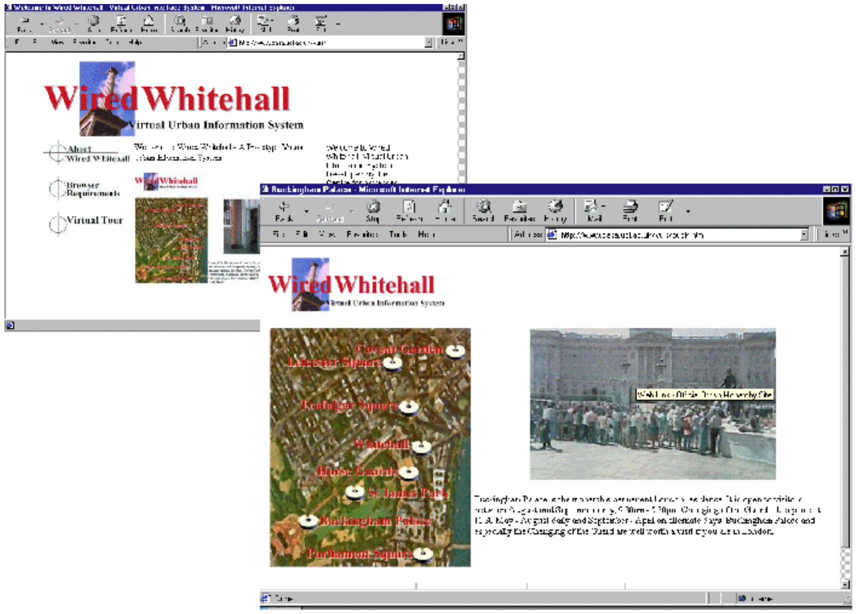


Figure 6.3. The* Wired Whitehall *Interface.

In order to increase the amount of information embedded within each of the scenes, a series of virtual billboards were digitally inserted into the panoramas. Additional images can be inserted in a standard paint package by simply overlaying the required billboard of information onto the original panorama as we illustrate in Figure 6.4.

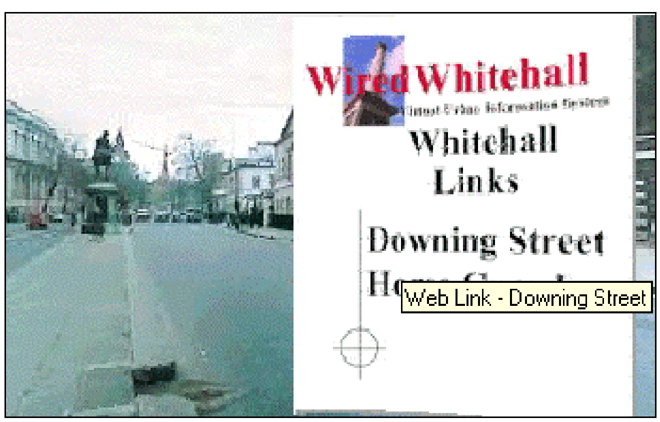


Figure 6.4. The* Wired Whitehall *Virtual Billboard.

Each billboard was subsequently coded in Jutvision to provide either additional links to other internet sites carrying relevant information or links to panoramic scenes which were not directly in line-of-sight. For example, the billboard pictured in Figure 6.4

provided a link out to the 10 Downing Street site and a hotlink to the panoramic scene of Horse Guards Parade. The use of geographically-related information is an example of the development of information navigation within *Wired Whitehall* using the urban scene as a metaphor. Geographical information embedded within the scene allowed the system to be used as a simulation of information from the real world built environment. For example in Leicester Square, you may walk into the Odeon Cinema to find out cinema times, you would click on the 'Odeon' to load up a relevant World Wide Web site. The urban scene provides an example of how panoramic visualisation can be used as a navigation system as well as a system to convey information relevant to the built environment. From this point of view, the system is comparable with Shiffers' (1995) early work on interactive multimedia support. Shiffers' system also utilised panoramic images linked to map navigation, although as the panoramic images were not web-linked additional information could not be retrieved from clicking objects in a scene. *Wired Whitehall* also represented a move away from the then industry standard of QuickTime Virtual Reality for the display and distribution of panoramic images via the Internet. As such, this allowed *Wired Whitehall* to be distributed with file sizes up to 300% smaller than the then standard. This allowed the system to reach a wider audience due to its compatibility with the then standard 28.8bps modems. We will explore to whom *Wired Whitehall* is addressed later in this section.

6.1.2 Augmenting Reality: Communicating Design Features.

Whilst version 1.0 of *Wired Whitehall* communicated a sense of location and place to the user, it did not convey any aspects of design information. In this sense, it was an early version of a 'flat' virtual city (see Chapter 7). Design information was limited as each scene within the system is 'fixed' i.e. it can be rotated to move viewpoints but aspects of the scene cannot be individually moved as in a CAD system. Due to limitations of bandwidth and technology, it is not possible, or indeed desirable, to simulate CAD using *Wired Whitehall* but it was possible to augment each scene. Augmented Reality (AR) is a technology in which a user's view of the real world is enhanced or augmented with additional information generated from a computer model. The enhancement may take the form of labels, 3D rendered models, or shading modifications. The potential uses of AR in modelling the built environment are numerous, from the placement of a piece of street furniture into a photo-realistic scene to the overlay of new physical forms at the building scale. To a limited extent, *Wired Whitehall* 1.0 was an early example of AR in that virtual billboards were created within photo-realistic panoramas in order to create hyper-links of relevance to the urban scene. However, an increased degree of interactivity within the urban scene is desirable if various planning or design schemes are proposed. This can be achieved by combining VRML 2.0 objects and panoramic scenes – AR - on the World Wide Web as we begin to illustrate in Figure 6.5.

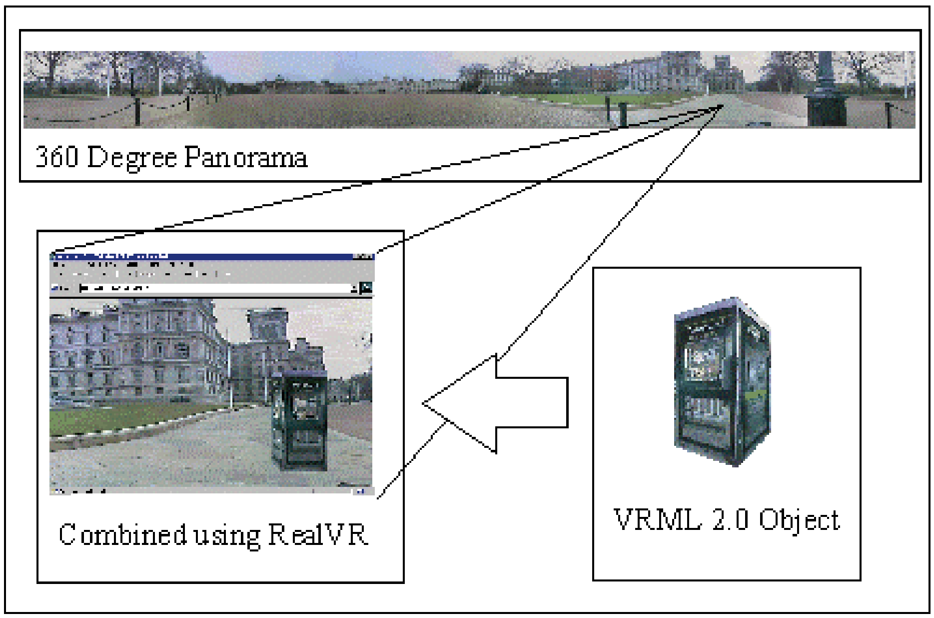


Figure 6.5. Design Object Augmented within a Wired Whitehall Scene.

Figure 6.5 illustrates an example of the placement of a design object into the Horse Guards Parade panorama using RealVR. RealVR was a 'plug-in' for the Netscape or the MS Explorer browser and whilst similar to Jutvision, RealVR allowed the insertion of VRML 2.0 objects into scenes. A simple VRML object, in this case a telephone box, was modelled in a text editor and additional behaviour was subsequently added, thus enabling the object to be moved within the scene. An example of the basic VRML code is provided in Table 6.1.

```
#VRML V20 utf8

NavigationInfo { type "WALK" speed 20 avatarSize [ 1, 5, 0 ] }

Vista {
type "SPHERE"
filename "HorseGuards.jpg"
vFov -12 12
pitchRange -12 12
position 0 10 0
}
DirectionalLight {
direction 025 -03 1
}
DirectionalLight {
direction 025 -03 -1
}
DEF PhoneBox Transform {
translation 0 -1 0
children [

DEF PhoneBox Size
geometry Box { size 10 18 10 }
appearance Appearance {
material Material { diffuseColor 01 01 01 }
texture ImageTexture { url "phonejpg" }
            }
          }
        ]
      }
   ]
}
```

Table 6.1. VRML 2.0 Code for Augmented Reality.

The code creates a sphere onto which an image of Horse Guards Parade is mapped (HorseGuards.jpg). Within the sphere a box is created and this is then mapped to provide the appearance of the telephone box (phone.jpg). The second version of *Wired Whitehall* combined photorealistic panoramas and VRML, allowing realistic representations of objects in the urban environment to be modelled quickly and easily. Any number of objects may be augmented into a scene, provided they are VRML 2.0 compliant. World Wide Web-based AR has potentially powerful applications in the field of comparative design and design visualisation. Figure 6.6 illustrates a telephone box augmented in a scene of Leicester Square taken from *Wired Whitehall*.

Figure 6.6. Augmented Reality Street Furniture, Leicester Square, London.

A range of designs for street furniture can be added into the scene, allowing users to visualise each design as a photorealistic representation of its proposed location. While the placement of the telephone box in the scene may appear realistic, it is in fact an illusion. The scene does not contain any three-dimensional information and this results in limitations in the placement of objects. If the augmented object is moved towards the background of the scene it appears to float above the ground, due to the fact it cannot be rooted to the scene through a lack of three-dimensional co-ordinates. It does however illustrate how realistic scenes relating to urban design can be constructed and manipulated over the Internet, allowing a range of design options to be explored.

6.1.3 Multi-User Object Visualisation

The original *Wired Whitehall* was asynchronous. The user had the ability to look around scenes, obtain information and in the augmented version, move objects, but no communication with other users was possible. To address the issue of communication, the VRML 2.0 version of the interface was ported into the *Blaxxun* multi-user system which we described in the last chapter. Figure 6.7 illustrates a working example of the multi-user system with avatars communicating within the Whitehall scene.

Figure 6.7. Avatars in Whitehall.

The use of avatars was further supplemented by the inclusion of the telephone box with attached behaviours which within the multi-user environment, allowed users to move objects and comment on their placement within the virtual world. Unlike the version in *Wired Whitehall* 2.0, the objects had true three-dimensional co-ordinates, allowing for realistic scaling within the scene and more accurate placement. Figure 6.8 illustrates the client/server model which allows two users to simultaneously exist in the virtual scene and interact with its objects.

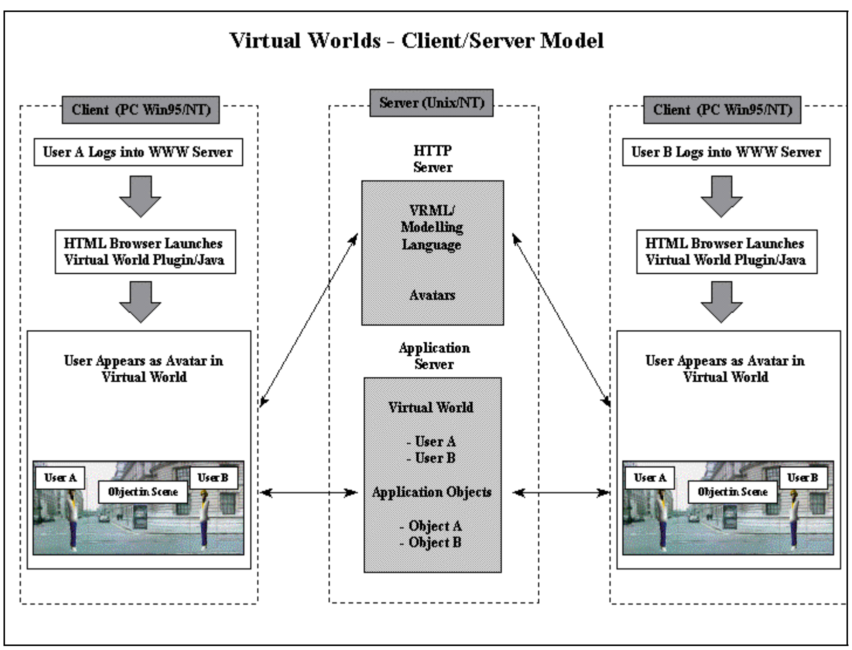


Figure 6.8. A Virtual Worlds Client-Server Model.

Problems were encountered with the overall functionality of the multi-user system, both in terms of design and communication. The panoramic scene as already stated, does not consist of any three-dimensional information. It is merely an image wrapped around a cone object in the virtual environment; as a result the scene does not have any true depth, despite existing in a three-dimensional space. Users are unable to walk around the scene as such, only existing on a platform from where the panoramic image is viewed. As long as objects are only manipulated within three-dimensional space from this platform, the various objects could be successfully placed and design issues discussed. Outside the platform, perspective would be lost as the panoramic images are only two-dimensional. As such the Virtual Worlds prototype of *Wired Whitehall* shows potential for local area design and collaboration over the Internet, but it is of more use as a communication tool for fixed options. For example, if a range of design scenarios were pre-modelled, users would be able to communicate in the shared space and discuss the options. If the options are to be non-fixed, then issues of perspective and shared viewpoints emerge which limit the system's success.

6.1.4 Feedback

Wired Whitehall was initially placed online as 'A Virtual Planning and Design Visualisation System'. Examination of the log files documenting site usage suggested that very few people were visiting the site and thus potential valuable research feedback on the system was being lost. To attract users and therefore to examine how effective photospatial media is in communicating information relating to the built environment, the name of the system was changed and a number of separate pages added, providing information about London. The newly named '*Wired Whitehall Virtual Urban Information System*' attracted considerable attention, ranging from articles in national newspapers Sunday Telegraph (Travel Section, October 25, 1997), The Times (November 26th 1997), features on local television news programmes (BBC 1 London Tonight), to interest from Japanese Radio Stations (interviews on Nagoya FM and Tokyo Today). So what does this demonstrate? Firstly, it illustrates that the system effectively communicates information in a low bandwidth environment and in this sense, the system can be deemed successful. Secondly, it provides an insight into the communication of information to the end-user. Information on the built environment needs to be presented as part of a wider system, that of a 'virtual town' or city. A system which offers only planning or design information may not reach its intended-user base. The system also attracted interest from developers and architects which led directly to the development of more advanced visualisation techniques for use in a Public Planning Inquiry.

6.2 Digital Visualisation – The Battersea Bridge Road Public Inquiry

Wired Whitehall illustrated how panoramic visualisation could be used to present a virtual tour of an existing environment. For the purposes of digital planning, however, there is a need for this environment to be augmented in order to visualise 'new build' scenarios. To achieve this aim, on the 16th February 1999, a series of digital panoramas were used to present evidence (in a legal forum) in relation to urban design on behalf of James R. G. Thomas of Rothermel Thomas Chartered Architects and Town Planners at a Public Planning Inquiry. The evidence, displayed on a white screen at the Inquiry, represented the first use of digital panoramic visualisation in a such an context in the UK. The visualisation, commissioned by Wates Built Homes, illustrated a series of 'before and after' panoramas relating to a small but prominent site in Wandsworth, South West London. A nursery group and community theatre occupied the site comprising two buildings - a former church and a church hall. The surrounding area, predominately residential in character had been developed with a variety of building heights and styles. The immediate surroundings consisted of two or three-storey terraced houses falling within the boundaries of the Battersea Park Conservation Area.

Prior to the current application, three previous requests for planning permission and conservation area consent had been submitted for the site. Two of these schemes were refused permission on appeal and the third was withdrawn by the appellant. Both previous planning appeals were refused on the grounds that the proposal would constitute an unsatisfactory over-development of the site with the scale and bulk of building detrimental to the character and appearance of the conservation area.

The site visualisation was undertaken with the agreement of Wates Homes Ltd. that the proposed development would be visualised with data relevant to the surrounding area; that is, no digital methods would be carried out to enhance the scheme in anyway, however unintentionally, thus misleading the public. This undertaking was provided on the basis of research documenting current visualisation techniques and an understanding that current visualisation rarely compared to the reality of development actually built. In short, the visualisation was to be as realistic as possible.

The aims of this digital visualisation were thus two-fold:

- to provide realistic views of the development site, both before and after the proposed development, aiding the appraisal of the scheme in terms of urban design.
- to illustrate how digital visualisation can enhance the Public Inquiry process, allowing all participating parties to gain a clear understanding of the visual impact of proposed development.

A panoramic image was captured at each location around the proposed development (as specified by Rothermel Thomas). The locations were chosen on the basis of line-of-sight and visual impact on the surrounding area. In order to create views after the proposed development, each panorama was augmented with views of the development exported from a CAD model. The CAD model was provided by the architects Frank and Luty in grey scale. Colour was added to the model utilising the software package *3DStudio*, based on artists' impressions of the development. Figure 6.9 illustrates the model before and after material rendering.

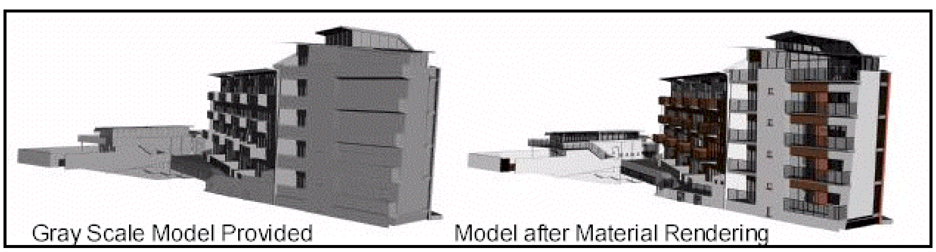


Figure 6.9. Texture Mapping Added to the Supplied CAD Model.

In addition, lighting was added to the model according to the location of the photograph in relation to the panoramic scene and the time of day, and this ensured that the model remained realistic in the augmented scenes.

To ensure that the perspective of the proposed development corresponded with the parallax distortion characteristic of panoramic photographs, each separate panorama required three augmented

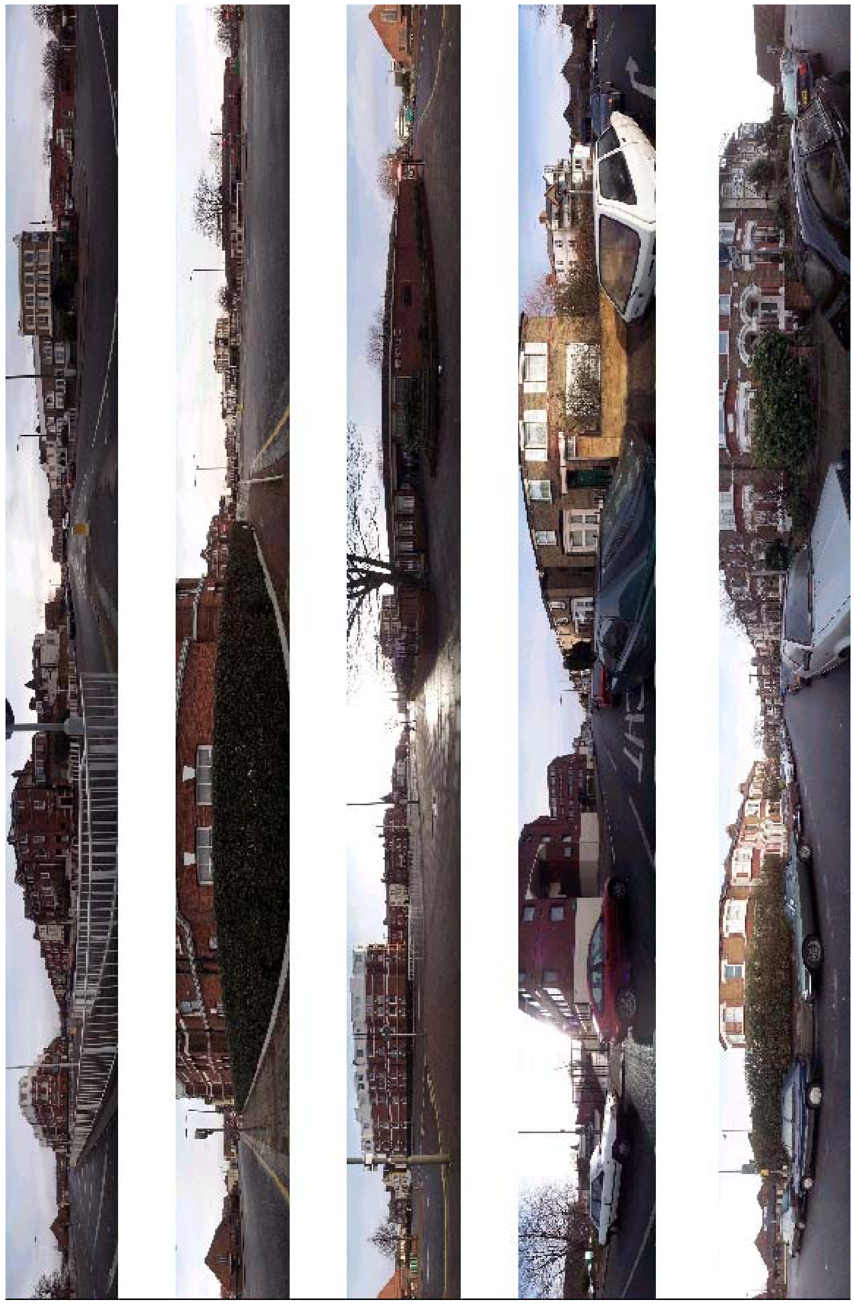


Figure 6.10 Panoramic Images of the proposed development site (1).

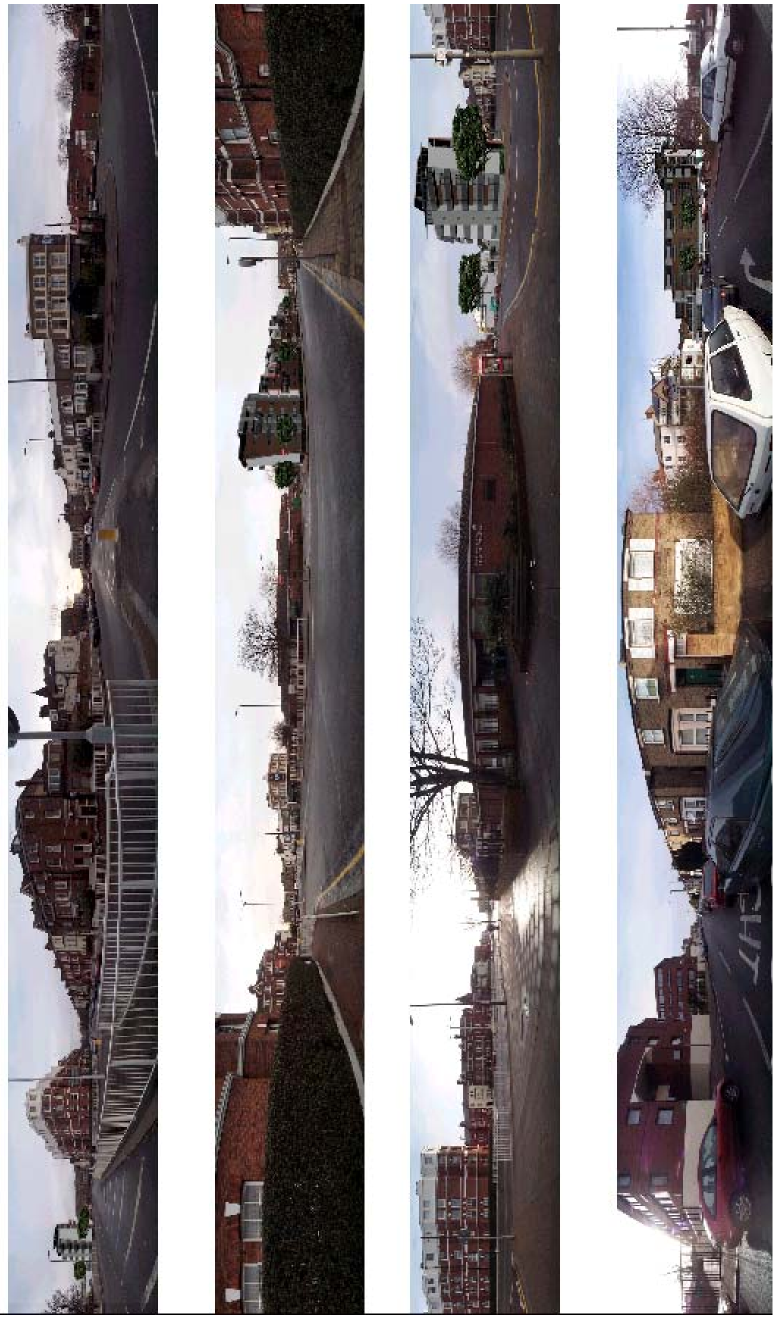


Figure 6.11 Augmented panoramic Images of the proposed development site (2)

images. The photographs were subsequently re-stitched creating an augmented reality panorama for each location. Figures 6.10 and 6.11 display the original panorama and the augmented reality created from adding in the proposed development.

By combining views of the development before and after from five site locations, the digital visualisation provided an environment whereby the user could gain a full understanding of the visual impact of the development. The visualisation was specifically designed for ease of use and multi-platform compatibility. An interface was designed to allow 'point and click' navigation through the digital scenes. Two views were made available for each location, before and after the development, and each view was coded by colour. Figure 6.12 illustrates the interface.

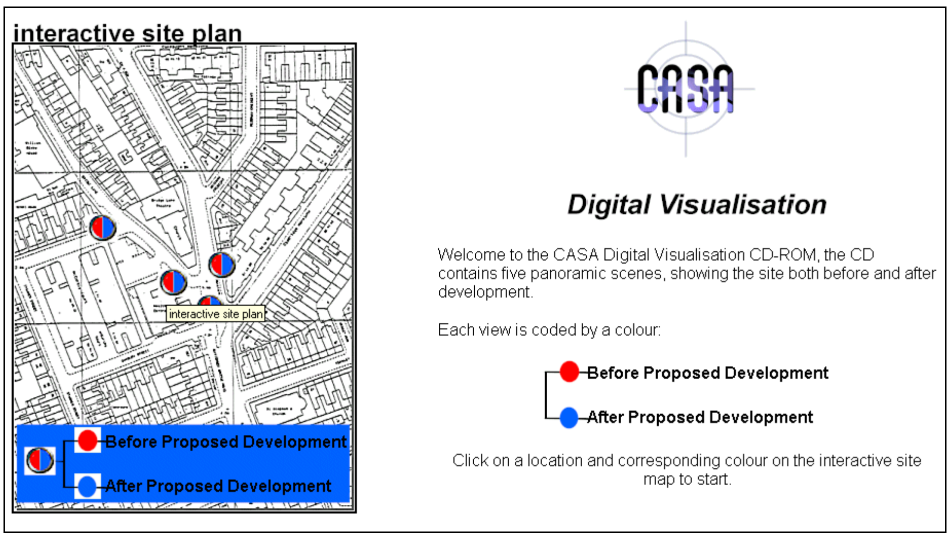


Figure 6.12. Wandsworth Planning Inquiry Digital Visualisation.

To view each scene, the user was required to place the cursor over the desired location, illustrated by the site location map and the corresponding colour. A click of the mouse loaded a JAVA-based panoramic scene into the right hand section of the interface. Once the scene loaded, the user was able to navigate through 360 degrees by placing the cursor over the view and clicking the left mouse while dragging, thus rotating the viewpoint. Users were also able to zoom in and out of the scene using the A and Z keys on the keyboard. Figure 6.13 illustrates the JAVA viewer with a scene augmented to display the proposed development.

Figure 6.13 JAVA Scene Viewer.

As a testament to the importance of the move towards using digital visualisation in the planning process, Rothermel Thomas stated that 'it was a 'major breakthrough' at a Public Planning Inquiry to have the digital visualisation. Solicitors involved in the case, both Russell Harris for Wandsworth and Cameron McKenna for Wates in their closing speeches to the Inquiry, referred to the importance of the visualisation as an aid to the understanding of the proposed development. Of note, however, is the fact the visualisation was not placed online. The original aims of the research were in fact to enable local residents to view the visualisation online before the Public Inquiry, thus being able to react to 'before and after' scenarios according to their own location. However, the developer decided, upon viewing the visualisation and its impact on the local environment, that if the residents had access to the information before it was used in the Inquiry, they would have a stronger case against. The visualisation was therefore not placed online. At the request of the developer a number of trees were also planted to 'green up' the scheme. One particular view of the development, a key view in the opinion of the local residents, was removed from the interface at the request of Wates Built Homes. The view was removed as it did not portray the development in a favourable light and thus would have further jeopardised the case of the developer at the Planning Inquiry.

As such, the use of digital technology to create a sense of space became more of a marketing exercise on the part of the developer than the intended original aim which was to aid public participation, collaboration, and visualisation in the planning system. The Public Inquiry found in favour of Wandsworth Borough Council and the planning application was refused, although a subsequent application for the site has since been accepted. In terms of developing the technique further, Wates Built Homes were encouraging in its prospect for use in 'before and after' panoramic visualisations for other projects. However, as the Public Inquiry found in favour of Wandsworth Borough Council and the fact that the visualisation served to illustrate negative aspects of the development, the technique has not been used since.

6.3 The Collaborative Design Studio

Planning is about communication for effective communication is the key to innovative planning and for an effective PPSS. The central question is how to effectively communicate planning information in a way that can be used by all the players in the planning process. A planning information system should be both useable and attractive to the public, the planner, the private sector, and the political representatives involved in the process. *Wired Whitehall* demonstrated that design information could be effectively communicated on a single user basis but not in an asynchronous virtual world based around panoramic imagery. Synchronous interaction is imperative to the design situation with groups deciding and acting together to plan an environment for the good of the whole. As Mitchell (1997) points out, designing a building or a town is not just contingently but fundamentally a collaborative, interdisciplinary, geographically distributed, multimedia activity. Collaborative design includes more than simple document exchange. It enables value to be added and dialogues to be conducted over sophisticated artefacts (McCullough, 1995). To achieve these assumptions, *Wired Whitehall* and the *Wandsworth Planning Inquiry* visualisations were used as the basis for wider collaboration in a digital design studio. This section details the methodology behind the development of a Collaborative Virtual Design Studio (*CVDS*), a planning/design system utilising networked virtual reality and geographical information systems. The *CVDS* allows intelligent collaborative planning support within a community/educational environment.

To date, planning information and design systems have focused on technology and not communication, resulting in support and information systems that are aimed at the professional player in the planning process but not the general public. The *CVDS* has been developed online, drawing upon present and previous developments in virtual design. One of the most influential systems has been the Virtual Design Studio (VDS) from the Centre of Design Computing at the University of Sydney. In the introduction to the VDS, Maher et al. (1997) state that a designer can meet with consultants, the client and other designers without leaving their desk. During the meeting, the individuals might chat socially, work on a specific agenda item, and/or develop a design drawing to be shown to the group. The sketches, drawings, and tables of data can be shared and marked up in a group meeting using inexpensive desktop computers. The VDS is essentially developed around the following principles:

- the team is comprised of people in various locations;
- the design process and communications are computer-mediated and computer-supported;
- the information "inside" the studio is handled in electronic form ; and
- the final design documentation is also in electronic form .

The VDS is developed with the aim of designers collaborating with designers. The *CVDS* develops this concept to communicate information between all the players in the planning process including non-designers, addressing the following points:

- effective communication – communicating planning issues in a way which is understandable to all players in the process;
- innovative communication – communication of information in a way which catches the public interest;
- usability – design of an interface that is both easy and intuitive to use;
- community-based – the integration of planning and community information into a community public support system;
- educational – presenting information about the design of the built environment in an intuitive and collaborative manner; and
- open access – creating a system which is compatible with existing data and modelling structures.

Two versions of the *CVDS* were placed online. Firstly, an educational version was used to teach students from the MSc Virtual Environments course at University College London aspects of design, location and place in virtual worlds. Running in the

ActiveWorlds virtual browser system, students were divided into groups of four and given the freedom to build and design in the collaborative environment. Building was undertaken as we have previously illustrated in Figure 4.13. Students were encouraged to work in groups remotely with the majority collaborating in the environment via their home-based personal computer systems. The project was innovative as it also linked up to other Universities during their three-year program. Liverpool's John Moores University and the Georgia Institute for Technology in Atlanta were both used to link up students from the Bartlett School of Architecture at University College London. The concept of allowed users the freedom to build and developed into our ideas for '30 Days in ActiveWorlds' which we explore in Chapter 7. A photorealistic version of the *CVDS* was developed using real buildings to create a virtual environment for digital planning rather than the standard ActiveWorlds building set. We explore this further in section 6.4 on Shared Architecture.

The *CVDS* provides an insight into the development of a virtual planning information system. The use of networked digital technologies to present planning information is becoming increasingly common, not just in education but also in practice. For example, as has been stated, a number of councils now have digital versions of their Development Plans available on the Internet. The use of web sites to provide information on the urban form and development may be seen as the 'First Wave' of digital design on the Internet. The Second Wave may be seen as the use of Internet-based Virtual Reality of which the *CVDS* is an example. The use of systems such as *CVDS* running on home computers, creates the ability to greatly enhance the level of public participation in the design process. The public will be able, via public access terminals or their own machines, to walk around virtual representations of real world developments with site developers, architects, and planners (and of course themselves), all represented as avatars. Such developments hold many implications for both the process as a whole and the professionals involved in designing the built environment. The *CVDS* provides an insight into these changes as the design process becomes increasingly publicly orientated as a result of digital networked technologies.

6.4 Sharing Architecture

Models of urban form currently available Online, for example Virtual Helsinki, New York and Ottawa, to name but a few, are limited to basic block form models with limited texturing. Such models are also non-bandwidth friendly, and as such, not in line with Brutzman's six components of graphics interworking. With this in mind, we pulled all these elements together into a project called '*Shared Architecture*' which was set up as a subset of our Online Planning pages. This was designed to explore how the built environment can be communicated online in three-dimensions compared to the two-dimensional augmented reality of *Wired Whitehall*. *Shared Architecture* focused on two concepts; firstly on how to rapidly construct urban models to convey a sense of location and place on standard home or office computers; and secondly on how to place models in a multi-user real-time environment, allowing collaborative design in photorealistic terms. The ethos behind *Shared Architecture* and indeed all the prototypes explored is the same: to develop methods to allow communication and design online utilising digital technologies. The only difference is that as the technology moves along at an ever-increasing rate, we moved to embrace the third-dimension with *Shared Architecture*.

Models were constructed and placed online which were selected from digital photographs available to our research group. These models included a range of London tourist attractions including Buckingham Palace. These illustrate how simple new-build constructions as well as buildings of rich architectural heritage can be distributed Online. Due to issues of copyright on high quality images and limited research funding, the majority of the models were produced from postcard images illustrating London's tourist attractions. A range of software packages were used in the initial analysis to show how we could effectively place photorealitic models of potentially geometrically complex buildings online. After a series of test models had been produced it was decided to build the models in *Canoma* which we previously discussed in Chapter 5.

The use of photographs allowed geometrically complex buildings to be modelled and textured. These textures allowed the simple geometry underpinning the models to appear architecturally rich. As such, it allowed models to be produced which had a small file size and in an output compatible with a number of Internet visualisation packages, thus meeting Brutzman's (1997) criteria.

Each model was initially placed online in Metastream format (.mts), available for viewing as single structures. Figure 6.14 Illustrates the Shared Architecture interface.

Figure 6.14. Interface to* Shared Architecture *Illustrating the Buildings Available for Viewing.

Metastream was selected due to its ability to both compress the overall file size and stream texture data to the end-user. Streaming results in a wire-frame version of the model being displayed on the user's computer with a size of approximately 5K, followed by the texture mapping. File size varies accordingly to a number of factors such as texture resolution and the number of photographs used for modelling. On average models on the *Shared Architecture* site are around 180K in size, a considerable decrease from the equivalent VRML file size and thus comparable with the digital panoramas used in *Wired Whitehall*. Users of the site were also encouraged to model their own buildings and submit files which would be posted on the page. This resulted in an American Log cabin from Newaygo, USA and a café from Los Angeles, being shared on the page. A number of models were also available to freely download in standard industry formats (.3ds / .obj). Users were encouraged to interact with the site so that a virtual archive of buildings could be created for illustrating the use of the technology and bringing it to the attention of professionals in the field. Models are continuing to be submitted, the latest being a model of the World Trade Centre in New York, prior to the 9/11 terrorist attack (September 11th, 2001).

Shared Architecture, however, only allows single buildings or small-scale models to be viewed due the limitations of bandwidth and computational resources. For effective site visualisation and potential collaborative design, a larger scale scene is preferable. With this aim, Shared Architecture was 'ported' into a number of multi-user formats operating via the Internet. Firstly buildings were imported into the Collaborative Virtual Design Studio (CVDS) in ActiveWorlds. Figure 6.15 illustrates movable buildings and an avatar in the constructed street scene.

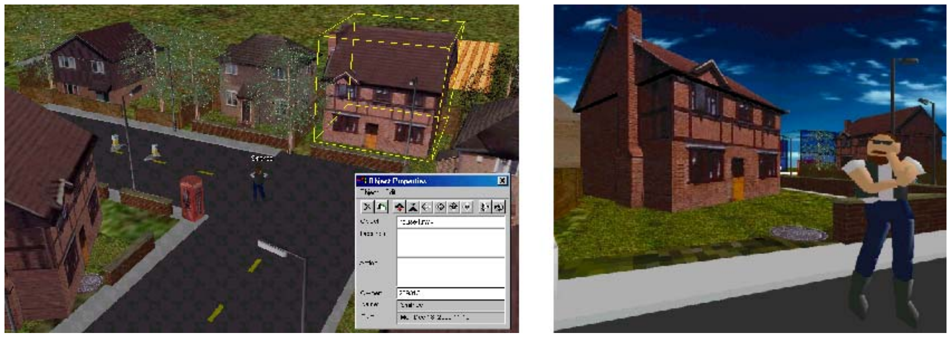


Figure 6.15. Photorealistic Buildings and Avatar in the Collaborative Virtual Design Studio.

The integration of models into the *CVDS* allows photorealistic scenes to be constructed which can be collaboratively rotated, moved and replaced in an avatar-based environment. This also integrates the ability to communicate via text with users logged in regardless of location, being semi-immersed in a non-fixed photorealistic environment. It is this ability to import models from the real world into a shared environment that underpins the concept of digital planning. The concept is similar to the multi-user version of *Wired Whitehall* which used the *Blaxxun* system. However the move to a full three-dimensional space allows true placement of objects and buildings on the x-y-z axis. It also opens up the ability to interactively change buildings in a linked environment. A range of buildings from the Shared Architecture page were converted into the Renderware format for Activeworlds and uploaded to an Internet server. By selecting each building and cloning it each separate model can be called up via a database. This database implies that each object in the environment is movable and viewable to each user as and when changes are made.

Models can also have additional information tagged to them with links to a web page. For example, if the building in Figure 6.14 is clicked, a web page with design information, site costing details, and planning history is called up. Linking this information to a database also opens up the possibility of real-time site costing and site layout via an interlinked two-dimensional map. Such a system is similar to 3D-GIS systems but running over the Internet within a shared collaborative environment. As the system is operating in ActiveWorlds, it also allows large-scale scenes to be constructed.

Individually the models conform with Brutzman's (1997) components of graphics visualisation. For large-scale sites, for example an area the size of Central London, the models require a high level of available bandwidth and computation power. Utilising the ActiveWorlds system of streaming discussed in Chapter 5, large-scale environments can be successfully ported with only the local scene viewable at any one time. As the user walks down a street, buildings will stream in, creating the possibility of visualisation and interacting with large-scale virtual environments in an intelligent manner.

As already mentioned the models are imported into ActiveWorlds in Renderware format (.rwx) for a number of modelling packages export files in this way. The conversion process is not simple and this inhibits the potential uptake of such applications. Figure 6.16 illustrates the path required to import the models from *Shared Architecture* into the *CVDS*.

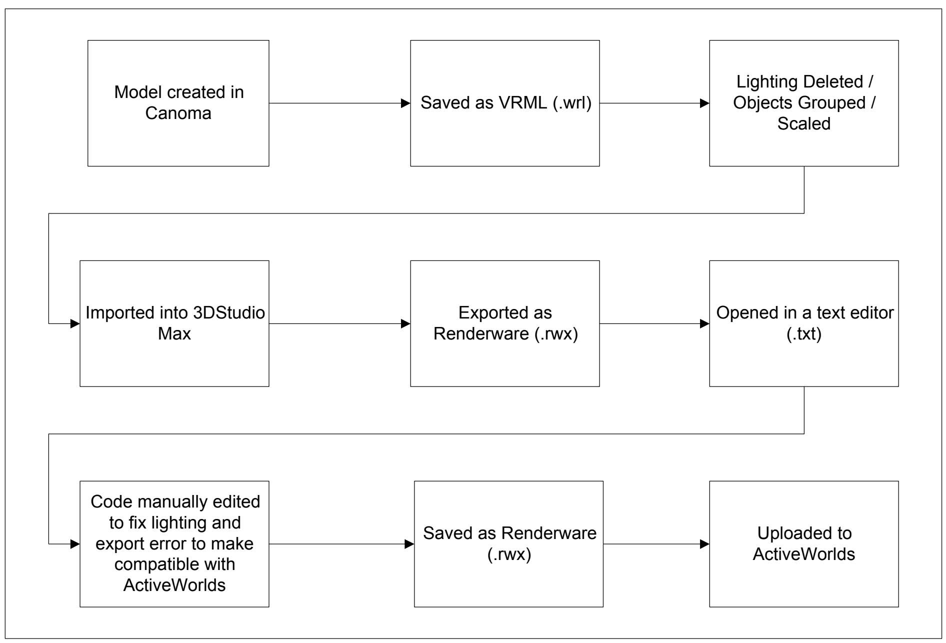


Figure 6.16. Converting from Canoma to ActiveWorlds Renderware Format.

Indeed a large part of this research has been in working out conversion routes for the three-dimensional models while the requirements to edit the code manually in Microsoft Word does not make this a user-friendly process. As such, the porting of models into the ActiveWorlds system is a specialised task and what is urgently required is an easier route. With the aim of simplifying this path, a number of other multi-user systems were examined for importing models into and out of the *Shared Architecture page*. Figure 6.17 illustrates samples from Holodesk and Atmosphere respectively.

For *Holodesk*, the authoring route is simple in that it imports VRML, thus cutting out the requirement to import into third party software packages. However as has already been noted in Chapter 5, this also means that the problems of VRML are carried over to the multi-user environment. The scene is non-streamed and a file size in excess of 5Mb results which makes it no longer applicable to modem users. It is also limited in terms of interaction. The scene is non-fixed in that objects can be moved and although it is synchronous, changes to the scene are not shared. This results in a semi-collaborative environment where a sense of location and place can be shared but changes can only take place in the single-user environment. It should also be noted that changes of scale were also experimented with as shown in Figure 6.17 The avatars in Holodesk were created at a larger than human scale to create the illusion of looking down on the urban scene. This was developed to introduce an aspect of the traditional physical model into the virtual scene.

Figure 6.17. Multi-User Shared Architecture in Holodesk and Atmosphere.

The benefit of such models is that the whole scene can be surveyed and changed from a bird's eye view. In traditional methods of public participation, the criticism is that the user is unable to gain a street level view. In the virtual environment, the user is able to either walk around the model as an overscale avatar or change their viewpoint to a street level view, thus gaining the best overall view of the model. The other package, *Atmosphere* by Adobe, imports directly from Metastream, since renamed Viewpoint in .mts format. This again cuts down the authoring path and the .mts format, allows object streaming as in the first *Shared Architecture* example. *Atmosphere* is currently in Beta Testing with a full release planned for late 2003. For this example, a smaller scale was used to create an option for digital 'table top' planning. The same benefits of a collaborative virtual environment are gained, but the models can be placed on a virtual workbench in a meeting room whereby design concepts can be discussed and objects viewed interactively. As already mentioned, the software is in Beta testing and research is on-going, illustrating once again the moving target of technologies and how they need to be utilised for digital planning and design.

The use of photorealistic models in a collaborative environment attracted a similar level of interest as *Wired Whitehall* with the concept featured in the Independent on Sunday Magazine and a section devoted to the research on Sky Television's 'Computer' channel. The program featured a virtual model of the 'Angel' Public House in London's Surrey Docks with filming of the actual location being directly compared to the movable interactive model. Such media interest illustrates that the public's imagination can be captured by photorealitic models within an interactive collaborative environment. The environment was designed to make the digital planning process enjoyable in a way similar to SimCity discussed in Chapter 4. By making the design environment friendly and attractive, yet suitably visual in portraying a realistic sense of location and place, the digital planning system can be opened up to wider public access and this ultimately extends our understanding.

Interest in these concepts from the *Shared Architecture* project led to the use of photorealistic modelling for larger planning sites, notably the Dounreay Power Station to which we now turn.

6.5 Digital Dounreay: Modelling the Environment of a Nuclear Power Plant

Shared Architecture is devoted to the display of single buildings in three-dimensions via the Internet. Large sites however were only possible with the use of the *CVDS* which allowed objects to be streamed. With this in mind, a series of larger scenes were constructed, aimed at creating entire localities in three-dimensions which could be interactively moved and manipulated online. Due to these technical limitations which have since been addressed in the Woodberry Down approach, elaborated on later in

Chapter 9, the scenes were constructed in VRML 2.0. Developed from two photographs, one taken from the top of the Telecom Tower, London and one from a postcard, a scene was constructed of the northern region of Tottenham Court Road. The model was constructed in a similar vein to the *Shared Architecture* models using *Canoma*, but with the grouping of each building using unique codes onto which VRML tags were added to enable movement of buildings along the x-y plane. The scenes are illustrated in Figure 6.18.

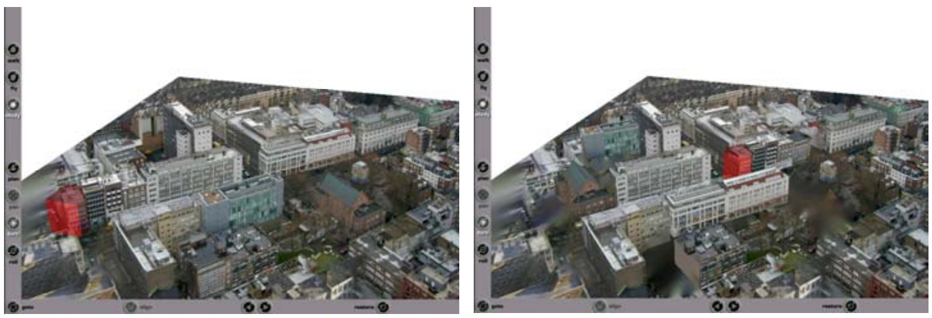


Figure 6.18. Tottenham Court Road, London, with Movable Buildings.

The object highlighted in red in the left hand image is an example of such a grouped object, and as the right hand image illustrates, it can be moved to another position in the street.

As a consequence of developing the rapid prototyping of the Tottenham Court Road scene, these techniques were then extended to model the environment of the Dounrey Nuclear Power Plant in relation to its decommissioning process. The Dounreay site was opened in 1955 with three reactors built on the 135-acre site. These are now decommissioned but the full process is estimated to take in excess of 40 years at a cost of £4.5 billion. A major part of this process is to be able to view the site over a time scale as buildings are gradually demolished. In this application, each building has a specific code linked to a GIS, enabling a two-dimensional view of the site according to which buildings are selected. Dounreay required the site to be visualised in three-dimensions with an end output viewable on standard office computers and with the possibility for future integration with on-site GIS to aid in site planning.

The route taken was similar to *Shared Architecture* but with the use of specifically commissioned photographs to ensure varying levels of detail, and overlaps on each photograph used to ensure a high level of detail. Figure 6.19 illustrates the sample photographs used in constructing the planning site.

Figure 6.19. Sample Photographs used to Model Dounreay Nuclear Power Plant.

Canoma and related photogrammetric software are suited to small area local scenes. In order to construct the 3D model, the site was split up into six sections with each section modelled, texture mapped, and exported separately. Sections were subsequently imported into *3DStudio* and layered onto Ordnance Survey Landline data exported from the Dounreay GIS into *ArcView*. This was to ensure a seamless merge for each scene. The end result was the photorealistic scene illustrated in Figure 6.20 which shows a side-by-side comparison of the current Dounreay three-dimensional model from *ArcView 3D Analyst* and the photorealistic representation. It also demonstrates the whole site structure with a side view rendered in *3DStudioMax*.

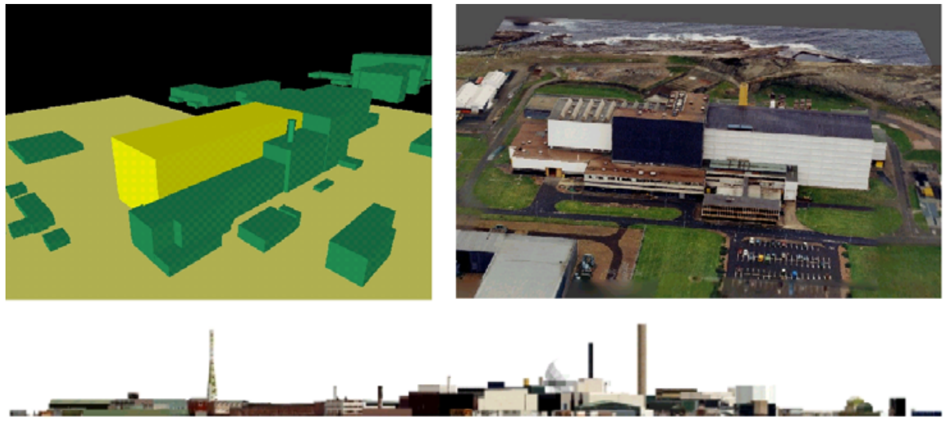


Figure 6.20. The Model in **ArcView 3DAnalyst** ***(above left) Compared to the Produced Photorealistic Model for Site Visualisation.***

Whilst other three-dimensional block and wire-frame models have been carried out for the site, the production of a site-wide photorealistic model provided the first integrated environmental visualisation. The model has featured at a number of international conferences and was featured in the January 2002 edition of GeoConnection magazine. Richard Wells, project manager of GIS at Dounreay, viewed the model as a major advance in real-time visualisation and the technique is now being used to visualise other projects including Silo and Shaft intermediate waste systems. The model was subsequently imported into 'Realimation', which provides game like real-time fly-though capability on high-end computer systems. In addition, the model has been linked to a Microsoft Access database, allowing data to be queried at an individual building scale whilst flying through the site. The model can also be ported into either the *ActiveWorlds* system or *Atmosphere*, producing a virtual table-top model of a full street level scene. The addition of the database results in individual buildings being queryable and various design options being explored with information available in real-time on site costing and environmental impact.

The Dounreay example shows how these techniques can produce large-scale virtual environments for site planning and visualisation in a professional context. However, such digital technologies can also be used as educational tools to explore concepts of location and place, and we now digress a little to show how these ideas were developed to educate users of the Hackney Building Exploratory.

6.6 Hackney Building Exploratory and London Bridges

The Hackney Building Exploratory is an interactive centre for environmental education in North London, set up to explain building form, construction, design, planning, housing history and local urban area management to the general public. It is a permanent hands-on exhibition which is host to a number of exhibits which double as education aids, focused on exploring specific aspects of the environment. As part of these exhibits, it is host to *Hackney Building Exploratory Interactive*, a CD-Rom and Internet-based interface developed under the Partnerships for Public Awareness Initiative' from the Engineering and Physical Sciences Research Council (EPSRC). From the development of *Wired Whitehall* and *Shared Architecture*, we developed an interface specifically aimed at letting children explore the local environment around the Building Exploratory and gain an understanding of both built environment and geographic issues relating to Hackney.

Such interfaces and the involvement of children in the future planning and understanding of the built environment are crucial to a digital planning system. Information needs to be displayed within an intuitive interface which is both easy to use and informative. The exhibit was divided into three sections, each with interactive three-dimensional elements as well as 'how' and 'why' sections to explain the concepts and their importance to our future understanding of the built environment. Two of these deal with Hackney itself. First digital panoramas built around the *Wired Whitehall* concept allow users to navigate and zoom into panoramas relating to Hackney. Second a series of housing types were modelled and displayed along the lines of Shared Architecture. The houses modelled were chosen to illustrate different types from the 1780's, 1920's, 1930's, 1960's, 1970' and 1990s, providing the user with a clear illustration of the changes in the style and architecture of housing in Hackney. Figure 6.21 illustrates typical screen pages from the *Hackney Building Exploratory Interactive*.

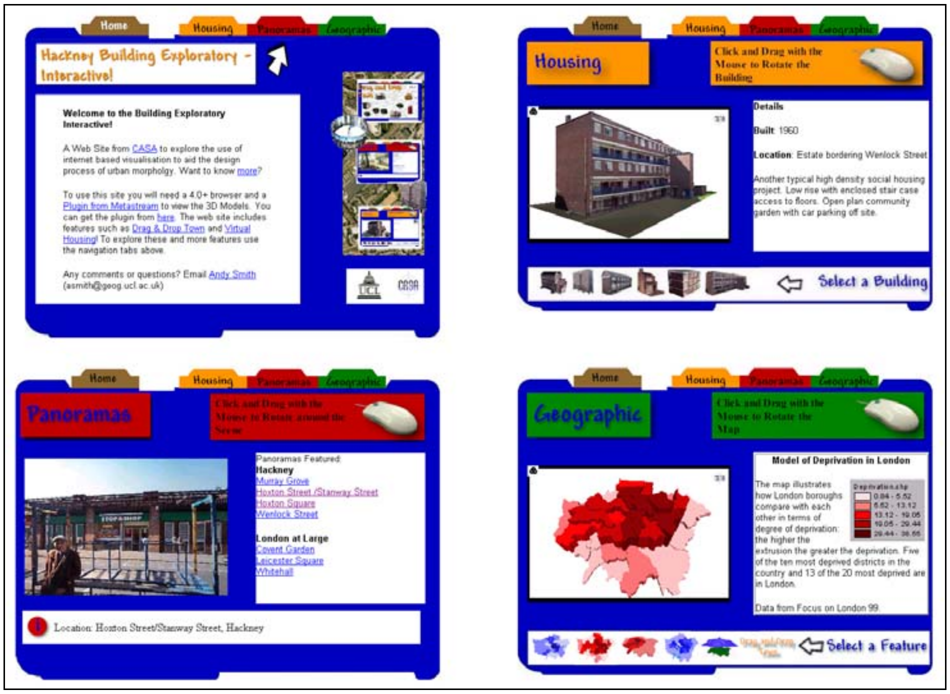
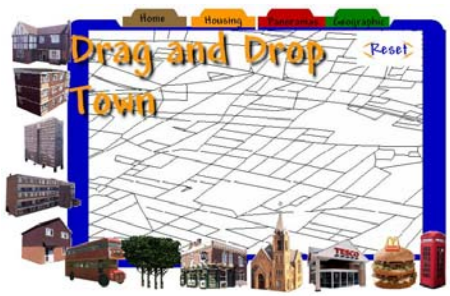


Figure 6.21. Sections of Hackney Building Exploratory Interactive.

The third section was developed around two themes: firstly the idea of displaying and explaining socio-economic data concerning key issues such as deprivation and house prices in all London Boroughs with a focus on Hackney. Such data is traditionally displayed via table/charts or shaded/coloured thematic maps. These two-dimensional ways to display data do not allow the user to closely examine the data within a graphic environment. To achieve this, data was thus collected and mapped in a GIS according to location. Values were given a three-dimensional value in *ArcView 3D Analyst* and exported into *3DStudioMax*. Before export, the data was optimised via a third party generalisation script, ensuring that the number of points required to display the map (and thus the file sizes) were kept to a minimum. The geographical information was displayed in a similar way to the three-dimensional housing in that the maps could be rotated as well as zoomed to allow close examination of the local context as well as the London-wide data.

A related theme in the geographic section was that of the 'Drag and Drop' town. Aimed at the younger-user, it was developed to include features found in many towns, such as a supermarket, church, a range of house types, a public house and so on. Each feature could be 'dragged and dropped' onto a site plan to create a layout of the town as illustrated in Figure 6.22.

(a) The Original Canvas



(b) A 'Design'

Figure 6.22. Drag and Drop Town.

The town was developed using Dynamic HyperText Markup Language (DHTML) and as such, did not require any plugin or specific bandwidth requirements. It was designed in collaboration with the education advisors at the Hackney Building Exploratory to allow users to think about areas and buildings that make up a town and their location to each other. Both the concept and the interface are simple, yet behind the entertaining façade is the concept of 'drag and drop' interactive site planning. As has been examined in Chapter 3, traditional planning visualisation is based around the two-dimensional site plan. These site plans are often digitally produced but distributed and annotated physically. The use of digital technologies allows each section of a plan to be made movable, similar to the interactive three-dimensional buildings in *Shared Architecture*. Whilst the 'drag and drop' town example was set on a fictional isotropic plane, the same concept could be adapted to actual site plans. Utilising non-fixed two-dimensional site plans would aid both professional planning and public consultations. Whilst it is not claimed that it would replace professional drafting tools, it would be of value in discussion and consultation over different design options. Options could be dragged and dropped into place to explore issues such as housing density on sites. The technology is Internet-based via a standard web browser but in this case it would have most value in a public meeting where the two-dimensional map and various options would require detailed explanation.

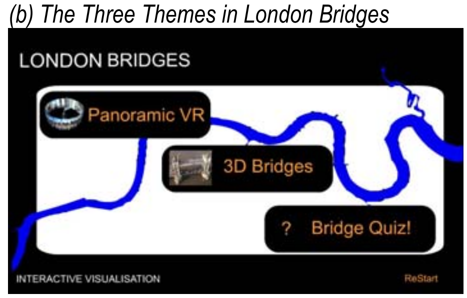
Hackney Building Exploratory was awarded 'site of the month' by PC Pro Magazine and described as *"being well worth a visit as you can manipulate buildings on display and even take on the role of town planner in the wonderful 'drag-and-drop town' feature, the sites complexity is disguised by good design so that it appears very simple to the end-user"*, PC Pro Magazine, February 2000.

As part of our quest to bring these ideas to a wider public, the knowledge used in *Hackney Building Exploratory Interactive* was developed for visualising a series of bridges across the Thames in London. This was part of the Museum of London's development of a bridge exhibit relevant to their series of mini-exhibits focussing on built form in London. The aim was to communicate location and space in a form applicable to a wide audience and to make it both informative as well as entertaining, issues that are central to the arguments in this thesis for maximising effective public consultation. An exhibit was developed around the Museum's 'Bridging History' Exhibition which was held from 17th March until 14th May 2000 as part of their Capital Concerns series. The exhibition was designed to capture the evolution of bridges, their architecture, and their social function over a period of 400 years and was focused on the topical event of the opening of the Millennium Bridge in June 2000. Figure 6.23 illustrates sections from the London Bridges Interactive Visualisation.

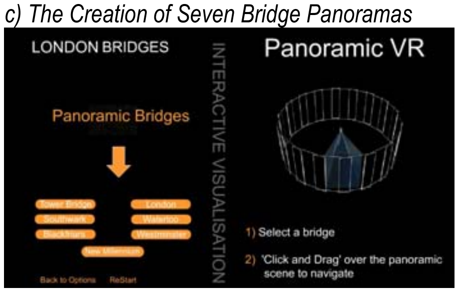
The development of these various visualisations for public participation will be further explored in Chapter 8 where we present applications to the Woodberry Down Regeneration project. The various themes of how to effectively visualise and communicate the local environment to a wide audience were central to the bridges project. Panoramic imagery was

(a) The London Bridges Home Page

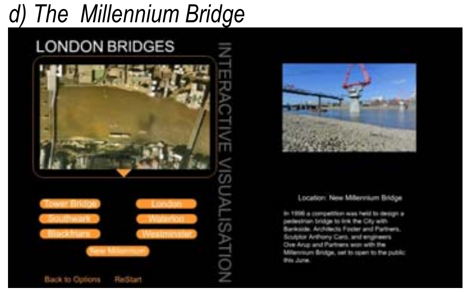
(b) The Three Themes in London Bridges



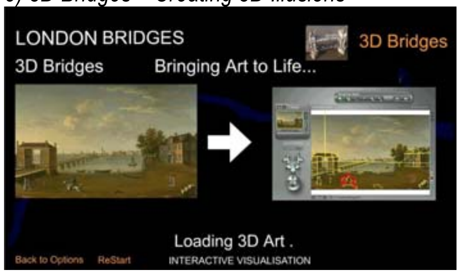
c) The Creation of Seven Bridge Panoramas



d) The Millennium Bridge



e) 3D Bridges – Creating 3D Illusions



f) Click on the Old Putney Bridge to the right

g) Putney Bridge from 1750 Comes Alive

h) Finishing with the Bridges Quiz

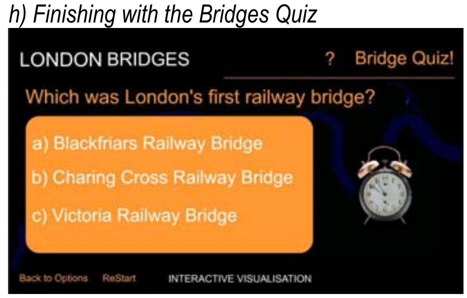


Figure 6.23. The London Bridges Interactive Visualisation Exhibit.

used in a similar fashion to *Wired Whitehall* and *Hackney Building Exploratory Interactive*, but with the addition of aerial photography which allowed greater control over zooming to centre on the location of each bridge. These images were supplemented by an historic bridges section which illustrated how three-dimensional art can be produced. Using single paintings of Putney Bridge and London Bridge, wire-frames were created and texture mapped according to the painter's location, thus transforming a two-dimensional painting into a three-dimensional scene. These were provided on CD-Rom as fly-throughs allowing users to view the bridges as painted in the 18th Century from different angles. For the Internet version, the paintings were placed online in a similar fashion to the objects in *Shared Architecture* where users could rotate, pan and zoom around the model. The final section was an interactive quiz developed in *Macromedia Flash* to provide information on the built environment in an entertaining context.

6.7 Technology Transfer

As we noted in Chapter 2, Klosterman (1998) states that planning academics will continue to develop extremely interesting prototypes that are rarely available in practice. The production of such examples explored so far have been largely academic but interesting prototypes with widespread dissemination in mind. In the cases of

Dounreay, *Hackney Building Exploratory* and the *Wates Built Homes* examples, the prototypes have been used for real-world digital planning and education but the move towards transferring the research technology to a public or commercial setting is still problematic. Universities are traditionally viewed as environments where innovation and research are carried out. The nature of the research often results in extended prototypes which are not directly applicable in the commercial market place. Research requires flexible time scales to overcome the obstacles which are encountered during development. This is especially true with emerging digital technologies often utilising Beta software and implementing new code and hardware during the development phase. In the case of Dounreay, the project was planned to take place in three weeks, but in reality, it took over three months. The research problems involving the scale of the site and the implementation of slicing the model into parts and rearranging it within separate three-dimensional software packages to deal with hardware limitations, increased the development time substantially.

With this in mind, a commercial venture was developed with Plannet Visualisations Ltd (Plannet) to provide a route to develop these prototypes and allow a transfer of technology through a range of visualisation services. These services provide what is essentially a 'one-stop-shop' for digital planning and visualisation of the urban environment. In association with this research, a number of commercial projects have been carried out for building photorealistic/interactive models of urban form which provide a sense of location and place online. One such project was to use the research developed around the Woodberry Down application, detailed in Chapter 8, and to develop this as an example of 'best practice' for public consultation in the planning process. The project funded by the Architecture Foundation, has produced digital models of the Teviot Centre, a community development in East London. As already explored in Chapter 3, development options for the Teviot centre were based entirely on non-digital techniques. As a result of our research prototypes, the Architecture Foundation funded the development of full three-dimensional models to embody 'what if' scenarios as part of '*The Glass-House*' Internet project. *The Glass-House* is jointly managed by The Architecture Foundation and Trafford Hall, home of the National Tenants Resource Centre. It has been set up as a new national design service for tenants and residents, often in deprived areas, offering access to high quality, independent advice and technical aid, either to help initiate and realise local projects, or to give residents an effective say in development schemes that affect their lives.

The ethos behind the project is that design is key to influencing how people feel about their homes, their community, and their neighbourhood. It has a role to play in everything from security and safety, parks and play areas for young people, what your home looks like, to how traffic is controlled in your area (The Glass-House, 2002). The three-dimensional model has been developed to illustrate how digital technologies can be used to aid the design and consultation process. As an illustration of best practice, it aims to encourage other agencies and developers to use similar technologies and thus increase the use of interaction and photorealism in digital planning. Figure 6.24 illustrates the three-dimensional model and some of the options available.

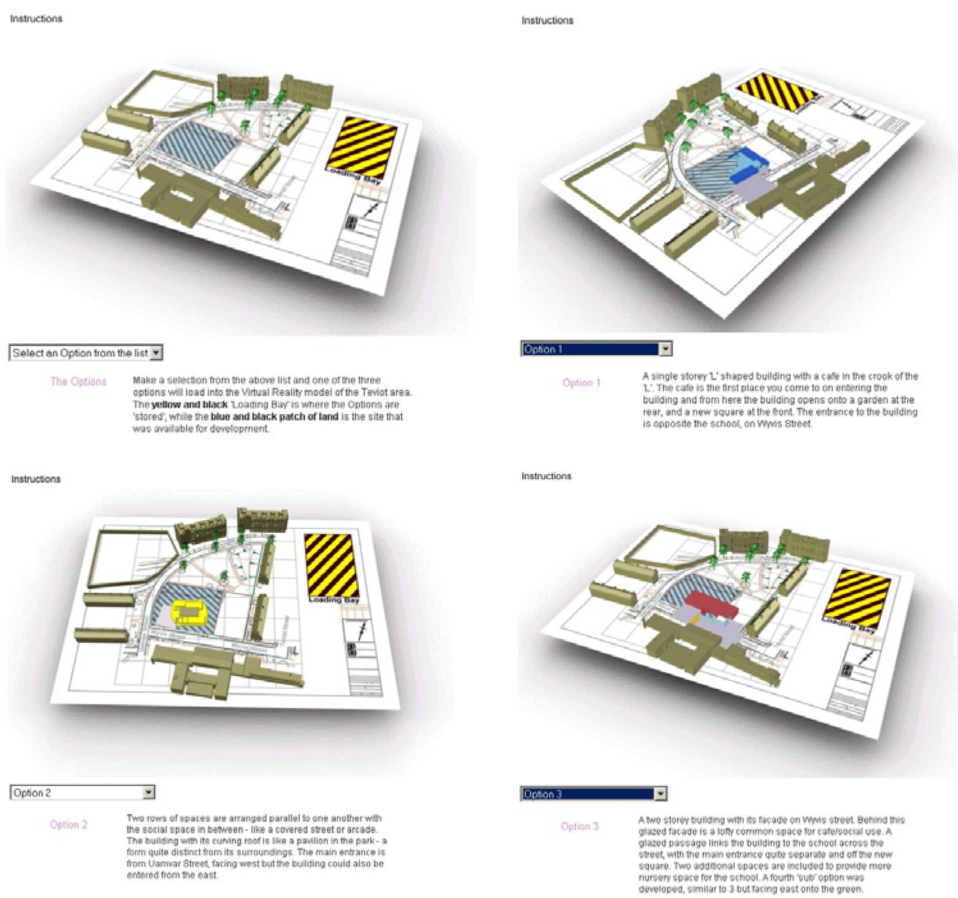


Figure 6.24. Three-Dimensional Models: Options for the Teviot Centre.

The models were developed on the basis of designs integrated into the options booth which we illustrated previously in Figure 3.5. By using the selection box, each model runs on a fixed animation path. Models appear out of the 'Loading Bay', fly above the houses and then drop down to their location according to the architects' plans. The ground plane of the model was developed to reflect the original site plans which link in with the key factors of *The Glass-House,* thus aiding the publics' understanding of two-dimensional plans and drawings. By making the options digital, the same level of interaction is possible as in the original options booth but the model is now viewable by any number of users across the web. It thus aims to illustrate that with the use of digital technology, there is no longer a need for expensive physical models which, as we have previously noted, are of limited use due to their lack of portability.

The digital model also allows a number of views to be displayed. The models allow free interaction for the user, allowing him or her to pan and zoom around at birds-eye, mid-level or street level views of the development. Such views are not possible with physical models, illustrating the flexibility that is introduced when moving into the digital domain. The site plan and option models were also designed to portray a 'sketch' feel to the designs. The use of basic colours and minimal detail on the surrounding area was used to portray this flexibility in the options to the end-user. As we noted in Chapter 3, the use of highly rendered CAD models can portray a sense that the buildings are already designed and thus the public's input is limited. In this case, we do allow the photorealistic portrayal of options and their surrounding context, but it was felt by the Architecture Foundation that photorealism should only be used to display the finished building. Once the users have viewed all the options and read the design details, they are able to move on to view the actual building as it is constructed. We illustrate the photorealistic model in Figure 6.25.

Building on these ideas which clearly explain how the architects' plans enable both internal and external views of the building, a series of panoramas were captured. The panoramas were taken using a similar technique to that of *Wired Whitehall* but with each capture point given a geographical location. One of the criticisms of systems such as *Wired Whitehall* is the lack of orientation to the user when viewing the panoramic scenes. This was addressed by linking each panorama to a two-dimensional plan illustrating the panorama's location and current orientation. We illustrate the panorama and plan interfaces in Figure 6.26.

Figure 6.25. Photorealistic Model of the Teviot Community Resource Centre.

Each panorama was linked with the architects' floor plans where moving the panorama results in the field of view on the site plan moving in unison and vice versa. The user is also able to zoom into each panorama, again resulting in the associated field of view being extended or restricted accordingly.

The Glass-House is focused on providing examples of best practice for professionals in the regeneration field; as such it provides the perfect place to present the technology. In this example, the technology behind the projects is not key to its success. It is the ability to tap into influential institutions such as the Architecture Foundation and through them allow the examples to be viewed by their partners, for example, Planning Aid. This allows the transfer of technology firmly into practice. The end-user is not necessarily interested in the technology behind the visualisation. They only need to know that it is easy use, operates on any (Mac and Windows PC) operating system and allows extensive and open consultation in the planning and design process. As a testament to the success of the Glass-House project and our use of digital technologies for planning Lord Rooker, Minister for Housing and Planning stated, as is reproduced in our introduction to Part 3, that he had "*never seen anything so sophisticated as the site anywhere…even in government. All we ever see when debating planning issues are paper plans and maps*" (2002).

Figure 6.26. Examples of Teviot Community Centre Panoramas Linked with the Architects' Plans.

The Glass-House and its resulting success in communicating best practice was commissioned as a result of the example of *Woodberry Down Regeneration* which we detail next in Chapter 8.Before we launch into this example, we will once again take one step sideways for the virtual worlds that we introduced in Chapter 5 and which have been used in part in this chapter, generate their own sense of community and it is this that we consider essential to describe before we begin to show how real communities can become involved in real problems through online planning.

CHAPTER 7

The Digital Magnet: Community and Design in Virtual Space.

This chapter first explores briefly the concept of the 'Wired City' before moving on to so-called Digital or Virtual Cities which exist on the Internet. We argue that despite various research papers published on the digital city, such a city is yet to emerge within the concept of Cyberspace. Indeed, it is argued that research into the digital city has been concentrated on HTML-based web sites, whilst a virtual or digital city requires a sense of presence and place as perceived in a real city. New definitions are then provided for the digital city and a set of examples illustrated which bring the concept of the virtual city closer to fruition. Discussion of virtual cities can be problematic in terms of their use for a digital planning system. It is all too easy to move into the realm of speculation and fall into the cycle of hype and utopianism that has affected every era of computing and planning to date. Yet glimpses of a future can be seen in the early systems, which may in time develop full-blown communities into three-dimensional digital space based on physical cities. As such, this chapter ties our work on practical applications relevant to real participation which we presented in the last chapter to ideas about virtual worlds that we introduced in earlier chapters.

Definitions of virtual cities vary widely: digital cities (Mino, 2000), city of bits (Mitchell, 1995), Web-city (3-D Net Productions, 2002), telecities (Telecities, 2000), wired cities (Dutton, 1987), infocities (Infocities, 1997), cybercities (Graham and Marvin, 1999) to name but a few, all refer loosely to this concept. Within these definitions, the common theme is the use of the city metaphor to describe a network of people and/or information, information that is digitally communicated with relevance to either a real or non-real (fictional) city. In short, the virtual city is a merger of the community and the city, embedding the current functions of the physical city in a digital form. These real/non-real communities are defined as either 'grounded' or 'non-grounded' respectively (Aurigi and Graham, 1998). At first sight, it may seem that digital planning is only applicable to the grounded virtual city, a city such as London, represented online in digital form. However a true virtual city will only evolve as a combination of a grounded and non-grounded digital space. These spaces have the potential to become the magnets of the 21st century, attracting people into cyberspace from where digital planning can take place. The basis concept of the virtual city can be traced back to the Wired City concept of the 1960's which has developed as the starting point for the communication of digital services.

7.1 The Wired City

The 'wired city' was first proposed by the US President Lyndon Johnson in his 1960's concept of the 'Great Society'. A panel was set up by the National Academy of Engineering to examine how urban communications and telecommunications could improve city living and stimulate the best patterns of regional development (Goldmark, 1972). The wired city blended utopian ideals of society with the growth of a communications network. The wired city concept was based around five core principles (Dutton et al., 1987):

- communication is of increasing significance to society;
- new media have inherent biases towards more decentralised and democratic modes of communication;
- electronic media should emulate and reinforce face-to-face patterns of communication;
- communications should be viewed as an electronic highway; and
- long range, rational-comprehensive planning should guide development.

The wired city, as first envisaged, consisted of four networks - telephone, cable, institutional, and community owned, each supporting a 'variety of social objectives' (Dutton et al., 1987).

During the 1970's, a number of experimental projects based on the wired city concept were undertaken in the US and Japan. These projects were predominately two-way cable-based, using the television as the display medium for information. An emphasis was placed on choice aimed at illustrating the scale of information that the wired city would deliver. In 1977, Warner Communications introduced a thirty channel interactive cable system in Ohio, based on two-way communication which produced a three-fold increase in choice of television channels. However consumer interest in these experiments was low and the cable industry, particularly in the US, rather than achieving a 'variety of social objectives', became merely a process for introducing 'pay-as-you-view' television.

During the 1980's, the concept evolved into the 'advanced wired city' (Dutton et al., 1987). The basic concept remained but the emphasis shifted towards satellite, microelectronic, and fibre-optic technologies, technologies which now form the communications hardware of the Internet. As these technologies have developed, bandwidth has increased and virtual worlds and virtual cities have begun to form within the networks themselves. These virtual cities have great potential to complement the 'real world' cities which the networks were developed to serve. It is within these virtual cities that the communication of virtual design information and wider participation in the planning process can take place.

7.2 The Virtual City

Computer screens are the electronic hub of the virtual city just as real cities are focal points in geographic space (Dodge, Smith and Doyle, 1997). The term virtual city is now common on the web. A search for 'virtual city' in Google will return over 2,140,000 links (December, 2002). However as we have seen, the definition of virtual cities is non-distinct. They can be both grounded and non-grounded, two-dimensional or three-dimensional, service-based or information-based. As such, it is worth examining the broad categories into which the term virtual city is cast with the aim of improving the definition, thus making it more usable.

7.2.1 HTML Virtual Cities: Web Presence for Real Cities

The first category is the HTML-based virtual city which are web sites that describe themselves as virtual cities but are essentially merely online guides, menus and listings. They are often created solely for advertising purposes and make no attempt to represent the built form of cities. Many examples are available, a typical one being 'Virtual Brighton and Hove' (http://www.brighton.co.uk/) which is illustrated in Figure 7.1.

Figure 7.1. Virtual Brighton and Hove HTML Virtual City.

Virtual Brighton and Hove is a standard HTML-based web page. It contains links to information about the local region and as such, acts a portal to information relating to the city. Such HTML-based sites are common, often set up by the local municipality or authority, small companies, or individuals with an interest in their local area. While such sites are not virtual cities *per se* but merely use the term as they exist on the Internet, they are important in the development of the concept as they act as a hub to information. As such, standard HTML based pages are the main focus of initiatives such as e-government and e-democracy which will undoubtedly be linked into systems such as Virtual Brighton and Hove as they become central focus points for community and local information.

Figure 7.2. This is London 'Have Your Say!' Section.

With web applications such as discussion forums becoming increasingly accessible, HTML-based portals are also gaining a community input, becoming focal points for not only news and information but also for communication between citizens within a given region. An example of this is the 'This is London' (http://www.thisislondon.co.uk/) site produced by Associated News Media Ltd, a division of Associated Newspapers. The site is based around the Evening Standard newspaper in London, offering live updates on the days' news stories. However, it has become increasingly focused on entertainment and the provision of guides to restaurants, theatre and tourist attractions in London and it is now London's premier website for information about life in the city. Central to the site is its discussion forums which allow users to have their say on a range of topics from the latest news to life in London. The choice of forums is shown in Figure 7.2.

Sites such as 'This is London' do not have the 'virtual' tag such as 'Virtual Brighton and Hove', yet they offer a similar service. As already stated, the term 'virtual' is not really applicable to such sites, yet such pages are an invaluable resource providing information which could, in theory, be tagged into much more elaborate forms of virtual city.

7.2.1 The Two Dimensional Virtual City

The second category which are the often mistaken for virtual cities are map-based, two-dimensional'. 'Flat' virtual cities utilise two-dimensional maps of cities of buildings as an interface to further information. Virtual Bologna (http://www.comune.bologna.it/MappaWelcome.html) is the typical interface as we illustrate in Figure 7.3.

Figure 7.3. Virtual Bologna, a Widely Mis-Quoted Virtual City.

The interface is indicative of the typical two-dimensional virtual city based on a clickable image map which leads to relevant HTML pages. Despite being widely quoted as a virtual city, this and other examples such as the 'De Digitale Stade' in Amsterdam (http://www.dds.nl/) should not be considered as such, but merely stylised front ends to web sites. Aurigi and Graham (1998) describe the majority of these cities as grounded, signifying the ambitions of innovative municipalities, keen to be seen to be 'switched in' to the blossoming worlds of high-tech modernity centred on the Internet. Interfaces such as Virtual Bologna are similar to the standard HTML virtual city definition for the technology behind them is the same. The only detectable difference is the use of the urban metaphor to tag information to specific places. For example, clicking on the 'city hall' presents the user with information on local government whilst selecting the 'radio mast' allows access to the latest news. The two definitions of virtual cities explored so far should not be confused with those virtual cities which we explore towards the end of this chapter. They do not portray a sense of location and place in three-dimensions and as we imply, true virtual cities should be based on interaction in the third-dimension using the technologies explored in previous chapters.

7.2.2 Three Dimensional Virtual Cities

Three-dimensional virtual cities use virtual reality technologies to model the built form to varying degrees of accuracy and realism. A survey of three-dimensional virtual cities was carried out at CASA to catalogue and explore three-dimensional city models both under development and developed around the world (Batty et al., 2001). The report, commissioned by the City of London, identified over ninety three-dimensional city models in various stages of development. The majority of these were developed using full volumetric computer aided design modelling and as such were not suitable for distribution or interaction across the Internet. They do, however, provide an insight into the development of three-dimensional modelling in the attempt to mirror the real world and create the virtual city of the future. Once sufficient advances in bandwidth capacity and graphics optimisation are achieved, they will become distributable across the net. Of note are the eight categories of use identified as reasons for their development:

- emergency services: such as applications to problems of policing, security, fire, and ambulance access. These kinds of applications largely dwell on the intricate geometry of the urban fabric and the need to understand how different locations can be accessed quickly;

- urban planning: problems of site location, community planning, and public participation all require and are informed by three-dimensional visualisation. Models focus on small areas and aesthetic considerations, such as landscaping and line-of-sight;

- telecommunications: the driving force behind many models, in particular for the sighting of new towers for mobile and fixed communications in areas dominated by high buildings;

- architecture: as with urban planning, small areas are modelled for site location and design review;

- facilities and utilities management: involving water, sewerage, and electricity provision as well as road and rail infrastructure;

- marketing and economic development: similar to the two-dimensional virtual city in that it is used as marketing tool. However three-dimensional models are aimed at providing visualisations for developers of locations suitable for property development;

- property analysis: models link in with marketing and economic development to visualise detailed data relating to floor space and land availability as well as land values and costs of development;

- tourism and entertainment: models normally focused on the cities entertainment sector and developed as a marketing tool;

- environment: models developed to allow various kinds of hazard to be visualized and planned for, in particular ways of visualizing the impact of local pollutants at a fine scale associated with traffic; and

- education and learning: visualizations enabling users at different levels of education to learn about the city as well as enabling other virtual experiences through the metaphor of the city.

The above categories benefit from the move to the third dimension. The two previous categories of virtual city which we examined are not able to provide a comparable level of functionality which can be achieved through the move to three-dimensional models. However with this move came the issues explored in Chapter 4 with respect to Brutzman's (1997) components of Internet distributed three-dimensional graphics. Modelling cities in three dimensions is predominately CAD-based with one of the best examples being Virtual Bath which we introduced in Chapter 4. The distribution of such models via remote networks is problematic. As Dodge, Smith and Doyle (1997) state, true virtual cities, are models which provide an effective digital equivalent to real cities, creating a genuine sense of the urban environment. To fulfil these criteria, a virtual city must have a sufficiently realistic built form, a rich diversity of services, functions and information content, and crucially, be able to support social interaction with other users (Dodge, Smith and Doyle, 1997). The social function only comes into play when such models are distributed across the net.

7.2.3 True Virtual Cities: The Digital Magnet

A true virtual city is yet to emerge over the Internet but it is certain that in the next decade such virtual cities will develop. These cities will not be planned in the same way that our current urban environment has been subject to strict regulation for they will contain expansive virtual space. This will be the result of increases in processing power and bandwidth capacity which will create vast stretches of virtual land. Such cities will develop either as part of future gaming developments, or social interactions using three-dimensional software, or a combination of the two. As such these cities will probably have the potential for adaptation to urban design and planning applications. Planned spaces will emerge in unplanned virtual cities which will mirror the real world. As already examined, the virtual environments of ActiveWorlds and Alphaworld in particular are the closest to the vision of the virtual city currently online.

The future virtual city is however still an unknown entity. It could be planned or unplanned although due to the size and nature of digital space, vast unplanned sections are the more likely. This is of course in direct contrast to the utopian vision of the planning system. Regulated frameworks such as the UK Town and County Planning Act (1947) have led to the current urban fabric. Yet to examine how virtual cities will develop and to provide a glimpse of the future planning system, one only needs to look back to the Garden City movement of the 1890s. Ebenezer Howard's publication in 1898, entitled 'To-morrow: A Peaceful Path to Real Reform, and later reissued in 1902 as 'Garden Cities of To-morrow' details his vision. Howard (1902) proposed that there should be an earnest attempt to organise a migratory movement of population from our overcrowded centres to sparsely-settled rural districts. In essence it was a merging of town and county to create a sustainable urban neighbourhood, typified by Howard's illustration of the three magnets which we illustrate in Figure 7.4.

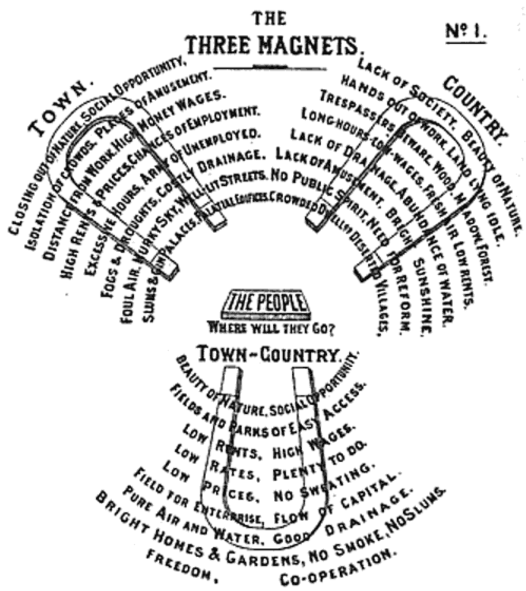


Figure 7.4. Howard's (1906) Three Magnets for the 21st Century.

If there were three magnets for a new town/city of the 1900's, then in the 2000's, it is envisaged that there will soon be a fourth magnet, a digital magnet of Cyberspace and Cyberplace.

From the resemblance of Letchworth in the Ground Zero of AlphaWorld to the towns of the Garden City Movement and the Utopianists of the 19th Century, this kind of cityscape both in structure and ideology is being mirrored in virtual worlds. In addition is the blending of the original 'Wired City' ideology of the 1960's with the emerging 'Virtual City' of the late 1990's. The wired city is increasingly moving towards the city in the wires.

7.3 Digital Hamlet: 30 Days in ActiveWorlds

To take this near fiction a little further but to show how virtual environments can be developed, we will provide an account of how a virtual world can be established. The ideology behind '*30 Days in ActiveWorlds*' was to fully document the development of a virtual environment from beginning to end, from the point where a plot of 'virgin' virtual land would develop into a community and fully-fledged virtual city. No specific guidelines on building or social laws were built into the system and this ensured that a 'frontier' culture would develop. The aim was not to create a dialogue of life in the virtual environment, such as the well-documented My Tiny Life by Julian Dibbell (1999) or The Cybergypsies by Indra Sinha (1999), but to explore how the world actually developed. Over the period of 30 days, a strong social structure developed producing a community and range of social actions that are now part of the history of virtual worlds and their documentation (Hudson-Smith, 2001). Such social status is central to the development of virtual cities and their utilisation for digital planning.

The title *'30 Days in ActiveWorlds*' stems from the free trial software of the ActiveWorlds server which allows users to host their own world. The trial software operates for 30 days before timing out, enabling users to set up and run their own worlds and small communities before having to purchase a full server from AW. *30 Days in ActiveWorlds* was based around the Collaborative Virtual Design Studio running on an ActiveWorlds server as we described in Chapter 6. The server - a P16XE - permitted 16 users to simultaneously log into the virtual environment and build on 1,000,000 square metres of virtual land. On the strength of a submitted proposal, Circle of Fire, the company owning ActiveWorlds, donated an additional 2,000,000 square meters of land and 16 additional users to the project, essentially creating a plot of virgin land 3,000,000 square meters in size, capable of holding up to 32 simultaneous participants.

A simple entry plot of land was constructed at 0N-0E, known as Ground Zero. Billboards were placed around Ground Zero with the Uniform Resource Locator (URL) web site providing details on the project. For users with appropriately configured browsers, the web site loaded automatically when the user entered Ground Zero. Figure 7.6 illustrates the loading location at Ground Zero.

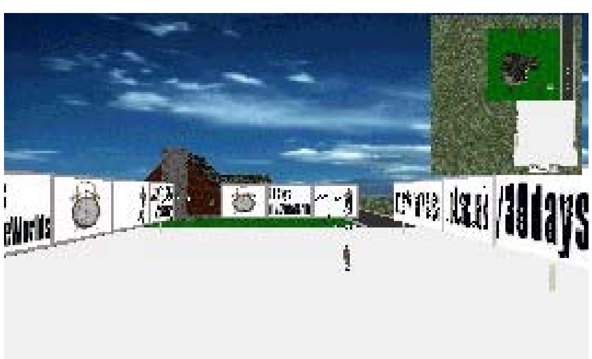


***Figure 7.6. Ground Zero, the Entry Point of* 30 Days in ActiveWorlds.**

Additional to Ground Zero, a builders' yard was constructed providing all the objects - 368 in total – with which users could construct any kind of structure within the world server. The objects were the standard set used within the ActiveWorlds system and included a range of walls, windows, doors, furnishings, and landscape items. Additional self-modelled objects were added during the second phase of the project. Figure 7.7 illustrates a view of the builders yard from 69N-69W.

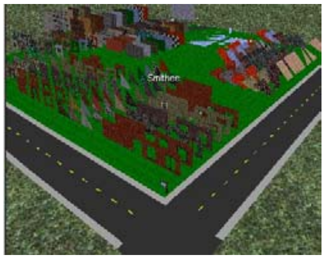


Figure 7.7. A section of the Builders Yard, 69N-69W

Full details of the project were provided via a web site, with the site providing extensive pages aimed at the 'newbie'-user, thus illustrating how to build, communicate, and move in the virtual space. All users were made aware of was that all conversations and buildings would be logged while users were within the world.

The author was represented at all times in the world as 'Smithee' using the avatar known as Butch which is illustrated by Figure 7.8. Avatars names and styles are predefined as part of the ActiveWorlds system. The avatar was kept consistent throughout the project to ensure that users would become familiar with the 'World Owner' but it should be noted that the Butch avatar was also available to all registered ActiveWorlds users.

Figure 7.8. Smithee's Avatar.

Tourists were provided with a choice of two avatars, either male or female. In addition to the author's avatar, a web-cam was set up, streaming images of the author to a large placard above Ground Zero. The web-cam added a human element to the project, images being updated every 3 seconds. This *CVDS* was the first world to open up without any guidelines or laws. The aim was to see what people would build if they were allowed to build anything they wanted. Allowing users to create their own utopian structure, the project was aimed at examining the structure of the environment produced. We did not know whether the environment would be low density, reminiscent of a Garden City or a more grid-like structure comparable to Manhattan. It was also set up to examine the type of housing which people built from high-rise towers to log cabins. The range of objects in the builder's yard allowed users to be creative and thus have a free rein in the design and structure of the environment.

Other worlds in the ActiveWorlds Universe have strict guidelines on what can by built, where, and by whom. Systems can also be put in place to filter out certain words or phases, resulting in ejection if guidelines are breached. Dodge and Kitchen (2000) view ActiveWorlds as being more akin to a theme park with entry as long as you comply with the various restrictions. As a test of the world and its open build philosophy, the server was left open to the world overnight, two days before the launch. Upon arriving at work and logging into the world two large signs were discovered, placed by an anonymous-user just above Ground Zero. The first sign had an image linked in from a sex orientated web site, and the second sign was text linking the image with my mother. With the world set to go live on a university server and the work being covered by the Times Higher Education Supplement, such developments were not regarded as encouraging although they are an essential part of emerging virtual cities. With environments in which users are allowed a free rein as in *30 Days in ActiveWorlds*, a certain amount of unsocial activity is to be expected. When such environments are used for e-government or digital planning, a series of user rights must be imposed on citizens, delineating certain restrictions on areas which can be utilised for building or on words and phases that are forbidden.

7.3.1 First Steps

The space that makes up the ActiveWorlds Universe is sparsely populated with, on average, 0.5 users per world. To get a world noticed and populated, there needs to be a 'hook'. There is no point in launching a world if no one comes to build which unfortunately seems to be the case in most areas within the ActiveWorlds Universe. There is a saying on the web, that 'if you build it, they will come' (taken from the movie 'Field of Dreams'). However in virtual worlds, this is not necessarily true, especially if you want others to build the world. To achieve this aim, a building competition was set up and a prize of one year's free citizenship to ActiveWorlds offered for the best design in the world. The fact that the prize was a 'citizenship' opened up the world for 'tourists' to build. Tourists are users of ActiveWorlds that have not paid their $19.95 annual fee to become a citizen. This leaves them as something of a 2nd class participant, for many worlds ban them altogether, and even where they are allowed to build, their buildings would not be guaranteed to remain intact at the end of each session.

Actively encouraging tourists into the world allowed them to compete for citizenship status, safe in the knowledge that the world was logged, and backed up every night in case of any crime or vandalism. It also aimed to achieve a level of integration which would change the social dynamic, a feature that exists in other worlds by giving tourists equal status. Equal status was achieved to a certain extent in that both tourists and citizens were allowed equal rights in where to build, but some aspects of segregation were 'hard coded' into the software. Tourists, for example, are limited to the choice of two avatars in the world, compared to the normal choice from over twenty. This instantly makes them recognisable; the normal 'tourist' avatar is a male or female avatar with a camera around their necks, with sunglasses, thus displaying a typical 'tourist' appearance. To get around this, two avatars were designed to blend more into the overall environment. By losing the cameras and giving them a more standard appearance, the tourists in *CVDS* were more easily able to integrate with fully paid up citizens.

The launch of the project consisted of Princess Tia, a citizen of ActiveWorlds, and myself standing at Ground Zero, looking up at the web-cam which was streaming a video image of myself, displayed at 50 feet above the central area. An advert was placed by AW in AlphaWorld, the most popular of the worlds in the universe, and various messages were spammed across relevant newsgroups. Princess Tia acted as a meeter and greeter, showing users around and letting them know that they could build whatever they wanted in the world. An automatic message also warned them that all conversation and building was logged. Dawny logged in from Pittsburgh, Pennsylvania around 2pm Greenwich Mean Time and acted as a tourist representative for the world. She went out into other worlds actively recruiting users to come into CVDS and start building. This gave the project momentum and more importantly started the word of mouth that would eventually create the complex virtual city (or hamlet as it turned out to be) on the Windows 95 server in the corner of my 'real' office.

As part of the website, a daily news section was set up to document the major events in the world. This site also provided images of the buildings constructed on each day and displayed a map of the world constructed so far. Over the first 24-hour period, the world experienced considerable development with 7219 objects placed. The amount of growth was surprising from the point of view that most worlds are sparsely populated: *CVDS* had overnight become the third most popular world in the AW Universe. It also provided interesting items on the news page and introduced users (or avatars) that would become regular visitors over the course of the next 29 days.

It is interesting that a number of these points are also applicable to virtual cities such as neighbourhood watch and policing, and we will examine these later.

The main vandalism experienced in *30 Days* occurred during day 4 when during a four-hour period, the world was substantially vandalised by a user logging in under a tourist account. The tourist logged in a number of times using differing IP addresses, placing over 85,000 separate objects on the world. The level of the vandalism was significant, even resulting in the incident being sited as a news item on TescoNet, Excite, Press Association News and BBC Online. The vandalism occurred during a period when the world owner was logged out, leaving users in the world at the time powerless to do anything but stand by and watch. If the owner had been logged in, the offender could have been ejected from the world as a result of privilege powers granted to all world owners. Regular users and tourists do not have the power to eject other users, resulting in them being essentially powerless in the world. The vandalism placed considerable pressure on the world server resulting in a lag in conversation, updates, and movement for users, due to the number and density of the objects placed. The text below, taken from the log files, documents Klassis, a builder in the world, deleting objects in the context of server lag, or 'doop' as it is referred to in the text (note spelling and abbreviations have been left as typed in all conversational text):

Klassi: !7.000 walls I have deleted
GOLDENGIRL: everytime hacker comes and starts building everyone gets dooped
Wondr: how so dooped
GOLDENGIRL: really good girl your so nice
Klassi: Nothing gets me off, apart from sleep
GOLDENGIRL: klassi meet wondr
GOLDENGIRL: he is really nice guy
Wondr: hi
Wondr: tanks GG
Wondr: thanks also
Wondr: I think we nee to more selective who we invite into our world
Wondr: need
GOLDENGIRL: yes i agree a tourist did this klassi and i was watching him do it
Wondr: F'ing assholes
GOLDENGIRL: everyone else got dooped computer not big enough
Wondr: how is what computer mot big enuff
Wondr: the teleprt is still working
GOLDENGIRL: today when i was here i noticed the server getting very slow then i saw hacker deleting stuff there were lots of people here they got dooped i didn't
GOLDENGIRL: they thaught it was the web page
GOLDENGIRL: but when he showed up again tonight there were 7 people here and i was the only one left
GOLDENGIRL: everyone disapeared

The text illustrates the frustration felt by the users logged in and watching the vandalism take place. The level of the vandalism eventually slowed the server to such an extent that the world no longer accepted citizens during the object placement. Thus GOLDENGIRLS final comment: "everyone disappeared".

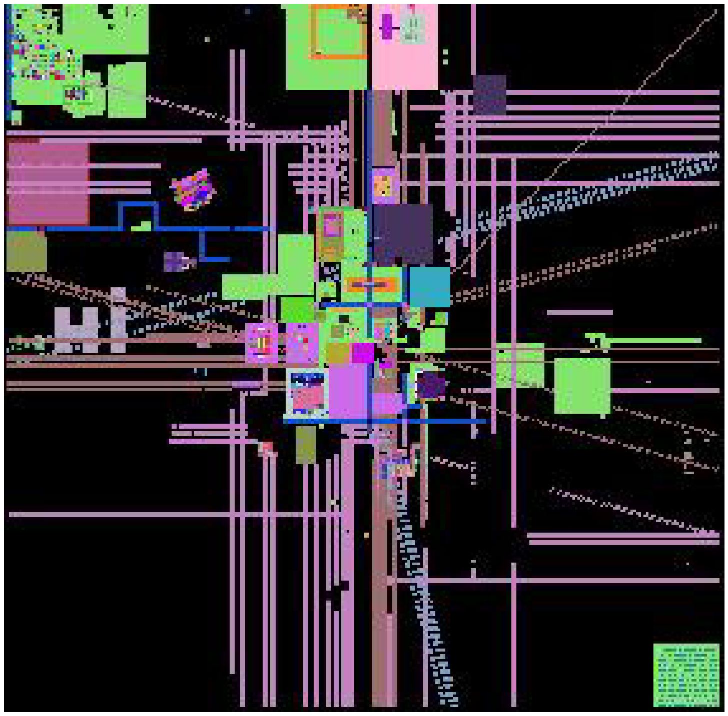


Figure 7.10. Vandalsim using 'Hambot' during Day 4.

Figure 7.10 illustrates the extent of the vandalism. The lines extending are dense clusters of cloned objects built using HamBot. Although no land belonging to registered citizens was encroached upon due to the registry, tourist objects were built over and the vandal made use of the free areas of land to build as much as possible before the server 'dooped'. The vandalism resulted in the server being shut down while the world database, known as a 'propdump', was cleared using deletion queries based on the tourist's logged IP address. A survey of the damage carried out was undertaken once the world server was reopened. The survey revealed that citizens' buildings were intact but a number of tourist-based constructions were deleted as a result of being encroached during the vandalism The deletion of some tourist objects resulted in a strong reaction within users of the world as the following logged conversation over-page illustrates.

Stick, the user who suffered the most deletion ends with the comment: "it wasn't much but it was home (sniff)", a comment which illustrates the personal attachment that the user had with objects he/she had built in *30 Days*.

"Stick": Will my work from yesterday be restored then or is it permanently lost because I'm a tourist?
Smithee: let me try
"Stick": Smithee - I've been adding a bit everyday because I don't have five hours to spare everyday. There's no point taking a screenshot of a half built place
Betty B: you don´t have to Stick
"Stick": Go on?
Betty B: this vandal
GOLDENGIRL: Smithee u need a sign to tell people that they dont have to delete vandel stuff that u will take care of it or u will loose them
"dogma": i stll dont understand but what is the point of a vandal/
Betty B: so better build far away from gz
"Stick": So? My place is already gone
Smithee: ok I'll put a sign up at gz
"dogma": i mean as i said i an new and i cant even believe that there would even be such a thing as vandalism
"Stick": OK. I'll start again miles away
Smithee: stick where was your house?
"dogma": its rediculous
Betty B: build a new one miles away Stick
"Stick": 14s 18w
Smithee: ok going to look
"Stick": Ta
"Stick": Big walls in the sky over it now. Only two little bits of the front wall left
Betty B: sheesh
"Stick": It wasn't much, but it was home (sniff)

The world continued to grow without any further incidents of vandalism until Day 9 when a tourist known as Jero logged into the world. Jero attracted the attention of Betty B, by then a core member of the

community, asking questions about the vandalism incident from Day 4. It became evident from the nature of Jero's conversation that he was involved in the vandalism. Jero admitted that the vandalism on Day 1 and Day 4 were carried out by the ActiveWorlds Terrorist Group, attacks apparently carried out on his orders.

A series of further threats were made and a message was posted to all users indicating that the world was on 'Def Con One' status with a new attack imminent. While Jero was logged on talking to Betty B, a trace was carried out on his IP number and Circle of Fire informed of the threat. As a result of the IP trace, Circle of Fire contacted the Internet Service Provider (ISP) of the tourist logged in as Jero and obtained a telephone number. The information was provided by the ISP due to the number of complaints that Circle of Fire had received from a series of reoccurring IP numbers. Circle of Fire contacted Jero who turned out to be a 15-year-old boy in Vancouver, Canada, and issued the threat of legal action on Jero's father. The time period between the initial contact with Jero and Circle of Fires legal threat was 3 days: a sample of conversations with Jero over this time period illustrate the reaction of citizens and the threats of further attack.

Day 9
Betty B: but why hurt innocent persons?
"Jero": You can eject me...... and ban me....I know a way around that, to get back in
Smithee: esp reserach projects
Smithee: theres always ways
Smithee: so i wont
Smithee: no point
"Jero": even if I am banned......I get back in..... :) (called IP\Domain Spoofing)
"Jero": 85,000 are you sure....... I thought only 40,000
Smithee: nope 85
Smithee: counted them myself
Betty B: so the tourist are upset
Betty B: what did they do to your group?
Smithee: this a free open world
Smithee: so tourist are welcome
Smithee: now if thats not open policy i dont know what is!
Smithee: rights for all i say!
"Jero": listen...... your just lucky the world is still here.... lol

Day 10
"Jero": I am not to pleased about yestrday....CoF calling my ISP........
Lorca: hahahahah
Princess Tia: hehehee
Smithee: lol
Smithee: I think the worlds on defcon 1
Princess Tia: defcon1?
Lorca: brb

Day 11
"Jero": Smithee...... sure..... I know you fear me..... i smell fear
"Jero": bye now.... be back soon
“Jero": 239 new mails.......
"Jero": I keep getting this junk mail....from the UK...... I banned the addess, also more than 3 mails from one IP is deleted, or with no IP
"Jero": do you understand?
"Jero": you upset the wrong person
Smithee: yeah yeah
"Jero": that’s all I’ll say
“Jero” has been ejected from CVDS

The log of day 11 was the last time a user known as Jero entered *30 Days*. His final comments indicated that he was turning his attacks towards Smithee, the world owner.

Hints of being able to ban IP addresses in the UK and the final comment of 'you upset the wrong person' were the closing act of Jero but within 30 minutes of Jero being ejected from the world, all internet and email access was lost from Smithee's machine. Entry was gained via the machine's personal web server and all network protocols deleted from the system files. The machine remained offline for 5 hours.

7.3.3 Digital Coffee – Community in 30 Days

Community is central to the development of all virtual worlds, whether they are purely text-based systems such as LamdaMOO or three-dimensional virtual worlds like AW. A system will either thrive or decline according to the size and enthusiasm of its community - and *30 Days* was no exception. By the 3rd day a group of 8-10 users were becoming regular builders in the world.

Figure 7.11. Group of Avatars at Ground Zero of '30 Days in AW'.

Figure 7.11 illustrates a group of the users participating in *30 Days*. The screenshot was captured on the final day of building by which time a core community was firmly in place. The names on the image are difficult to decipher but the users, as in real life, can be identified from their appearance alone. Dawny adopted the 'Tanya' avatar with long flowing red hair and the rather 1970s green dress. Betty B on the other hand chose the 'Rachel' avatar with blonde hair tied in a ponytail. Lorca always logged in as 'James' and Stick chose 'Hotep', walking around the world in his Egyptian outfit. The users had over

20 avatars to chose from and each person adopted a certain look, essentially recreating their own identity in the virtual world. In more populated worlds, the restricted choice of avatars limits the ability to choose an avatar that represents one's identity, but in *30 Days* with its 8-10 core users, each could have their own look.

Nevertheless the limited range of avatars can be restricting compared to text-based virtual worlds. For example, in LamdaMOO users create their own identity through textual expression, allowing each to create their own unique personality in the environment. *30 Days* allowed the avatars to become associated with each person and in a sense each avatar began to resemble a friendly face when entering the world, or walking in on one of the social gatherings that took place. The exception to each person's use of a fixed avatar was National Butch Day organised by Stick. Stick organised the day via a series of email and telegrams informing users that they were required to adopt the Butch Avatar for the duration of day 20. Butch was selected because he was my chosen avatar identity in the world. I was blissfully unaware of the nature of the day until I logged in as usual and found a group of users around Ground Zero all looking like me with the Butch avatar! My initial confusion, not having recognisable faces to identify, was greeted with much amusement and provided the opportunity for numerous Smithee impersonations by the members of the community. Much more analysis of the social patterns from this community could be developed. Although it is important to the development of virtual worlds for this can help us understand real worlds, by analogy, our focus here is on techniques and the opportunities for real community participation and digital planning.

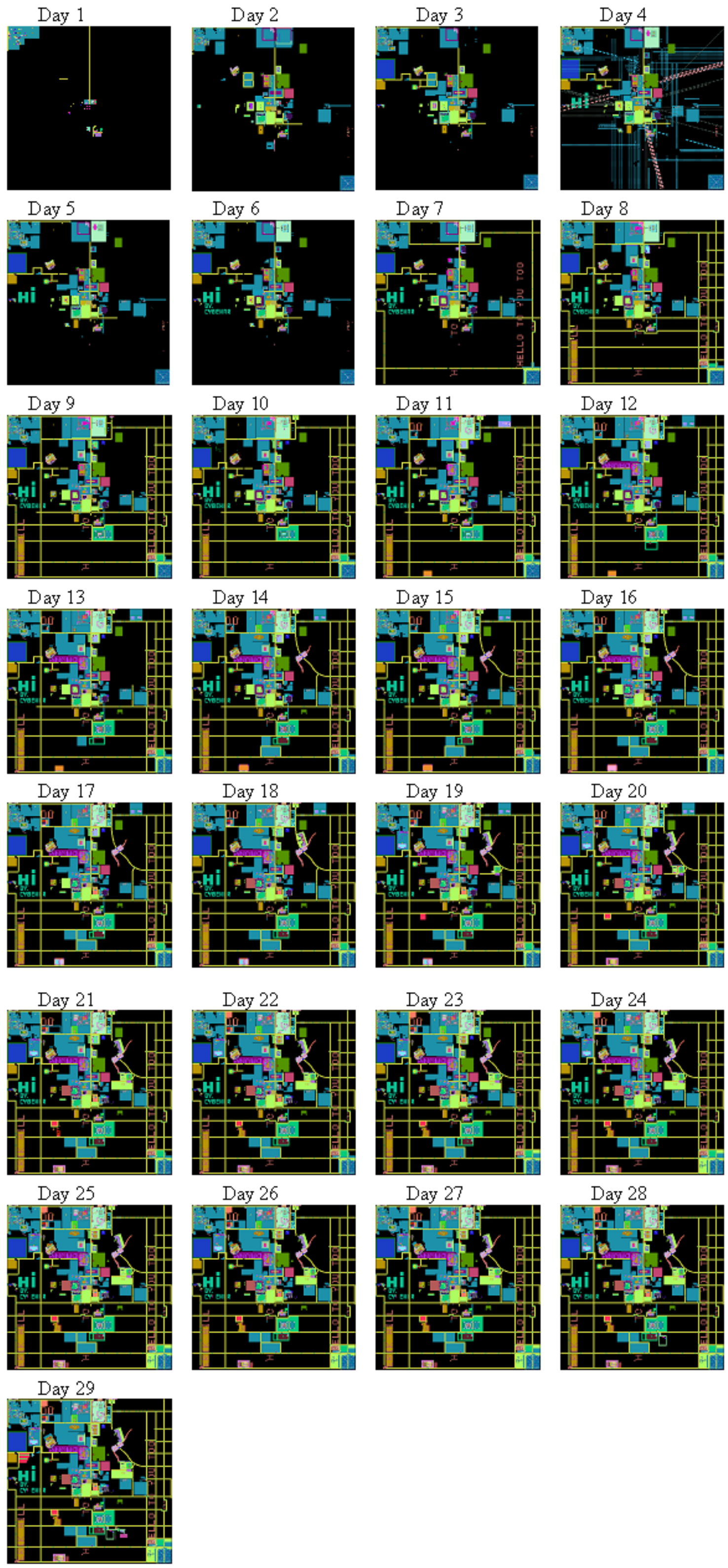


Figure 7.12 Maps Illustrating Day 0 to Day 29.

7.3.4 Spatial Development

The only sections of the world that I personally created in '30 Days' were Ground Zero and the Builder's Yard. By the end of day 30, 27699 objects made up the world, placed by 49 registered users and an unknown number of tourists. The world was mapped every 24 hours using third party software and posted to the news page online. Figures 7.12 and 7.13 illustrate the world's growth from day 1, before the opening to day 29 and day 30 respectively.

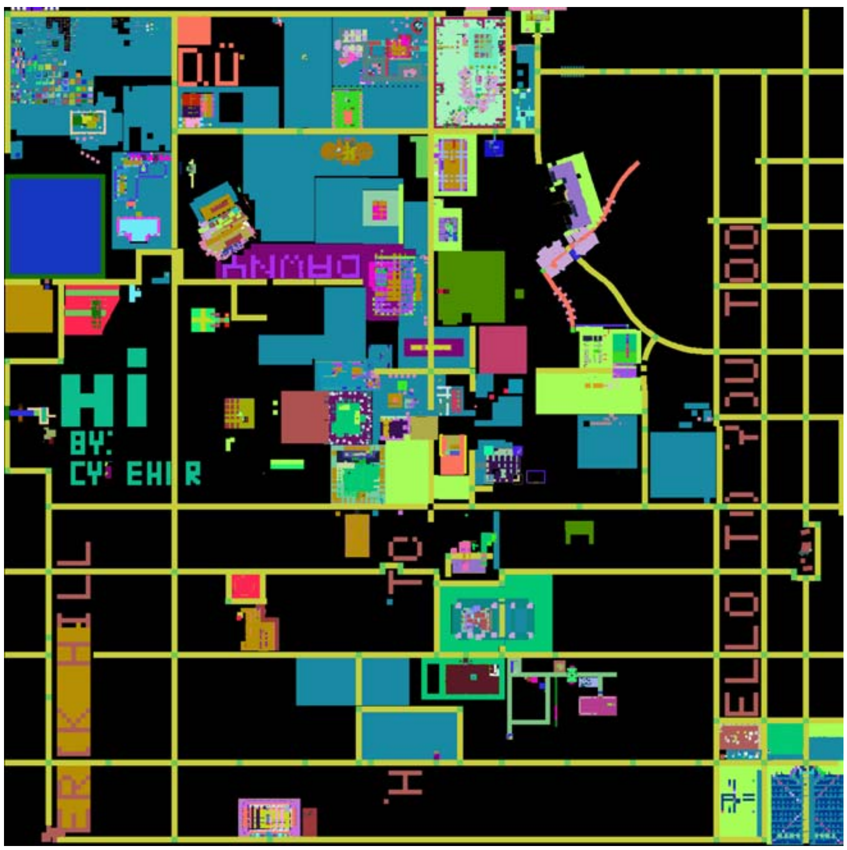


Figure 7.13 Map of Day 30.

The first 2 days experienced rapid growth with 8115 new objects being placed in the world. As Figure 7.12 illustrates, the majority of this growth was based around the central district with people claiming land to be developed at a later date. Much of this building was two-dimensional, the laying of vast areas of grass or paving aimed at claiming the prime real estate around Ground Zero. The claiming of land also took place to the north of Ground Zero on the edge of the map (illustrated in blue). This is a result of users following the road that lead to the Builder's Yard claiming land along that route. After the second day, building continued at a more linear pace with, on average, 753 new objects added each day. Figure 7.14 illustrates the growth of the world from day 1 to day 30.

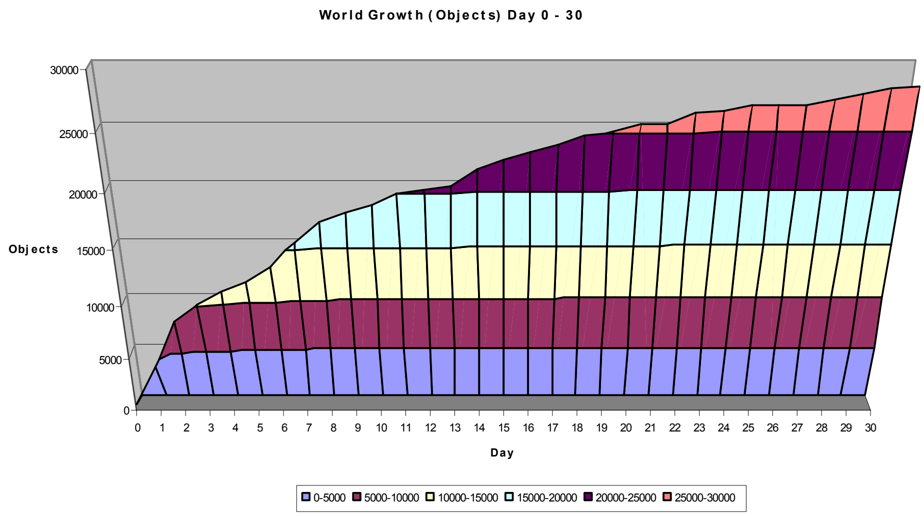


Figure 7.14 Charted Growth of the World, Day 1 to Day 30.

Once the initial land was claimed, building took more of a three-dimensional nature. Figures 7.12 and 7.13 only illustrate a top down view of the world. Using third party software, it is possible to map the world to view the z-axis of growth. Figure 7.15 illustrates day 30 with an illustrative zoomed area showing a section of the world. Is should be noted that this is an object map for the world with colours assigned to various object types; it does not represent the actual buildings.

The world consisted of a number of houses, nightclubs, museums, bars, health centres and even a lovers' lane, complete with an adjacent motel. The majority of the structures mirrored reality or rather a utopian view of reality. The world consisted of a number of country cottages with long, tree-lined paths leading to rustic front doors and into open spaces with a roaring open fire complete with sound effects. Wooden American-style lodges are also prevalent, standing side by side with glass skyscrapers and floating castles. The placement of American style log cabins harks back to the initial building when the AW Universe first opened. As Schroeder et al. (1998) state, the early buildings in ActiveWorlds were like log cabins, owing more to the television series 'Little House of the Prairie' than to imagined 'cyberspace', *30 Days* seemed to be mirroring this frontier philosophy as we illustrate through a sample of the buildings in Figure 7.16.

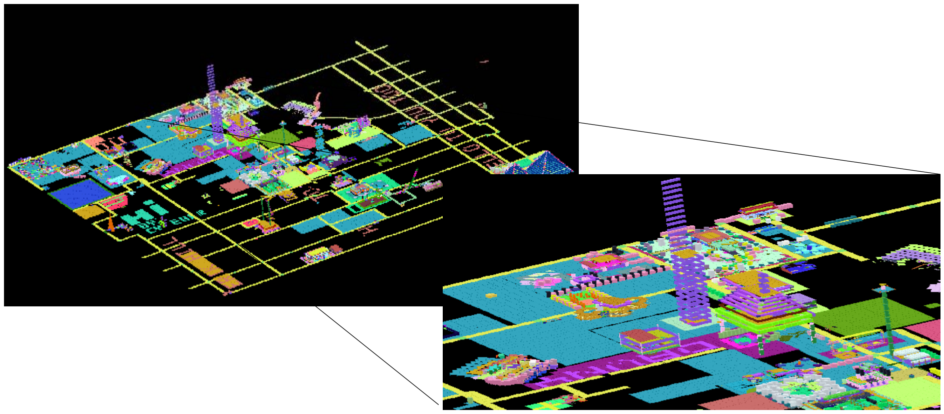


Figure 7.15. Map of day 30 Illustrating the Z-Axis of Building.

Cubist style house built by Betty B

Interior of Betty B's house

Hotel constructed by a tourist

Wooden Lodge by Princess Tia

Figure 7.16. Sample Buildings from 30 Days in ActiveWorlds.

The majority of these structures have doorways, windows, and flights of stairs or escalators. Yet in the virtual city, there is no need for doorways or stairs as avatars can walk through walls and fly up to reach new floors. Indeed, the navigation system of ActiveWorlds makes the climbing flights of stairs notoriously difficult with the avatar often getting stuck and being forced to fly. Stairs, doors, and chairs (avatars are unable to sit) are all part of the standard set of objects, and this has a direct influence on the structures built in the world.

ActiveWorlds can be seen as a huge construction set with a set number of objects. In addition to the nature of the objects, there is the widespread inclination of users to create structures that mirror the real world as much as possible, given the constraints of the system. An example of this is the Dark Night Bar. The bar has a gents' toilet, complete with urinals, washbasins and a mirror. None of the objects are there for obvious or functional reasons but they add to the level of immersion in the world. Similarly, there is the grid-pattern road layout that criss-crosses the world. The road network was mainly developed between the 6th and 10^{th,} day clearly aimed at influencing the development of the world and extending its development along the newly placed highways as illustrated in Figure 7.12. This was a highly labour intensive exercise, especially when one considers that there are no cars or vehicles in ActiveWorlds.

Part of the reason for the construction was that people knew that the world was mapped every 24 hours with a new image placed on the website's news page. The prospect of seeing one's creations mapped led to a spate of incidents known as satellite writing (see Figure 7.12). Satellite writing is text that although indistinguishable from the ground, appears when the world is mapped from above in the same manner that the Nazca Lines in the Peruvian Desert are only discernible from the air. Mapping the world each night was like taking a satellite view of the world as it developed, and this revealed structures that could not be seen from the ground. The first words to appear were 'Hi' on Day 6. By day 7, the words 'By Cyberhar' had been added. Cyberhar was also the architect of the CyberHar Castle and an Alien (made out of coloured glass) in the northern reaches of the world.

All of these structures were lone creations. Lovers' Lane was the only creation in the world that engaged the whole community. Lovers' Lane was set up by Dawny and her real life partner Ken as a romantic area of the world where love poems, and more importantly photographs of partners, could be posted. With input from the community, this transformed into an area where pictures of persons generally (not just romantic partners) were displayed, and it provided a focal point for members of the '30 Days' community to find out about each other. The photos even extended to images of people's pets, family and friends, essentially providing the world with a human face.

Lovers' Lane was a section of the world built by the community for the community, whereas Stick was working on his own building project for the benefit of an external community. Stick's Community Church was built specifically for the purpose of prayer in '30 Days'. The Church resembles a Victorian style English Christian Church, complete with bell tower, stained glass windows and a church organ. Although built in '30 Days', it was not aimed at the internal community. Instead, it was built for the youth section of the Alpha Church, based in Brompton, (London) specifically for the Sunday School section. The churches name 'Alpha' and it closeness to AlphaWorld was purely coincidental, but allowed it to fit seamlessly in the AW Universe. It was actively used for meetings, and represents the only structure in the world that served a purpose outside the virtual environment. The external and internal structure of the church is illustrated in Figure 7.17.

It is also worthy of note that although it may seem that a church in '30 Days' could not portray any of the features of a real world church service, it is a sign that the community was coming of age. Virtual churches are a factor in many virtual world communities and as a service, they tend to appear when the community has matured. Schroeder (1997) in a study of virtual religion, notes that a prayer meeting in a virtual world may not provide the same type of religious experience as a conventional church service, but it certainly reproduces some of the essential features of the latter – albeit in novel ways. With the inclusion of a church, a range of small shops including a supermarket and a hairdressers built by Betty B, and a public house, the environment can be seen to represent a digital hamlet. Whilst hardly a virtual city in the sense of its size and density of both its population and services, it does however detail the traits of how such a virtual city can develop spontaneously, without top-down planning.

External view of the church

Internal view showing avatar in the church

Figure 7.17. Alpha Church in 30 Days in ActiveWorlds.

As it stands, the environment became part of the wider ActiveWorlds universe, interlinked via a series of teleports, 48 in total, which we illustrate in Figure 7.18.

The teleports were mapped according to their start and end co-ordinates illustrated by a linking circle. Circles intersecting with the outer limit of the world's sphere represent teleports to other worlds in the ActiveWorlds Universe. A total of 32 teleports linked in other sections of the ActiveWorlds Universe with *CVDS*. In this sense, *30 Days in* ActiveWorlds can be viewed as a satellite hamlet, similar to Howard's concept of Satellite Cities which typified the Garden City movement as pictured in Figure 7.19

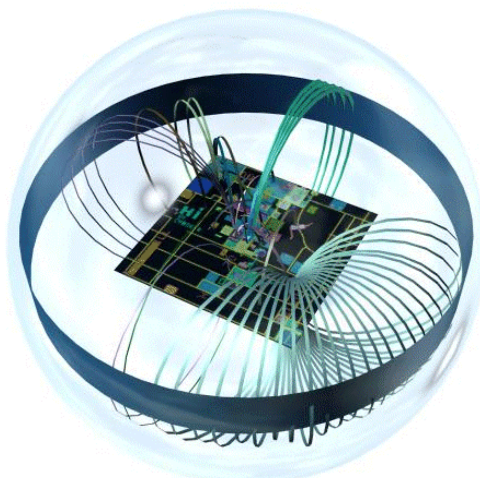


Figure 7.18. Graphical Depiction of Internal and External Teleports.

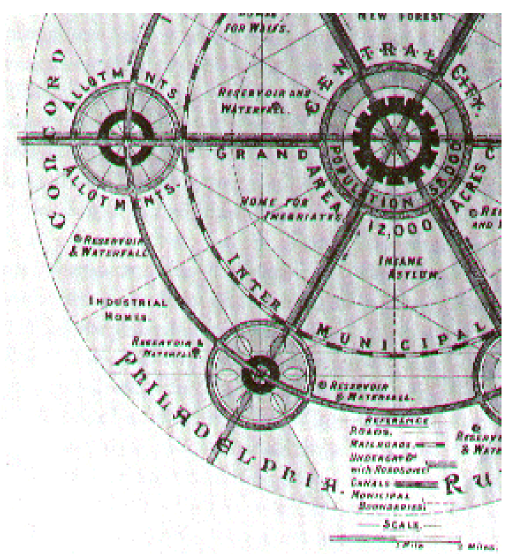


Figure 7.19. Section of Ebenezer Howard's Satellite City Network.

Howard's satellite, or social cities as they were also known, were planned to develop into vast planned sparsely populated agglomerations, extending over time without limit (Hall, 1998). An Inter-Municipal Railway, a rapid transit section allowing a high quality transportation network, would connect each city. Teleports in the virtual city can be seen as the virtual equivalent of Howard's Inter-Municipal Railway, connecting each virtual city, world, or in our case, hamlet to one another.

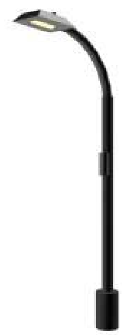
7.3.5 '30 Days II' and beyond

From the outset, the fate of this world after the '30 Days' was clearly stated on the web page. It was in the path of an incoming asteroid and would be destroyed. This linked back to events in the first ActiveWorld, AlphaWorld, which was similarly wiped out in a cataclysmic event. In reality of course, all that would happen would be that the server next to my desk could be reset and the world's filespace utilised for other research. However towards the end of '30 Days', members of the community made it clear that they wanted the world and its community left intact. Due to its success in gaining media attention, Circle of Fire granted a free one year's licence to enable the world to be kept running. This extension was marked by the launch of *30Days II* in which it was planned that rather than using the existing object set, users could build their own objects and import them into the world. A web site was created and linked to various 3D software packages and information about making objects for AW, a task that is by no means easy. A new prize was placed on offer - a CD-Rom version of AW (value $50) - which allowed high-resolution textures, and the world to be continued to be mapped and logged. The import of external objects into a virtual environment is crucial to digital planning, a technique which we have covered with regards to ActiveWorlds in Chapter 6. These objects such as the range of housing types developed in *Shared Architecture*, have been modelled in high-end software packages. Software provided via the webpage was shareware and therefore free to use although it was also specifically designed for ActiveWorlds object creation. The webpage specified that objects of street furniture would be accepted into the world to enable issues of urban design to be explored around Ground Zero. However only four objects were submitted. We illustrate these in Figure 7.20.

Park benches

British style postal box

Water fountain



Street Lamp

Figure 7.20. Street Furniture Objects Submitted as part of 30 Days in ActiveWorlds II.

The low number of objects illustrates the difficulty in making custom objects. A high level of expertise is required to build objects that fit in with Brutzman's (1997) criteria for graphics internetworking. The objects submitted became available to all the users of 30 Days II and as such became part of the street level environment. The street lamp was the main object to be taken up by the citizens as an object used to line the gridded road system.

The number of users of the world began to decline during *30 Days II* and due to other commitments, it was not possible for me to stay in and monitor the world to the same extent as during the original project. Eventually the world come to be populated by only 2-3 users at its peak. The world therefore became another empty world in the ActiveWorlds Universe and began to resemble a ghost town, a feeling that is present in many areas of ActiveWorlds. The 'ghost town' effect may also be seen as a symptom of the frontier philosophy in ActiveWorlds. Population levels in newly created worlds tend to be higher as people are attracted by the ability to take part in a new project. Once a world has grown and land has been claimed, people often move on in search of the next virgin plot to build on, leaving behind them a virtual ghost town.

30 Days saw rapid growth, initially in the physical structure of the world and then in its community. Once the users had built their houses, nightclub, etc. the world increasingly became used for socializing and the rate of building declined. The world's 'hook' was that it would be logged and mapped for 30 Days with a prize at the end, and despite the community's initial intentions to keep things running, the members moved elsewhere. Some of them moved onto other multi-user systems, such as the Everquest role-playing game by Verant Interactive. Stick continued to use the Church for a year before his membership in *ActiveWorlds* expired. Lorca caught up on all the work he had missed while being drawn into the experiment. Dawny and Ken decided to get married in the world which was set to be the first '30 Days' reunion with Stick acting as the Virtual Vicar. Unfortunately Dawny and Ken split up and the wedding never took place. Dawny recently got back in contact to let me know that Ken had died of a heart attack and asked to re-enter *CVDS* so she could see what he built in Lovers' Lane. It now stands a memorial to his work in the world. Other users set up their own worlds in the AW Universe and the central region of *CVDS* was cleared so that other research could take place on the server.

7.4 Towards a Truly Virtual City

30 Days in ActiveWorlds allowed a community to develop, and for a time thrive, resulting in what may be defined as a non-grounded virtual hamlet. The community was a success in that it attracted users who actively participated in issues relating to the environment and who downloaded information relating to their virtual space. The community was an enjoyable and informative place in which to participate, a key aspect to developing any form of community online. It was based on communication through three-dimensional space and two-dimensional text. As Hoogvelt and Freemans (1996) stated (in Aurigi and Graham, 1998), communities online grow from communication rather than information retrieval. As Aurigi and Graham (1998) also note, this could mean that a virtual city with high tech facilities, rich information, service provision and an advanced interface, could still fail to let people communicate and participate.

This is a very real risk. People need to be involved, each site requires a 'hook', and in terms of virtual cities, this needs to be a strong hook, an incentive to log-in, communicate and ultimately participate in the future of the actual physical space of the city. To this end, it is proposed that a truly virtual city should be a hybrid between a three-dimensional representation of a physical space - a grounded city - utilising techniques for modelling and distributing as explored in Chapter 6, and a non-grounded community such as *30 days in ActiveWorlds*. Such virtual cities will form as bandwidth availability and computer power continue to increase which in themselves are the very basis for the Wired City. These foreseen increases in connectivity and processing power allow access to software and information leading to an environment in which truly virtual cities can develop. We illustrate this combination of computing access and a hybrid of grounded/non-grounded virtual space in Figure 7.21.

The virtual city in Figure 7.21 would form in an avatar-based virtual world, with a series of satellite non-grounded communities surrounding the grounded city at its centre. The main communities would be able to build, as in *30 Days in ActiveWorlds*, in certain areas separated from the grounded city by a virtual greenbelt. The grounded city would be a source of information relating to the physical reality, allowing information retrieval and e-democracy relating to community issues, one of which would be digital planning. Information would be sourced from the current two-dimensional HTML-based virtual cities as well as other relevant wired organisations. The outlying satellite non-grounded communities would be social and unplanned, a space where communities can thrive. These satellite communities are the all important hook, simple to implement in terms of technology but providing the population with an interest in using the information-rich core of the grounded city. Such a population would be global as was the case in *30 Days in ActiveWorlds*.

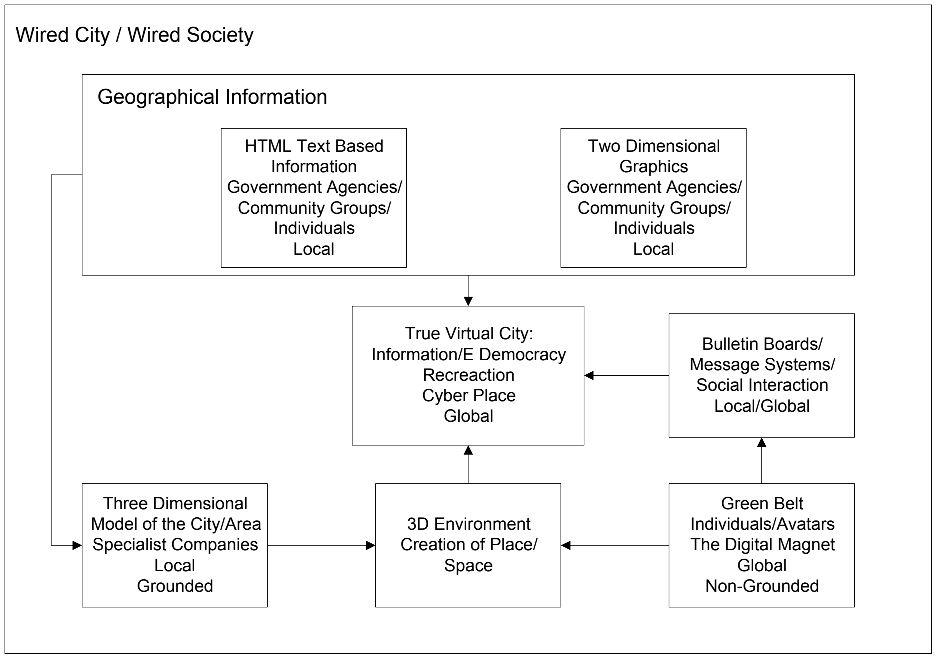


Figure 7.21. Hybrid Grounded/Non-Grounded - A True Virtual City.

This is an emerging theme as issues that were once regional, or indeed local, increasingly become global with the development of virtual representations in cyberspace. Such systems are already attracting users in their thousands as access to such technology becomes more commonplace. With more examples online, these virtual cities have the potential to become the digital magnets. People will not only be able to build, communicate and retrieve information in these virtual worlds but they will also be able to design and plan. We explore these issues more fully in Chapter 9 with regards to our *Virtual London* project. First and foremost, however, for small scale digital planning, information retrieval at a local scale and the involvement of the community using a PPSS, is essential. We move onto this next with the development of *Woodberry Down Virtual Regeneration* which illustrates how we can synthesise many of the previous tools and applications for real public participation.

CHAPTER 8

Woodberry Down Virtual Regeneration

The application detailed in this chapter relates to developing a fully operational Public Planning Support System (PPSS) as detailed in Figure 2.2. The opportunity to develop such a system came about as a result of demonstrating the previous research examples documented in Chapter 6 to the Woodberry Down Redevelopment Team (WDRT). As a result of the demonstrations, we were invited to bid for the development of WDRT website which was timed to go online at the start of the consultation process for the regeneration of the Woodberry Down area in Hackney, north east London. Before we explore the development of the site, it is worth detailing the background to the Woodberry Down project and the WDRT's views on public participation during the regeneration process.

8.1 Background to Woodberry Down

During the last decade, British local government has been dominated by problems of grappling with the issues relating to public housing, which were by and large created by those same governments two or more generations ago. The slum clearance programme and the re-housing of a very large proportion of the British population began in earnest in the 1950s and many inner cities came to be dominated by high rise dwellings under municipal control, built to relative poor standards, and housing an increasingly deprived population. The run down in this housing stock due to poor maintenance has been exacerbated by the migration of the most active and able into owner occupation, either privately or through the massive sell-off of public housing that has accompanied the demolition of the welfare state over the last 20-years. These inner areas are now dominated by a series of initiatives associated with regeneration, all of which involve frighteningly complicated sets of policies and instruments (Power, 1998). Many of these involve the financial underpinning of such actions using variants of the Private Finance Initiative in which the private sector is encouraged to provide the funds in turn for long-term ownership of what is essentially public property.

There are 1370 housing estates in England, which have been defined as 'deprived' and 112 of these – 8 percent – are located in Hackney, which is one of the poorest London boroughs. The best way of illustrating the context is through the index of multiple deprivation (IMD) which is composed of 6 indicators – based on income, employment health, education, housing, and access, with child poverty identified as a critical subset of the income indicator. These 6 indicators are weighted as 25-25-15-15-10-10 and then aggregated to form the overall IMD. When mapped, they provide a picture of the relative geographical concentration of key problems and problem estates in the country. Hackney is one of 33 boroughs in London with a population of around 207, 000 in 2001. 40 percent of its population are ethnic minorities and 60 percent of its housing is in the public or ex-public sector. As a municipality, Hackney is the second most deprived borough in England but it has the largest concentration of deprived estates in the land. All 23 of its wards are in the most deprived 10% of all wards in England (where there are 8414 in total). 9 of these are in the top 3 percent and the ward in which the Woodberry Down estates are located is one of these. The pattern of deprivation is shown for Greater London, for Hackney and then for the estates in question in Figure 8.1.

In fact the various housing blocks that make up Woodberry Down do not contain the most deprived households in the borough but in terms of the housing indicator within the IMD, this is in the top half of 1 percent of the worst housing conditions in England.

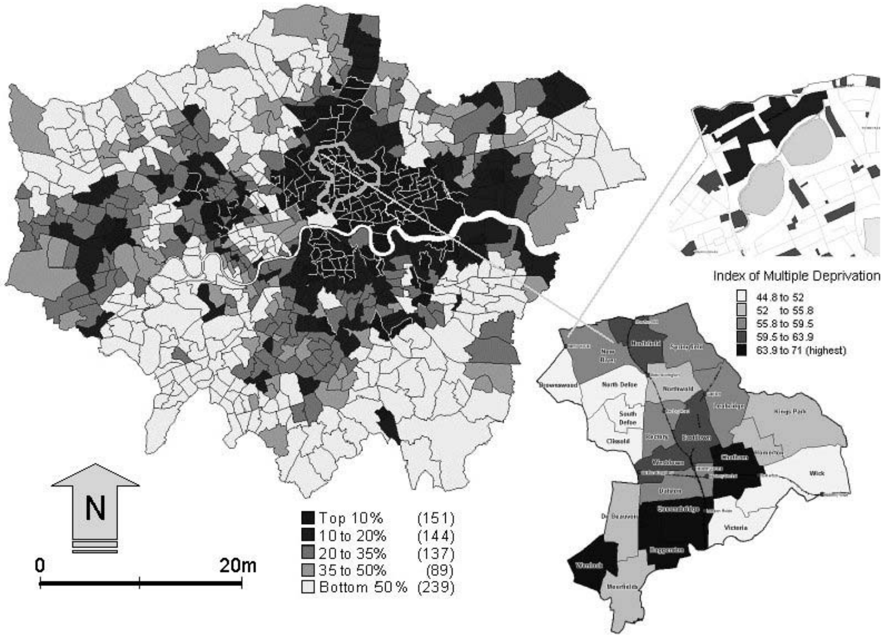


Figure 8.1: Deprivation in London, Hackney and the Woodberry Down Estates.

The Woodberry Down estates are in the Woodberry Down and Stamford Hill Single Regeneration Budget (SRB) area, the renewal projects being financed from this source of funds which is bid for competitively each year. In the wards that cover this area, more than 50 percent of all households reside in public housing and if the stock that has been sold off is added to this, then it becomes clear that the area is dominated by estates that are likely to require some substantial regeneration. We do not intend to develop an exhaustive analysis of the demographic profiles of the population for it is clear enough that the populations housed in these areas lack basic amenities. The estates in fact tend to be residual sinks for the worst-off and for immigrants in the area rather than being dominated by long-standing, aging residents. There are problems of aging of course but the key issue is one of poor housing conditions in the first instance. To provide a quick visual impression of the kind of housing that we are dealing with, we show a collage of views around the 25 blocks that make up the estate in Figure 8.2. Like so many illustrations, the real sense of how run down the area has become is hard to imagine from these photographs although there is a degree of desolation to the environment which is captured by these pictures.

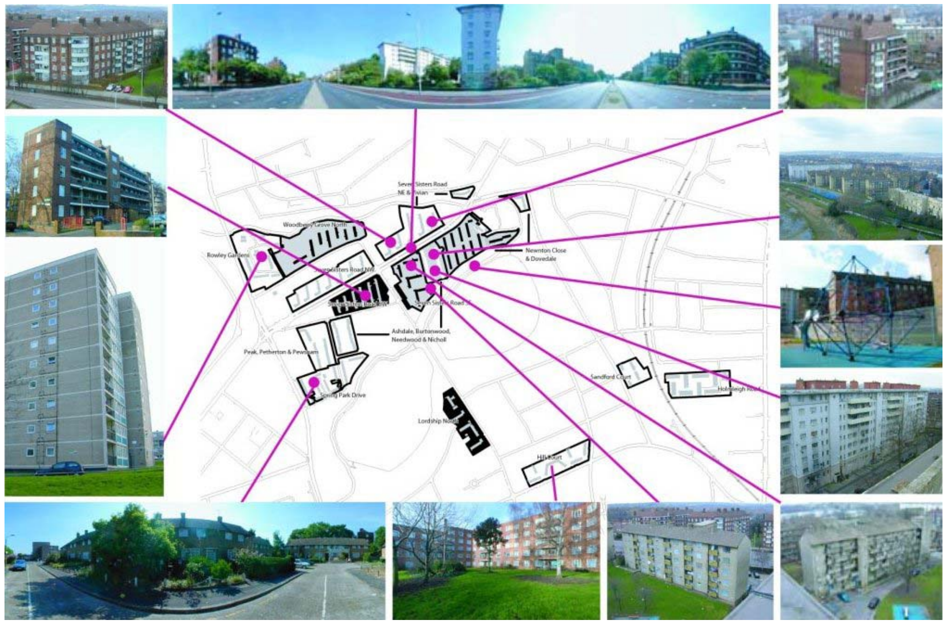


Figure 8.2: The Estates that Make up Woodberry Down.

The area, which is to be regenerated, is comprised of the estates shown in Figure 8.2 which physically cross various administrative and historically integrated, ethnic neighbourhoods. The estates were originally designed as part Herbert Morrison's vision for better housing in London and the first housing blocks were developed in the late 1940s by Forshaw as part of his and Abercrombie's vision for London. The form drew their inspiration from the Bauhaus, even appearing a couple of years ago in the film *Schindler's List*. The oldest blocks are listed. There are around 6000 residents in 2500 housing units of which some 29% are owner-occupied. The WDRT have divided the area into 18 distinct geographical areas although for purposes of resident consultation, these are currently aggregated into 14. There is considerable confusion with respect to tying the official statistics, noted above, to what actually happens on the ground and local surveys reveal that in these estates, the white population is in the minority at less than 40 percent with a strong dominance of Black and Turkish populations. These estates permeate the area of Stamford Hill, which is the largest concentration of orthodox Jewish population in the UK.

The Woodberry Down project began in 2000 with the establishment of the on-site team and the beginning of negotiations for a Single Regeneration Budget proposal for some £25m which has been successful. Currently much of the project is dominated by the negotiation of a Private Finance Initiative to find the lion's share of the cost which is estimated at some £160m over 10 years. However, the project did not get off to a good start. The WDRT were located on site in public offices that were then a local library and the conversion to the team's HQ/centre led to substantial hostility amongst the local population. The team (WDRT, 2001a) report: "Local residents are still angry that not only was their library taken away but also that the centre is, to many of them, not providing any tangible benefit or service to the estate. The WDRT believes that this is not because of the fault of the resident managers but due to the conception and delivery of this project" (page 11). In fact what this issue reveals is that there is substantial community participation and representation in the area already and the entire project is attempting to manage the regeneration through utilising this.

In the area, there are nine Tenants' and Residents' Associations with another two in the process of registering. There are six estates Committees serviced by Hackney Council and these meet quarterly. The Stamford Hill Neighbourhood Committee meets nine times a year and is attended by Council officers and local Councillors. The Council's housing stock in Stamford Hill is managed by the Paddington Churches Housing Association and there is a monthly tenants' panel that discuss management. The Estates Development Committee (EDC) which has been set up to represent the regeneration of the estate cuts across these. It currently has 27 members whose role is to liase with the WDRT and to represent the views of those affected by the considerable disruption that is about to occur as the regeneration gets under way. The process of online participation has been both motivated and endorsed by the EDC and the WDRT, and the web site reflects the close involvement of this Committee.

The WDRT have spelt out on behalf of the Council and the community very laudable and ambitious aims for the project (WDRT, 2001b). The approach of the WDRT to public consultation is refreshing; it acknowledges that the regeneration process is not solely about the area's physical reconstruction but also about improving the residents' standard of living not only in terms of environment but also in terms of education and social standing. Their approach encourages new community leadership and structures for the long-term management of the estate. They acknowledge that the opportunity exists at Woodberry Down to do things better and the website was intended to be central to this opportunity. WDRT define the use of the website in a similar fashion to the argument which has run throughout this thesis; a site which will inform residents, act as a discussion forum, and utilise the latest research in presenting images of the estates' current and future plans (WDRT, 2001a). The fact that the team were keen to utilise the latest research provided an unparalleled opportunity to develop a digital planning system into action with the full backing of all the parties involved.

The WDRT's consultation strategy was developed to address a number of issues. Firstly to follow the guidance in the DETR's Housing Green Paper (2000) "Quality and Choice: A Decent Home for All" that all local parties need to be involved in the production of a housing strategy and that authorities should set up consultative structures and be prepared to listen and empower others to play their part in delivering the strategy. Secondly it aims to address the current apathy in the resident's management of the estates to date. The team identified that that the residents take a view that the council does not listen to their views and even when it does listen it does what it wants anyway (WDRT, 2000b, page 2). Residents have thus seen little point in getting involved in the management of their estate and a feeling of distrust between the residents and the local council has developed. With such an air of disillusionment a new open strategy was required. As the DETR "Code of Practice for the Dissemination of Information during Major Infrastructure Improvements" (2000) states, very often the success of a proposed development is dependent to a greater or lesser extent upon the support and goodwill of the general public. This is a common sense point of view, yet one, which required considerable effort by the team to overcome the loss of support as a result of previous council decisions. As a result of this, the WDTR has sought from day one to maximise the resident's involvement in the project and ensure that all proposals and information are available to the public.

Before the development of the website which we detail later, all methods of consultation had been non-digital. The team had engaged in three rounds of consultation, firstly in visiting the existing estate committees and tenant and residents associations to brief them on the regeneration proposals. Secondly a comprehensive program was put into place knocking on all 2500 front doors, leafleting twice and holding 12 local meetings. Such consultation provided the basic groundwork for rebuilding the public's trust and set out to inform all the parties involved that the area was planned for regeneration. Basic principles on consultation were established early on to ensure that the trust of residents was maintained (WDRT, 2000b, page 3) these are:

- Honesty - the WDTR know that it must keep any promises it makes and keep its word;

- Reality - it easier to deal with the reality as it is now. Once this has been acknowledged, it is possible to move on;
- Open file policy - residents know they can come and look at all the information that relates to themselves even it is commercially sensitive; and
- Local, open access office - residents know they can drop in anytime in a non-hostile (counter-free) informal environment.

As we have stated, these techniques to fulfil the WDRT's principles outlined above, fall squarely in non-digital forms of public participation reaching, level 3 on Arnstein's Ladder of Participation (Figure 3.1). The process of informing the public is obviously not enough to ensure that sufficient levels of public involvement take place. In the third round of consultation, a more formal structure for public feedback was needed, leading to the establishment of the Estate Development Committee (EDC). The EDC was formed by the election of residents from each of the 14 local consultation areas with the aim of creating a group representative of the overall background of the estate. As is typical in matters of public consultation, it takes a certain type of resident to wish to take part in meetings or become a member of an elected group. In recognition of this, the WDRT have identified 6 levels of public involvement for which consultation strategies need to be tailored. The first level comprises those residents that are actually willing to take part in representing the estate on a daily basis. These are residents who would be willing to become elected to groups such as the EDC and represent the highest level of public involvement. At a second level are residents that are willing to get involved in the regeneration process through actively taking roles in public meetings and steering groups; the team estimate that there are approximately 150 residents at this level. The numbers of residents in each group is based purely on observation during the first three rounds of consultation and experience of other regeneration schemes. As such, the actual numbers are unknown but it provides a useful guide on levels of public involvement to expect and therefore instigate methods to ensure all the residents are targeted in the most suitable manner.

As the proposed level of involvement decreases, the number of residents starts to rise. This is to be expected as the majority of residents will not have either the time or the inclination to commit to the consultation process. Level three provides a mid-range of involvement with residents attending public meetings and disseminating information via word of mouth to the residents at the lower levels of public involvement. It should be noted that word of mouth is not the most reliable method for information communication and structures are in place to ensure that rumours do not hamper the informing process.

The majority of residents are at level 4 with no real interest in getting involved or attending public meetings but still wanting to be kept informed of the development changes. Within this category are residents that are unaware of the regeneration process. It is at this level that the consultation process needs to outreach and actively encourage residents to take an interest in their local environment. The team estimate there are approximately 1500 residents at this level. At the lowest level - level 6 - are residents who are at either ends of the age spectrum. The WDRT state that at this point there are barriers making it difficult for these residents to become involved but that they have the same rights as everyone else (WDRT, 2000b page 8). With 1300 residents at this level, it could be argued that digital communication would be the easiest method to reach such a demographic profile, especially the young.

To summarise the WDRT's views on consultation, they state that there must be much greater clarity about the differences, roles and purposes of public involvement, participation and consultation (WDRT, 2001a). It is accepted that paying lip service is no longer acceptable for public participation and only acts to alienate the residents as well as instigating an environment of mistrust in the whole regeneration process. The team believe that their methods of consultation represent a significant change in the way consultation is normally carried out (WDRT, 2001a). This is a bold statement which may or may not hold up to scrutiny in the long term but as a starting point, it is refreshing to see such a major redevelopment undertaken with the residents being central to the whole process. Of course such consultation requires strong leadership and a driving force behind it. We will return to this point later.

Such statements are consistent with the Government's 'Modernising Britain' campaign. The worrisome aspect of the project, like most such initiatives in Britain at present, is that it is beset by different kinds of financial bargaining. These continually threaten the scheme by throwing it off-course in terms of timing and diverting valuable resources to open-ended and inconclusive debates about showing 'best value for money'. We are currently three years in, £25m has been committed, £135m still has to be negotiated and signed off, designs have still to be prepared, and there is nothing to show for any of this on the ground where it counts. Little wonder the resident community are frustrated. We believe that the web resources we have developed at least go a little way to pushing what is clearly a tortuous process forward, and to these we now turn.

8.2 Website Development

The decision to develop an online method for participation in Woodberry Down emerged in early 2000 as result of the applications referred to in Chapter 6. The first stumbling block to getting the project up and running was within the University itself. As the website was to be developed based on ongoing research it was considered to be a consultancy project by research administration at University College London. With such a status, work carried out on a purely consultancy basis requires consultancy rates and 'overheads' to be charged. This incurred a substantial increase in cost, effectively placing in jeopardy the entire project. With the University demanding such rates to put research into practice, it is not surprising that academics only produce Klostermans' (1998) interesting prototypes. With this in mind, the Architecture Foundation was contacted as they had already shown considerable interest in the project. By running the project's finances through the Architecture Foundation who have charitable status, we were able to defray the University's 'overhead' cost and thus continue with the project. While it is understandable that Universities need to capitalise on research, it puts into doubt a research ideal and means that other routes need to be explored. Without the Architecture Foundation, the Woodberry Down project would not have gone ahead.

It was important during the development of the site that the residents felt they 'owned' the design, information, and interactive sections. It is this sense of ownership which makes 'Planning for Real' so successful. When moving to the purely digital realm, ownership it is not so easy to establish. With this in mind it was decided that the information on the site would be written by a local resident, Olwenn Martin. Olwenn was given the task of compiling information for the site in January 2001 with the aim of it being launched in April. A new logo was designed for the website by an outside consultancy which also coincided with a rebrand of the WDRT information sheets and newsletter. The EDC were fully involved in both the design of the website and the information included. To ensure that a focus was maintained, a 'web sub-group' of the EDC was formed to oversee matters.

A first draft of the website was presented to the EDC in March 2001 with the aim of introducing the basic web concept for the site as well as the proposed interactive elements used to visualise the regeneration plans. As part of this meeting, the concept of wiring the residents' homes was introduced. Throughout this thesis, we have argued that to allow people a say in the planning and regeneration process the next step is to embrace the Internet. The logical argument against this is that the people for whom you are trying to provide information too often do not have access to a computer, let alone Internet access. To rectify this we pushed the WDRT to fund a free computer with unrestricted Internet access for each of the members of the EDC. As a result of this, part of the overall funding was set aside to purchase enough computers with Internet access to enable each representative to go online. This was with the agreement that representatives would use their computer access to engage their wider community in the participation process. This decision was rooted in problems. The notion of a public authority providing residents with free computers, the fact that their usage could not be controlled and the requirement that representatives would engage those who they represented in their own homes – all these were highly controversial and debatable issues. The notion too that if representatives did not use their computer, they would be taken from them also raised difficult issues. As a result, the computers once purchased remained in a warehouse for the first 12 months of the project before the council agreed to their release. To an extent, the idea that homes would be wired when those very homes would then be demolished or refurbished goes against the grain. Yet it represents a far-reaching issue – that to replace physical infrastructure one may need to add to that infrastructure before the replacement takes place. We return to the issue of wiring residents homes later.

As we illustrated earlier in this thesis, many online resources for participation are one way; that is, interaction by users is passive, being based on rarely anything more than email and comment forms. However in Woodberry Down, interactivity - two-way communication between providers and users as well as between users themselves – is central to the process and the web site is thus configured to contain various comment forms, bulletin boards, animations, fly-throughs, and pictorial manipulations. We would maintain that the structure of this site is more robust than several of those we have examined previously in Chapter 3 in that its foundations in basic software and community interests provide a robust basis for its continued development, an essential requirement given the length and severity of the problems governing the local community.

The web site has a particularly simple organisation. Essentially there are four main types of information: *textual information* about the entire process of regeneration and the site itself, services, and related facilities; *multimedia* as maps and panoramas about the various component housing blocks which make up the estates; *design options* reflecting the kinds of designs that might be developed for the site; and a *discussion forum* which enables users to interact with the WDRT concerning any aspect of the regeneration process. Textual data forms the vast majority of information that the site is able to deliver and this is accessed as pages through various drop-down menus accessible from the home page. These menus cover seven topics: What We Are Planning, 3D Virtual Tour, Regeneration and You, Your EDC, Background and Research, Community and Services, and Youth and Kids. We show a version of the home page in Figure 8.3.

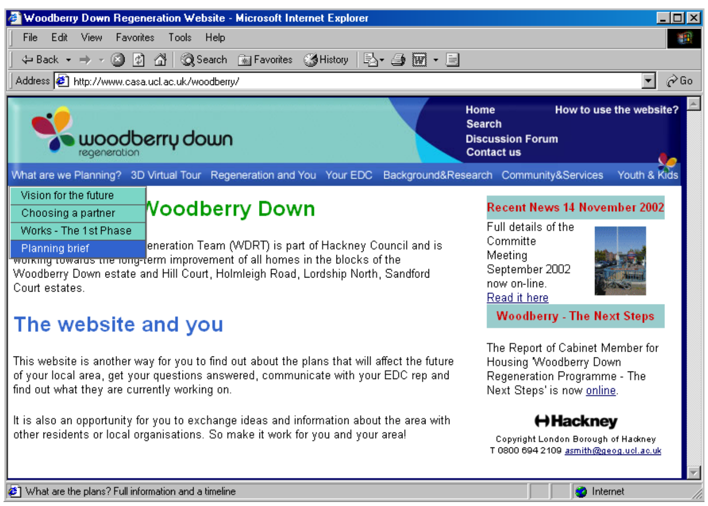


Figure 8.3. The Woodberry Down Web Site Illustrating Drop-down Link Navigation.

The site was constructed with a clear design brief - to allow each page of the site to be accessed from a drop-down menu. This is an important although often overlooked factor of planning websites in that the user interface needs to be clear and understandable. If the interface is poor, as for example in the Wandsworth example from Chapter 3, then people are not encouraged to fully utilise the site. The site contains a wealth of information to ensure that the residents have access to all the information that is currently available to the WDRT. As such, it has been divided into logical sections which act as a guide to the residents to show not only how the regeneration will affect them but also provide background into public participation and how the regeneration process operates. Next we will run through sections of the website, explaining how it was constructed in terms of web-based virtual reality and the concepts behind the display of textual information.

The first section of the site is entitled 'What We Are Planning' and provides access to four pages – relating to the vision for the future, the partnership which will enable the site to be developed through various private finance initiatives yet to be chosen, the first stage of the works with access to the 'decant status' of the various housing blocks, and the planning brief. As we have mentioned, each section of the site can be accessed via the drop-down menus and this is further supplemented by hotlinks for each section at the bottom of each page. We illustrate this layout in Figure 8.4 which is typical of the rest of the site.

Figure 8.4. A Typical Page from the Woodberry Down Site.

Each page has a photo of the housing on the estate which is not only there as an aspect of design, but also to let those visiting the site from outside Woodberry Down gain an understanding of the type of housing planned for regeneration. As a website, it is obviously global in nature and thus the users will not exclusively be Hackney residents. We return to this later.

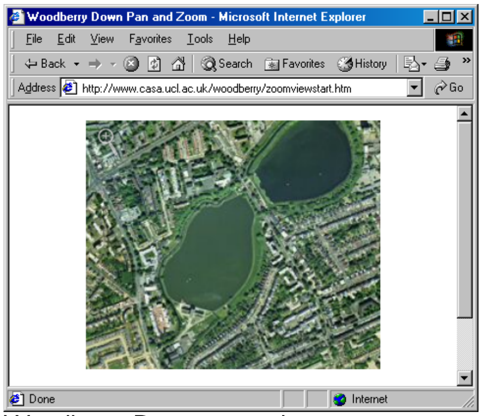
The process of regeneration is plagued by esoteric terminology and acronyms. Under the menu associated with Regeneration and You, there is a section on 'Frequently Asked

Questions' (with answers), and a jargon buster which defines the various terms used by officials such as 'Basic Credit Approval'. There are links to the decant status page and to housing advice – links to other housing agencies from associated pages, while under Community and Services, there are links to housing management advice and local services, all of which lead to their own pages. There is a section here that lets users provide the WDRT with information about local events. Background and Research provides a brief history of the area as well as key documents referred to as 'Yellow Books' about the regeneration; these can be downloaded as *Acrobat* PDF files. To produce Acrobat files requires the appropriate software which was purchased for the project. PDF readers are free although hampered by a 8.6Mb download. Such a file size take approximately an hour plus to download via a standard 56K modem with which the members of the EDC were provided. This is not an acceptable situation although one which we are unable to change or work around due the current standard of Acrobat for the distribution of documents over the Internet.

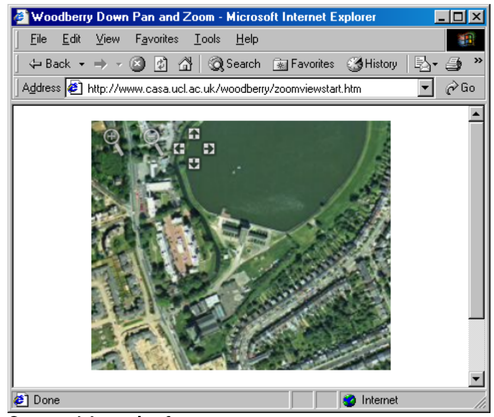
It is recognised that residents not involved in the consultation process may not be aware of the EDC. Therefore extensive information is provided about the constitution of the committee, how often it meets, what it does, and its local representation. We now move onto the main section of the site, the Virtual Tour. This 'Tour' was decided by the WDRT to be the main focus of the site, allowing the residents to gain a sense of location and place as well as providing a focus for 'what if' type scenarios. Before such scenarios were developed, the difficult task was how to capture the local area and display it online via a clear and user-friendly interface. Previous research has concentrated on VRML but for reasons we have already covered, this was quickly ruled out. It was also noted that while a sense of location and place was required, it would have to include both the second and third dimensions. Two-dimensional visualisation was required to provide some sort of map interface to the area. This would aid navigation as well as provide a base on which to display the various regeneration options.

The first proposal was to use an internet map server to deliver maps online which residents could query. However then and now, it is not really possible to use typical map servers for explicitly the purpose we have in mind here. After an initial meeting and presentation to the EDC, it was decided that the residents did not want to query a map but they did need to see visual information in both two- and three-dimensions quickly and easily. They need to be able to do this over standard telephone lines. Thus although ESRI (UK) donated a copy of *ArcIMS* map server for this purpose, it was decided to move to much faster and simpler media, developing and using freeware/shareware based on various software products developed by *Viewpoint* (http://www.viewpoint.com/). We have examined Viewpoint in terms of Shared Architecture in Chapter 7 from a three-dimensional modelling standpoint. An email to the developers of Viewpoint in New York revealed that they were also working on software to display high-resolution images over the Internet. Termed 'Zoomview', the software is defined as a serverless "pixels on demand" image transmission technology that makes high-resolution, detailed images available online, even over narrowband connections. Where a traditional Web page would ordinarily display a low-resolution, thumbnail image, Zoomview permits the deployment of large, print-quality images online, allowing users to zoom in and examine the finest of details without the need for special graphics cards or high-speed Internet connections (Viewpoint, 2001). The software was initially aimed at publishing high-resolution images of consumer products over the Internet which we realised, in terms of this project, would be equally applicable to high resolution aerial image data.

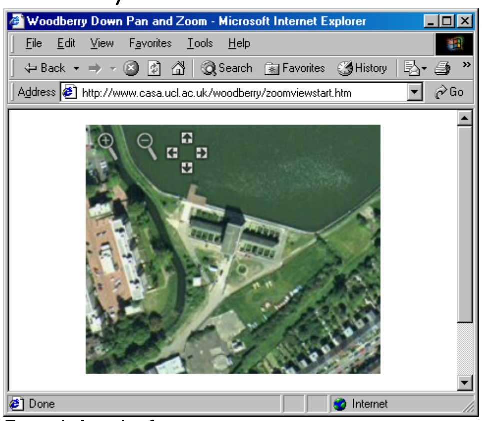
Zoomview at the time had a number of advantages and disadvantages. The major advantage was its ability to divide an image up into sections depending on a user's level of zoom. This allows a low-resolution image to be displayed when the image is viewed at its full extent, similar in nature to a traditional website image. When zooming in, a new high-resolution image is streamed into view. This allows resolution to be maintained complying with Brutzman's (1997) components. The second advantage is the ability to zoom in smoothly with a click of a mouse, a feature which is not currently possible with ESRI's ArcIMS map server. ArcIMS is able to deliver high resolution images via the web from standard layers within the GIS but the images are merely refreshed when the user clicks, thus losing all sense of location and place. Using an aerial photograph donated to the project by *Cities Revealed* (http://www.crworld.com/), we were able to build in five distinct levels of zoom; we illustrate three of these in Figure 8.5



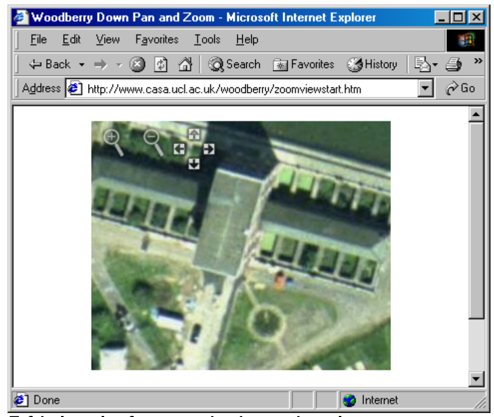
Woodberry Down zoomed out



Second Level of zoom



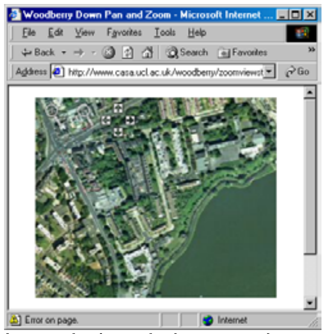
Fourth level of zoom



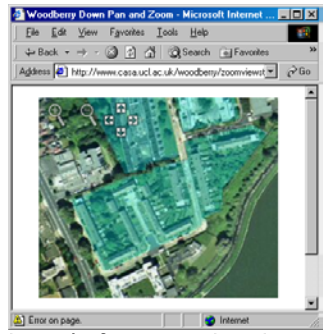
Fifth level of zoom, highest detail view

Figure 8.5. Woodberry Down Aerial Photograph Utilising Viewpoint's Zoomview Software.

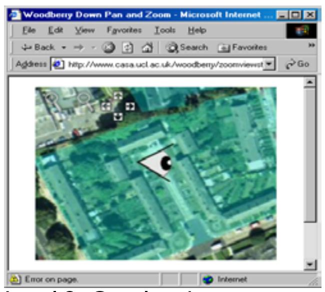
The image is divided into 1085 segments according to layers based on the user's level of zoom. This is an important point. By using layers we can supplement further information according to which layer the user is zoomed into. This ability to zoom into layers with additional information is termed 'logical zoom' by Viewpoint (Viewpoint, 2001). In addition to multi layers, Zoomview can integrate vector-based animation and information using Macromedia Flash. For the Woodberry Down interface, we integrated two levels of additional information overlayed onto the aerial photograph. An example of this is illustrated in Figure 8.6.



Layer 1: Aerial photograph



Level 2: Overlay with redevelopment regions



Level 3: Overlay showing interactive elements

Figure 8.6. Multi-layered Information in Zoomview.

While the map interface is of use, the residents needed to be able to easily identify and navigate to their own block of flats or area. In ESRI's ArcIMS, this would be carried out via a simple postcode search or flat number. Within Zoomview, separate scripts had to be added allowing the map to automatically zoom into an area dependent on a list of addresses covering each region. We illustrate this final aspect to Zoomview in Figure 8.7.

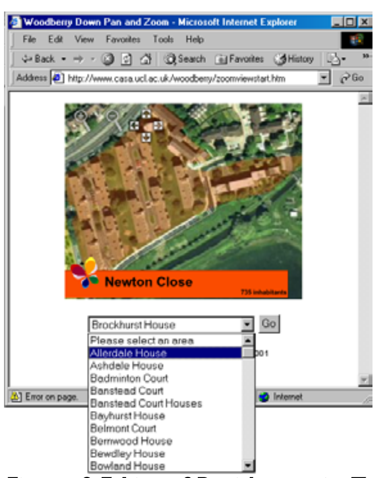
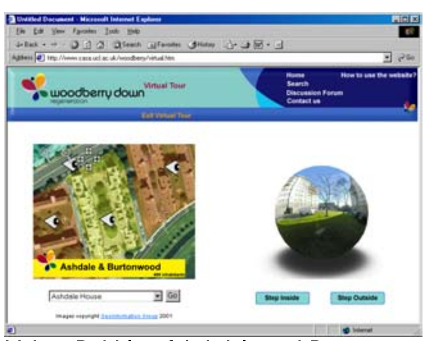


Figure 8.7 List of Residences in Zoomview.

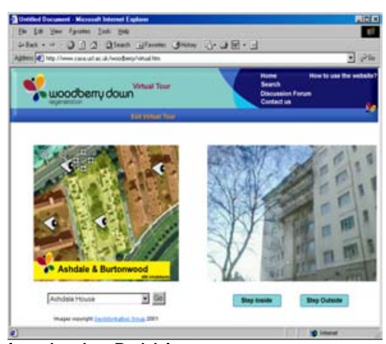
In order to impress a sense of location and place on the estate, a series of panoramas were captured for each area of Woodberry Down. The panoramas were in a sense similar in nature to the previous application *Wired Whitehall* but captured by a much higher resolution camera with a wider angle of lens. An increase in the field of view as well as the use of additional software allowed full 360 x 180 degree panoramas to be taken. We illustrate a sample in Figure 8.8.

Figure 8.8. Sample Panorama from Woodberry Down.

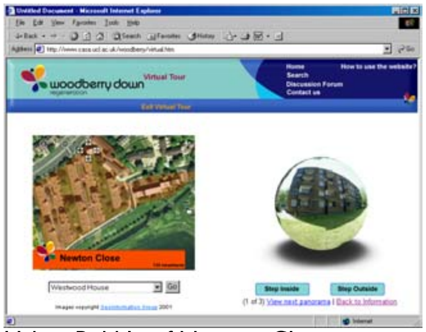
As each panorama has a 360 x 180 field of view, it can be texture-mapped onto a sphere to enable the photograph to be viewed interactively. We term these 'urban bubbles' and Figure 8.9 illustrates the Zoomview map linked to these bubbles.



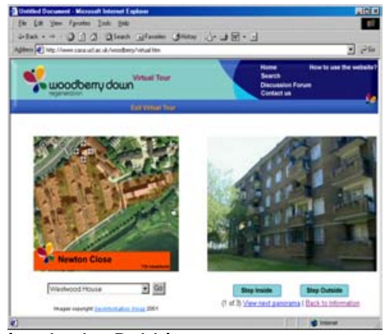
Urban Bubble of Ashdale and Burtonwood



Inside the Bubble



Urban Bubble of Newton Close



Inside the Bubble

Figure 8.9. Woodberry Down Interface: Zoomable Map Linked with Urban Bubbles.

The interface is a hybrid of *Wired Whitehall* and illustrates how far the technology has moved on during this research. We now turn briefly to the disadvantages of Zoomview in its use for such map-based interfaces. It obviously does not have the flexibility of an out-of-the-box GIS solution although we argue that this is far outweighed by the levels of interactivity achieved in this example. However, the levels of interactivity such as the ability to zoom-in to fixed locations and the use of multi-layered information, are hard coded. If new locations are added or information on the layer is changed, changing the code behind the site is a manual task which is both time-consuming and impractical. The software was also being developed whilst the site was being written. Acting as a Beta tester has advantages for it allows the research to be cutting edge, but at the same time, it is both unreliable and unintuitive to use. A number of problems were unearthed with the software which required the developers in New York to rewrite sections before the website development could continue. The outcome was, however, worthwhile as the software delivered both a usable interface and high level of interaction accessible via a standard modem. The aim of providing the residents with a sense of location and place about their environment was thus achieved.

At the time of writing, there are no specific regeneration plans in place for Woodberry Down as the regeneration scheme is currently undergoing a cost appraisal which will complete by the early of 2003. Once plans are developed, each panorama will be augmented to show any scenario which is developed, in a way similar to our previous Wates Built Homes example. Although augmented panoramas are highly visual, regeneration options also require a three-dimensional visualisation to fully appreciate any changes in the environment. With this in mind, a prototype was developed on the site to illustrate how future scenarios would be visualised. The prototype is based on the Rowley Gardens area of Woodberry Down which consists of four high-rise blocks of flats surrounded by mixed low-rise buildings. The models were developed in a similar fashion to those in *Shared Architecture*, from photographs. The optimal photographs for such models are oblique. However due to costing limits, we were not able to undertake an oblique aerial survey of the site. This has meant that models have been built by gaining roof access to surrounding buildings which complement a ground-based photographic survey. We illustrate the three-dimensional options for Rowley Gardens in Figure 8.10.

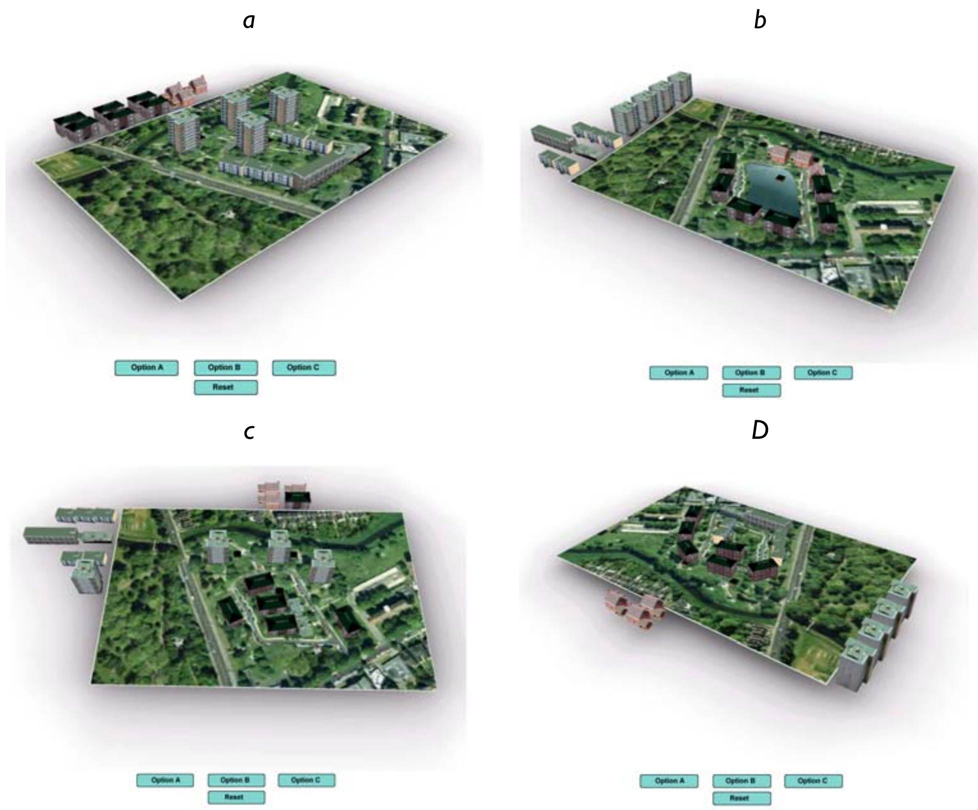


Figure 8.10: Options for the Redevelopment of Rowley Gardens.

When a user clicks on one of the options, the current configuration of housing at a) above moves to the side of the map and new housing options automatically assemble themselves in b), c) and d).

The three-dimensional model interface was designed to ensure the users would be able to easily navigate the options presented. Navigation is notoriously difficult in three-dimensional packages but in the example we have presented, all the user is required to do is click on one of the options and the redevelopment animates automatically. Although this seems a simple enough procedure, again using Viewpoint Beta software, it required an element of hand-coding and time to ensure it met the requirements of the site. Once the options for each area are in place, the whole of Woodberry Down can be made three-dimensional. This is no longer a massive task for many of the problems have been ironed out during the first phase of the site's development.

The final section of the site is the discussion forum. The forum was set up to be the centre of the public participation and discussion, with the ability to vote on issues and discuss any element of the Woodberry Down regeneration process. Linking in the ability to vote and discuss issues with the virtual tour ties together all the elements we have argued for in terms of the requirements for digital planning. It allows residents to gain a sense of both their current and future environment while having a direct route to the WDRT and the ability to make their view count. The discussion forum was set up to ensure that each user had to register with a valid email address, username and password. This would allow voting to be restricted to local residents as well as allowing others to participate in the discussion. Electronic voting is a wider issue which we will not discuss further here but the procedures were put into place to allow it within the site. We illustrate the forum we have set up and the user interface to the discussion board in Figure 8.11. In Figure 2.2, we illustrated the factors required for the successful use of computing in planning and it is this which we turn back to now.

8.3 Evaluation of the Woodberry Down Website

In terms of research and software implementation, we have shown that it is possible to gain a strong sense of location and place via a website and implement procedures for consultation. Our techniques enable a considerable move up Arnstein's (1969) Ladder of participation compared to non-digital methods. In one sense, this is where the research stops and other factors intervene over which we have little or no control. This has certainly been the case with Woodberry Down.

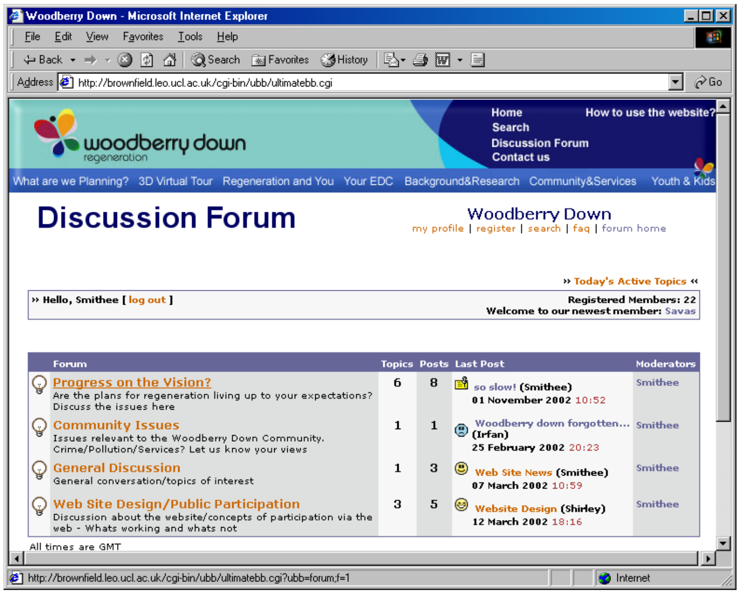


Figure 8.11 Woodberry Down Discussion Forum.

The site was officially launched by the Mayor of Hackney in November 2001 along with exhibitions of designs for the regeneration of the estate. One click of the mouse and the site went live; all the members of the EDC and the WDRT were in attendance. The site had been delayed from the original April deadline by a series of problems in collating text and images for the site. As the overall project management of the site was handled by the Architecture Foundation, this added another layer to the level of communication between the site's development and the WDRT. As a result of this, messages did not always filter through and eventually it was decided by the WDRT to deal direct with the University to ensure that the development was moved forward as quickly as possible. In addition to these levels of communication was the main Hackney Council web team which further sub-contracted to a third party to upload any content to their web server on which the site is hosted. This caused further delays. (http://www.hackney.gov.uk/woodberry/). Such delays are to be expected and minor in detail but they do add another issue to the factors governing the successful implementation of computers in planning.

Despite the delays once the site went live, it received the accolade of being named 'editors choice' by UKOnline.gov – the Government's e-democracy website. The site was the first local government initiative to receive this accolade for the process of e-democracy. The editor recommended that other parties involved in online participation look at the site as it provided a template for good practice. The site was also named 'site of the month' by Viewpoint for its use of the Zoomview and Viewpoint three-dimensional technologies. As such, the website had the full support of the WDRT as well as being flagged by the government as a site to take note of. Political support is a key factor in the successful use of computing in planning but it is also one of the most tenuous.

Every project needs a champion and the unsung hero of Woodberry Down was Micah Gold, the then head of the WDRT. Micah firmly believed that the website was central to the regeneration process and had driven the process forward, especially in securing the wiring of the residents' homes. The infighting that dominates such projects is legendary. Funds are always in short supply, residents always disadvantaged, tempers frayed, and good ideas sink without trace. The decision to stop the computers being given to residents' representatives, which was only revoked in May 2002, hardly helped. Hackney's continuing bankruptcy in the face of hard central government performance targets, and the failure of various regeneration bids took their toll. Micah Gold resigned soon after the web site was launched.

Micah's resignation had a considerable impact on the project. Without direct political support, the site did not continue to receive the drive it needed from the team. However this was expected as during the following 6-month period, two temporary replacements were found for Micah but he was not the only member of the original team to resign. Olween, the resident involved in providing text for the website, also resigned due to disagreements with fellow members of the team over her contract. This arguably had a greater effect on the website as it cut off the flow of information to ensure the site was up to date with current developments. Finally, the champion behind the project at the Architecture Foundation, Haruo Morishima, also resigned. Shortly after the sites launch, the only remaining member of the team was myself at CASA.

In light of this, a meeting was arranged with the WDRT to regain support for the project. Due to other issues taking a higher priority in the regeneration process, the website was not given the same level of support it had first received. Development of a website is an emotive issue and it needs a driving force behind it, advocating the view that this represents the future of e-democracy. The changes in the WDRT shifted this view to something that was of mere novelty value. Staff turn-over in local government is of course high, and this is especially the case in Hackney which has been suffering the kickbacks of bankruptcy and low morale. The WDRT has, at the time of writing, a new team leader and information is again beginning to flow to the website. We will return to the current state of affairs later after looking at the site's success in encouraging feedback from the residents.

The discussion forum is central to the whole site, allowing residents a free and unmoderated say in regeneration. The discussion forum was singled out in the original site plan as being of central importance to the consultation of the regeneration project. The WDRT planned to log into the site at least once a day and reply to any posts from residents or other interested parties. To develop an online community behind a discussion forum takes time. Wooley (1998) states that to develop a successful forum online you need to take into account several factors involving issues such as a clear purpose, experienced hosts, interested participants, and good software. Such factors can be built into the issues already identified for the successful use of computers in planning and were taken into account when developing the forum. The software was carefully chosen to avoid creating a forum intimidating to new users. The forum was developed around the widely used 'Infopop' (http://www.infopop.com) forum system. The software was chosen both for its low cost ($199 per annum) and the ability to customise it to the specific needs of the forum members. A final consideration was its ability to run on an in-house server rather than using that on the main Hackney Council site. This was important to ensure that direct access to the board was maintained to deal locally with any malicious or litiginous posts . The board also had a clear purpose, defined in the topic headings of 'progress on the vision', 'community issues', 'general discussion' and 'website design'. Finally it had interested participants in the form of the WDRT, members of the EDC who had access to machines, and other interested parties using the public access facilities provided in the WDRT office.

The first posts were related to the website's overall design with a comment starting the discussion from a user with the online name of Ugo. Ugo posted that: '… (the website) is well designed/presented, allowed the community a say and promoted discussion amongst the parties concerned....well done Hackney (we know you have problems in other areas)'. The site was also a topic for discussion on other bulletin boards related to regeneration issues, specifically Regen.Net (http://www.regen.net). A notable post on regen.net came from a user called Richard who posted 'Take a look at the Woodberry Site, the residents have a real say in what's going on, read it and weep'. A total of 20 posts at the time of writing have been made on the site, a number which is disappointing but understandable. We discuss the reason for the lack of posts after the last message to date which is displayed below. All text and grammar have been kept 'as is' from the discussion forum.

> the design and user friendliness of this site is great there is one major problem with it, it is so out of date.
> The whole point of a website is to keep those who use it up to date with news and information on the topic they are looking for.
> I dont see that here! I regularly log in to check on the regeneration of woodberry down for the LATEST information and it never changes!!!!
>
> I leave messages they are never answered!!!
> You should have a section with the latest and most recent events that have passed and not just go on about what you hope will happen.
> People on the estate are really under whelmed with the lack of progress on what has been so far achieved!
> We attend the meetings in the hope of new and exciting progress only to be told old regurgitated news weve heard time and time again!
>
> No answersd no progress just talk!
>
> You are messing people about when you talk of what and when you hope to achieve this report and that report while we sit around unable to make any plans of our own because we have lost our hope in the planning of this regeneration.
>
> No doubt a lot is happening behind the scenes but why oh why for the sake of those of us who work and cannot make the meetings can you not keep this website updated so we at least have some idea as to what is going on!
>
> I have absolutely no clue as to whether there has been any progress since July and am frankly at the end of my tether.
> SORT IT OUT!

The message below brings into focus the problems which have been encountered with getting up to date information from the WDRT for the website. It also notes the importance of the website to communicate information to the residents who are not able to attend any meetings. Despite the loss of Micah and Olween from the project, information has been updated on the site although it is mainly out-of-date minutes of EDC meetings which do little to inform the residents of how the current

regeneration process is progressing. As the message states, faith in the planning of the regeneration process is being lost and the website, rather than acting as a means to invest confidence in the residents, may also be the cause of a loss of faith. It is basic common sense that a website needs to be constantly updated to ensure that the information is current, thus encouraging debate about the issues via the bulletin board. Obtaining information from the WDRT has been a tortuous task, far from the teams original aims of developing a site which will inform residents and act as a discussion forum (WDRT, 2000b). While the lack of information can be put down to political and organisational changes in the team, and a minor hiccup in the long term process, the lack of replies by the WDRT has had a more serious impact on the consultation process.

Discussion forums involve multi-way communication between participants discussing shared topics and contributing to debates. To ensure the forums are used, there needs to be a constant flow of information in the first instance from the organisers, in this case the WDRT. Once residents observe that topics have been posted for debate and replies are received, an online community can start to develop. Such communities are tenuous and rely on strong leadership from the topic providers, especially in the first few months of usage. A major set back in the use of the site for public consultation has been the lack of any posts from the WDRT. This has not however been down to a lack of interest but due to Hackney Council informing the team that any posts on the site could be legally binding. As such, the team are now unable to post their views on the regeneration or answer any questions without having them checked first for any compromising comments. This has effectively made the discussion forum a one-way basis for communication with the only posts made by myself with whatever information I have to hand. Obviously this is not a satisfactory situation and it is one that was unforeseen when the idea of a discussion forum was put forward.

Digital networked communication has been around since 1972 in the form of email and since the 1990's it has become an invaluable business tool. With this tool however have come legal ramifications. As Halberstam (2002a) states the consequences of being able to send anything to anybody has potentially serious implications for companies and individuals. Organisations need to be aware of the legal ramifications of email content as in the much publicised they (Western Provident Union) defamation case which came about because they had discovered that Norwich Union were circulating untrue rumours about their finances on Norwich Union's internal e-mail system (Galashan, 2002). Thus the doctrine of vicarious liability applies equally to emails as it does to other forms of correspondence (Halberstam, 2002b). Making the logical leap, this doctrine also applies to bulletin boards and thus Hackney's inability to post in an official capacity. It was suggested that due to the anonymous nature of the Internet, members of the team could register with the site under a pseudonym and thus continue to post information. This was rejected by the team on ethical grounds, although it would, at least, provide a voice on the site for supplying information.

The other route for information to be provided on the site is via the members of the EDC who have been provided with free Internet access in their own homes as part of the project. The decision to wire the residents homes, as we have noted, has been controversial. A number of other problems have also been encountered during the process of installing computers. Some of the residents have been reluctant to have the computers in their homes for fear of theft. As a result, it was requested not to publicise details on the website that member homes have been wired. This, to some extent also goes against the original proposal as the members' homes were intended to be drop-in points for other residents wanting access to the website. The physical size of the computers has also caused unforeseen problems, although those purchased were small Internet-only computers supplied with 15inch standard cathode ray tube-based monitors. These are bulky and due to the nature of the flats they are being installed in, residents often do not have the space to house them. Finally not all residents have a phone line in their flats so arrangements have had to been made to install lines before they can access the Internet. Full training has been given to the residents on how to use their computers. But with all these setbacks of where to house them in the flats and the unwillingness to publicise the fact that residents have over £1000 of equipment in their homes, the use of the site by the EDC has been limited. Since installing the computers, the price of liquid crystal display monitors has fallen. These have a much smaller footprint and would now be a more suitable alternative. The team at first pushed for all the members of the EDC to have laptop computers which would have helped the issue of space. However these were at the time deemed both too expensive and foreseen as more controversial than the provision of standard computers.

By way of a brief conclusion and update, the WDRT have contracted CASA to carry on the development of the website until 2004. Weekly updates will now be provided on the front page of the site with a series of new three-dimensional visualisations planned to coincide with the publishing of full plans for the area's regeneration in early 2003. The issue of the bulletin board has also been resolved with any replies by the team to be approved by the Council's legal department before posting. Procedures have been put in place to ensure this happens as quickly as possible.

CHAPTER 9

A Prospect for Digital Planning: Virtual London.

In concluding the applications developed in this thesis we will now detail a proposal for a digital model of inner London, which we refer to hereafter as 'Virtual London'. Virtual London is designed to provide a visualisation of all the buildings within the inner London area through which users can navigate at street level as well as fly across in panoramic fashion. Central to the model is of course data. Users will be able to query the model by simply pointing and clicking on the buildings and streets to obtain the data embedded within the model. The model will be 'non-fixed' in that users will be able to ask 'what if' questions which involve the placement and visualisation of new buildings, their demolition, changes to the road and rail system, and other design reviews at different scales down to the level of street furniture. The proposal which has received backing from a number of parties which we note later, is the logical cumulation of the applications documented so far. Notably the *Woodberry Down Regeneration* (Chapter 8), the *CVDS* (Chapters 6 and 7), and the *Shared Architecture* and *Wired Whitehall* (Chapter 6) projects have led to this possibility of rolling out the ideas on a London wide-scale.

We detail in the following sections the problems in moving what Klosterman (1998) describes as interesting 'academic prototypes' into policy tools for the parties involved. We aim to provide an insight into the problems encountered when raising both the profile of this research as well as gaining an all-important foothold on further funding and the ability of interested parties to co-operate in the sharing of data and issues of copyright. Of course the aim of a full scale digital planning system has been central throughout this thesis. *Woodberry Down Regeneration* provided the ability to integrate such planning with a number of parties, most importantly the residents. Virtual London aims to move this up a scale and make three-dimensional digital planning a core concept within the city. This has allowed a number of parties to become involved through the Greater London Authority (GLA). As such, it not only enables the prospect of city-wide digital planning but also the development of a truly virtual city, as we detailed in Chapter

7. Before we present the background to Virtual London, it is timely to explore various three-dimensional models of London which already exist.

9.1 Three-Dimensional Models of London

As part of our worldwide survey for the Corporation of the City of London (Batty, Smith, et al., 2001) we detailed the development of digital city models based on GIS and CAD, a few of which focused on London itself. The report identified six organisations focused on developing three-dimensional models. Applications of these models varied but of note is that none of the models were developed as part of government initiatives. Sizes and levels of detail of the models vary considerably and none have been produced which provide three-dimensional visualisation for the entire central area. As the report illustrates, there are also some ad hoc developments, in particular the Planet 9 model, which has been under development for a number of years. The model, currently offline, was originally planned to be part of a multi-user network of cities using the Blaxxun VRML 2.0 browser. Blaxxun has recently gone into liquidation and as such prospects for Planet 9's Virtual London remain unclear. Of particular note and referring back to the discussion on gaming environments in Chapter 4 is the Metropolis Street Racer developed by Bizarre Creations for the Sega Dreamcast gaming console. Metropolis Street Racer, now renamed as Project Gotham and released on Microsoft's X-Box console, is a driving simulation based on three cities: London, Tokyo and San Francisco. The X-Box version has also added New York with all the cities modelled in high photorealism over a number of fixed racing circuits around each city. Sample screen shots in Figure 9.1 illustrate the level of photorealism portrayed in the London model.

Figure 9.1. Metropolis Street Race on the Dreamcast (Bizarre Creations, 2001).

Project Gotham features 200 circuits over the four cities, each rendered at 60 frames per second with graphical effects such as real-time weather and lighting changes. The game offers the highest level of realism of all the models we have examined at street level. However it has been designed purely as a racing game and thus the models do not have consistent three-dimensional geometry. The model is only designed to be viewed from in-car or slightly above-car viewpoints, thus it is not possible to have a bird's eye view or freedom to fly around the city as in other virtual models. Project Gotham does however further underline how the games industry is becoming a major player in the modelling of built form as demand from the consumer for realistic environments is met by the increase in processing power of the latest gaming consoles. With gaming exceeding cinema in terms of consumer spending in the UK, developers have mass-market appeal, allowing games to be developed on budgets often exceeding £2m. Such budgets allow realistic cities to be modelled although it should be noted that such games are developed only as 'games' and are thus unsuitable for most of the applications which we detailed in Chapter 7. However once a city is modelled, it is possible to 'port' it over to other platforms, thus enhancing the geometry by filling in the gaps from a street level view, hence enabling a bird's eye CAD-type model to be constructed.

The other models have been developed along more traditional CAD lines and no longer represent the state of the art. One such example is the model developed by Miller-Hare, a small design consultancy specialising in the production of high quality visualisations of architectural design to support planning applications and for the marketing of proposed buildings. The development of city models is often on an ad-hoc basis with small areas developed over time on a project-by-project basis. This is true with regard to the approach by Miller-Hare in their three-dimensional model of London which was developed as a result of surveys over the last fifteen years. As technology has moved on, the model has been developed in varying levels of detail which Miller-Hare categorise as 'levels' ranging from A-G in Table 9.1.

Level of Detail (LOD)	Description
A	Detailed architectural models including fenestrations
B	Detail equivalent to 1:100 measured building survey
C	Detailed elevations
D	Major details of building elevations
E	Accurate building volumes
F	Roofscape
G	Prismatic Block models – Coarse massing

Table 9.1. Level of Detail in the Miller-Hare Models.

The majority of the Miller-Hare model is divided into city blocks with the Ordnance Survey 1:1250 building footprints designated by a height derived from aerial photogrammetry. Extruded footprints provide a basic prismatic model at level G while upgrading of the model on a project-by-project basis has resulted in a number of sites at levels A-B. Figure 9.2 illustrates two views from the model.

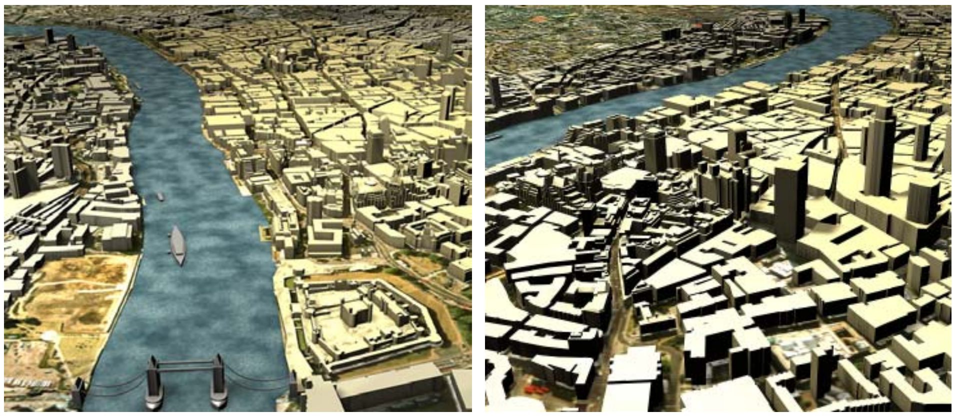


Figure 9.2. Millar-Hare model of London (Millar-Hare, 2001).

Similar in nature to the Miller-Hare model is a photogrammetric derived model by City University. Commissioned in 1996 by Trafalgar House, the City model is probably the most detailed large-scale model of London to date although on the local scale, the Miller-Hare model is more detailed. The model was produced using 3D Microstation, a highend CAD package and includes full roof detail, constructed over 3 man months at an estimated cost of £50K. The model has been used to visualise a number of projects in the City including the proposed Millennium Tower for Foster and Partners. Figure 9.3 illustrates the City University model with a view from Tower Bridge.

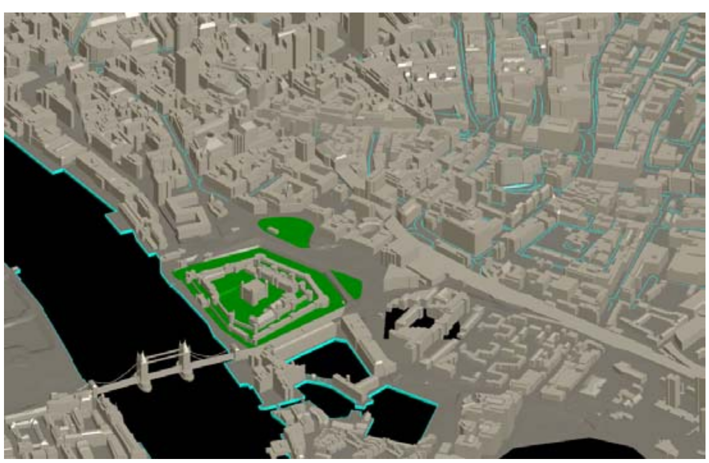


Figure 9.3. City University Model of London.

This model is no longer being updated as the researchers have since left City University although there is a possibility of licensing the model to third parties to generate revenue for its maintenance. A similar although larger scale model has been produced by the Department of Computer Science at University College London. The model was developed using Cities Revealed building outlines and height data creating a simple prismatic model at level G on the Miller-Hare scale. Simple roof structures have been added although these have been randomly assigned. The model has not been constructed for use in architecture or planning applications but more with the aim of seeing the speed at which polygons can be rendered on state-of-the-art machines in the visualisation of cityscapes. Figure 9.4 depicts a screenshot of the model running in the Silicon Graphics interface.

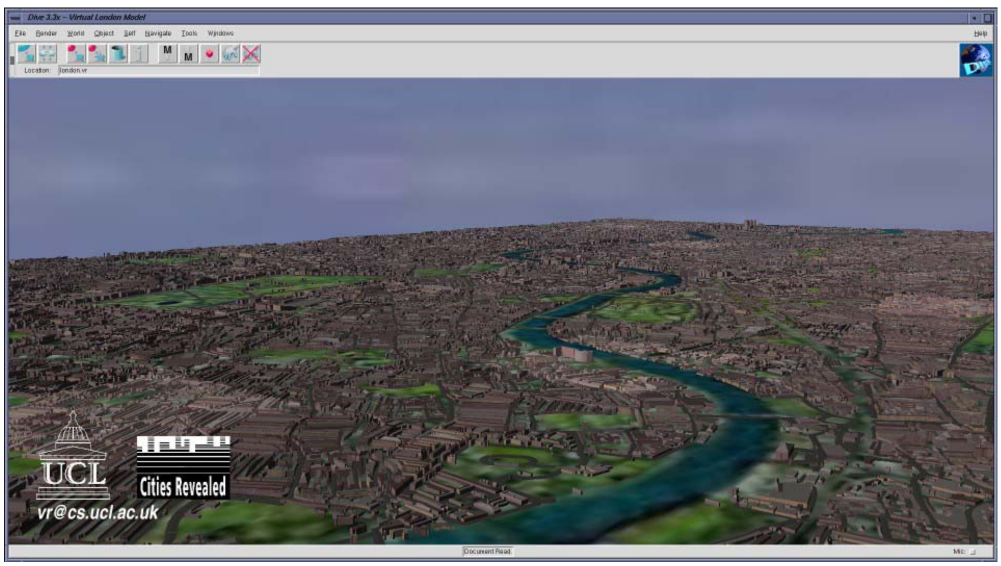


Figure 9.4. University College London Computer Science Model of London.

On a smaller scale, Bath University have developed a prismatic model of Soho in Central London. The model is the only networked example identified in the report for the Corporation of the City of London (2001). It is developed in VRML 2.0 and described on their web site as "The Map of the Future". We illustrate an aerial view in Figure 9.5.

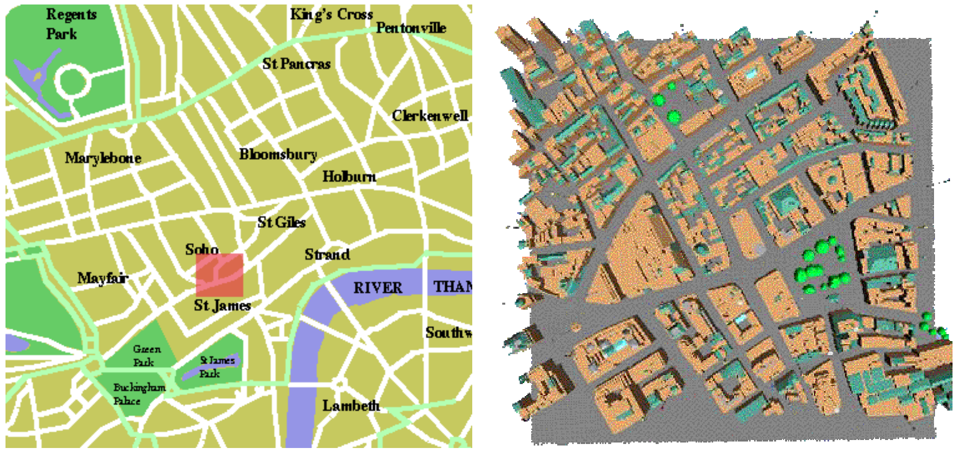


Figure 9.5. Soho District of London Modelled by the University of Bath (CASA, 2001).

Hayes Davidson developed the only non-three-dimensional model that we identified. In association with the Architecture Foundation and termed 'London Interactive', the system is based on a CD-Rom multi-media presentation providing information about contemporary urban design and major architectural projects in London. Although only two-dimensional, the system acts to illustrate how multi-layered data can be used to provide compelling information about design. The system has made extensive use of panoramic imagery similar to our example of *Wired Whitehall* in Chapter 6. Linking panoramic imagery to various levels of data provides a quick and easy way to portray a sense of location and place to the user and should never be overlooked in favour of three-dimensional models. Virtual London should have both aspects of panoramic imagery and three-dimensionality where appropriate, as we illustrated in the case of the *Woodberry Down Regeneration* in Chapter 8.

The three-dimensional models discussed so far do not link to any underlying data. They are merely CAD models which can be rendered, visualised on high-end machines or in the case of the Bath University model, viewed via the Internet. All the models are fixed which draws back to our discussion throughout this thesis that if three-dimensional models are to be used for digital planning, they need to be interactive to enable 'what-if' type scenarios to be tested. These scenarios should also be linked to various types of data and visualised within a collaborative environment and it is this which we aim to achieve with Virtual London. The integration of data, both photographic and textual, such as that in the Hayes Davidson example, together with non-fixed three-dimensional representations delivered across the network and communicated in a collaborative environment, is the basic goal which we consider must be met if an appropriate environment is to be established for digital planning.

9.2 The Case for Virtual London and Digital Planning

As we have detailed throughout this thesis, the use of emerging technologies is now enabling us to plan at a distance, digitally. Using bandwidth-friendly techniques which combine to support all the role players in the planning process, the planning system is on the verge of being radically opened up. The main drive behind this in gaining support for the ideas previously presented in Chapters 6 to 8 is currently 'e-government'. It has enabled political support for a vision of a Virtual London with a move towards the Public Planning Support System which we illustrated in Figure 2.1. We will come back to the problems involved in gaining the support of organisations for a Virtual London and the implications of Virtual London for the planning system later in this chapter. Snyder (2002) states that despite disappointing progress over the last 20 years in the adoption and use of PSS and GIS in the field of land use planning and community design, there is growing evidence that we are on the cusp of large-scale adoption of these tools. Snyder's views in 2002 are similar to Klosterman's (1998) prediction that we are on the edge of a new revolution in the use of digital tools for planning. Klosterman's prediction has not stood true so far for as he has said, the last decade has merely led to a series of interesting academic prototypes Klosterman's (1998).

It is however these prototypes, such as those detailed in Chapters 6 and 7, that can lead to the development of digital planning in practice as shown in Chapter 8 and further detailed in our outline for Virtual London in this chapter. Gladwell (2001) in Snyder (2002) details how major changes in our society happen suddenly. Snyder (2002) illustrates Gladwell's (2001) key ingredients for the rapid adoption of ideas, practices and products, which he identifies as the 'stickiness factor', and the 'power of context'. The research detailed here can be seen as building up the 'stickiness factor' to enable key players to see the value of digital planning and thus enable the process to gain the backing that academic prototypes need before they are widely adopted as part of policy. Synder (2002) suggests that a 'tipping point' for the widespread adoption of PSS is near at hand. He identifies several reasons:

- planning departments and communities are increasingly grappling with how to deal with the growing complexity behind land use planning, resource use, and community development;

- emerging tools for community design and decision-making have the potential to dramatically change the planning profession. Computers are getting more powerful and less expensive;

- data is becoming more readily available and challenges with respect to interoperability of geographical systems (across different platforms and among different models) are being resolved;

- tools are becoming more user-friendly. In addition, there are a growing number of early adopters of these systems that demonstrate their usefulness and power; and

- PSS have the potential to transform decision-making in two ways: they can help communities shift land use decisions from regulatory processes to performance-based strategies, and they can make the community decision-making process more proactive and less reactive.

Snyder (2002) puts the emphasis on PSS. While these also have the potential to reach the 'tipping point', it is PPSS that has the most potential to create a dramatic change in the planning process. The linking factor is that of the network and although the planning process in PSS is important, PPSS is the public face of the system. The Woodberry Down Regeneration Team, project managers at The Architecture Foundation, and organizers of the Hackney Building Exploratory can be identified as Synder's (2002) early adopters. They have had the courage and forward thinking to invest in a series of academic prototypes developed to demonstrate digital planning and provide the funding to put them into practice. Such early adopters provide the all-important 'working version' with which to get other potentially larger parties interested and thus create a 'snowball' effect for a wider implementation. It is this snowball effect that is leading to the funding and future implementation of digital planning in the form of Virtual London.

9.3 Role Players in Virtual London

In Figure 2.2, we identified the factors central to the successful use of computers in planning. Through the examples so far documented, we have identified the level of expertise, software, hardware, connectivity, and cost of implementing digital planning on a large scale. However, the two remaining factors involving data and political support are perhaps the most important and act as guiding factors in the widespread adoption of such technologies. Political support is gained by creating a series of prototypes that show potential. These prototypes can then lead on to realworld working examples which in turn gain more support from the players in the planning process if they are successful. Figure 9.6 illustrates the series of academic prototypes developed through this thesis, and the players who have become involved through the process of implementing Virtual London.

Raising the profile of the research and thus gaining third party support outside of the academic system has been ongoing since the development of *Wired Whitehall*. The first interest in Virtual London was shown by the Architecture Foundation as a result of the development of *Hackney Building Exploratory Interactive*. Chapter 6 provided full details of the way these applications emerged. Hackney Building Exploratory Interactive was built on the *Shared Architecture* platform to demonstrate how three-dimensional models as well as geographic data can be viewed and distributed via the network.

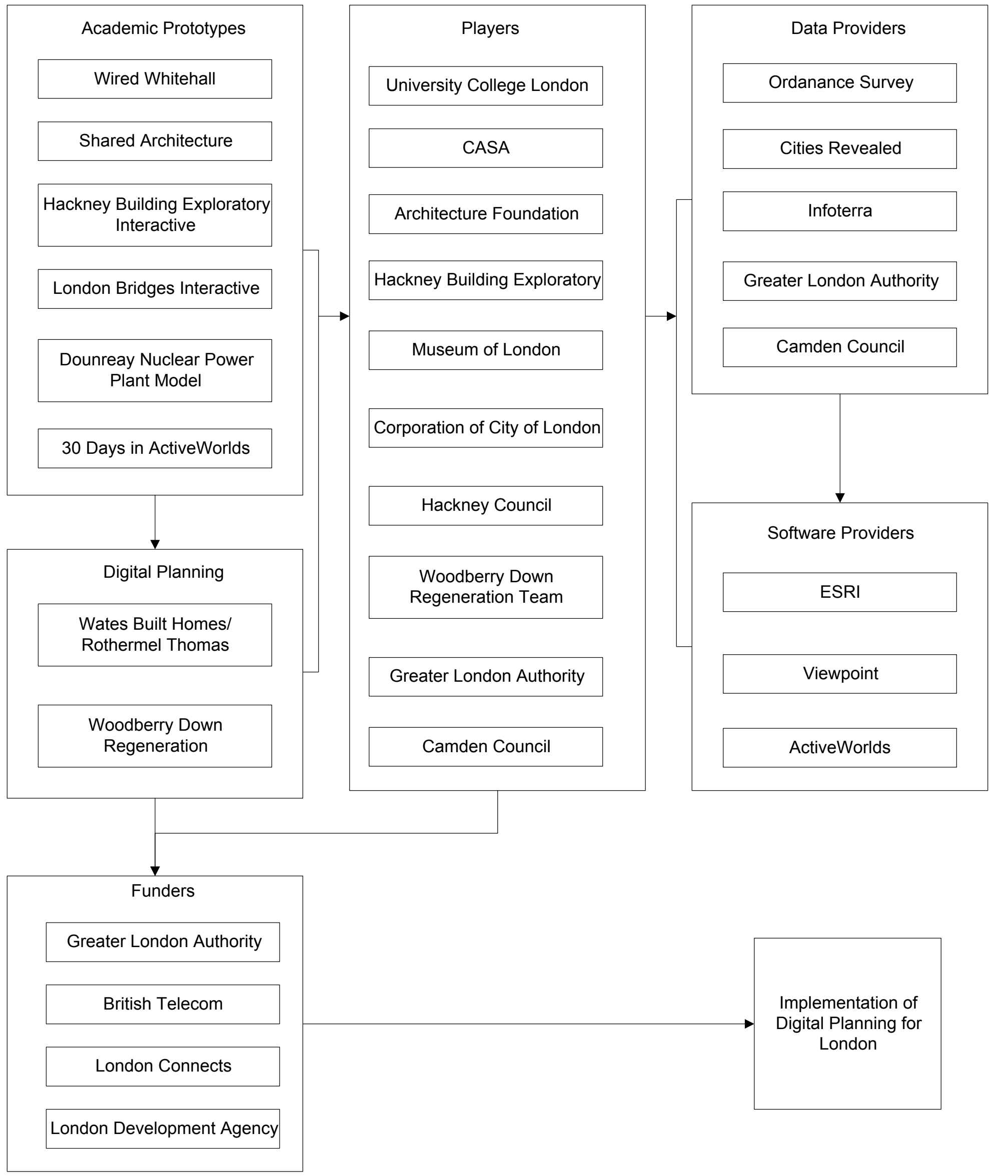


Figure 9.6. Prototypes, Players, Providers, and Funders of Virtual London.

This in turn led to the development of *Woodberry Down Regeneration* which was funded through CASA as Phase I of Virtual London. This application provided a proof of concept and demonstrated how we could set up a two-way dialogue between the community and those involved in the regeneration process. By placing an emphasis on e-democracy, the GLA showed an interest and a funding bid for five further sites to be developed in London was put forward through the Government's 'Invest to Save' strategy but the proposal has still not been formally accepted. The nature of funding can be identified as the reason why many interesting academic prototypes do not reach the point where they snowball and become policy.

Raising funding for Virtual London has taken over four years, four separate grant proposals to various funding bodies, both academic and private as well as the production of numerous demonstration products and meetings with the various parties involved. To move academic research into the wider arena requires a strong sense of belief in the end product and the ability to not only carry on research when funding is not available but also to be able to market the product to the players involved. Yet Virtual London is not a product as such. It is a concept which involves placing a digital planning system online. It is the development of a planner's toolbox building on existing PSS systems and moving them towards a PPSS which has the potential to dramatically change how the planning process operates. It is this wider body of ideas that has developed, and these now need to be moved into the public arena to enable their successful use of computing (Figure 2.2).

This then is the nature of the technology transfer that we consider essential if the ideas in previous chapters are to be made workable in practice. The UK Government's current commitment to e-government which we examined in Chapter 2 is central to Virtual London. The use of the bulletin board in *Woodberry Down Regeneration* and the potential to develop it to include online voting for e-democracy provided the emphasis in the previous bid to enable the GLA to secure a base level of funding to develop a key site in London undergoing redevelopment and requiring a level of public participation in the process. This in turn bought interest from the London Borough of Camden in terms of the regeneration of the Kings Cross area, an area just three kilometres square with 20,000 residents which crosses two boroughs, Camden and Islington. Regeneration of the area is set to take place over the next fifteen years. Being one of the largest regeneration projects in the UK, it has secured £37.5million from the Single Regeneration Budget Fund with a further £250million of public and private investment expected. In November 2001, Camden put out a consultation document on the regeneration reflecting key objectives for the area to be integrated into the areas Unitary Development Plan. The approach to the regeneration is described by Camden (2001) as being ambitious. To succeed, it requires a viable, comprehensive development that sets new standards for sustainable urban quality. The emphasis is on the community and as such, Camden aims to extend the participation process to a wider base, listening to those voices that are not always heard and ensuring that local people and businesses are well informed and able to contribute effectively (Camden, 2001).

To initiate Virtual London, it is proposed to focus on this area and build a three-dimensional model of the site as it is now and the site as planned through a range of development options which will be visualised as part of the model. While this area does not constitute Virtual London as whole, it has enabled funding to be secured with a number of high profile companies and agencies such as British Telecom and London Connects. These see the investment as part of a wider vision of a three-dimensional London, viewable via networked technologies, notably broadband. The move to broadband is of note as it releases many of the constraints posed by Brutzman (1997) which we detailed in Chapter 5. Combined with the drive towards e-democracy, it offers the opportunity to move these research ideas to the public domain, building on the examples we have already developed.

The model will be a developed around a fully functional GIS which users can interface in both two and three dimensions. It will be built initially in the Kings Cross area to focus on the regeneration process and subsequently extend to include the City and its northeastern fringe (Hackney). It will be then extended east into Docklands and west into the West End, thence into Victoria, Kensington, and beyond. The later stages of its construction are dependent on additional funding once the area around Camden has been modelled. For the first stage, data would be acquired to provide a basic level of visualisation by extending a prismatic three-dimensional model out towards the City with the aim of attracting other London Boroughs through the backing of the GLA.

The project will be a partnership between CASA and various sponsors who will be organized through the GLA. The input of the GLA is the central factor in gaining support of the Boroughs, but this is important to gain the support of companies who can provide data and funding. The model will be designed around an 'open access' system whereby data can be quickly and easily added. The type of data will depend on the parties involved and the requirements of the GLA, on what is available for free in the public domain, what we can enter ourselves, and what we can negotiate during the course of the project.

9.4 Participants in Virtual London

The complete fully functional model will be delivered in different ways for different audiences. There are at least four potential audiences for which the three-dimensional model and its underlying data will be used. The level of usage is dependent on the delivery method and its method of visualisation via the network. We view four broad categories of use:

- fully professional usage - the use of the model by architects, developers, planners and other professionals who are anxious to use its full data query and visualization capabilities. For example, an architect might place a building within the model and use this to assess a variety of issues, from its basic visualization to the impact it might have on traffic and surrounding land use. This could potentially be set up with 'subscription-only' access, raising revenue for the continued development of the model. Subscription-only access would also allow potentially delicate data to be distributed and queried via the three-dimensional model with users requiring a password and user name to view such levels of data;

- concerned citizen usage/public participation - the use by concerned citizens and the role of public participation would be both educational and participatory in the sense that interested groups and individuals would use the model to learn about London and/or to visualize other proposals. This is seen as the main level of usage of the model with the link to e-democracy and the evaluation of 'what if' scenarios informing digital planning at the citizen scale;

- virtual tourism - the use of such models for tourist navigation and visualisation is a side product of the development for digital planning. A version would be developed in which users of the model on the web can learn about London as tourists, using it to navigate and view scenes, picking up web sites of interest, not unlike our *Wired Whitehall*. With the appropriate level of underlying data, such a model could also be used for marketing areas in London to encourage outside investment in the city; and

- educational usage - we have examined how three-dimensional models and simple geographic visualisation can be used for education in the Hackney Building Exploratory. Virtual London is proposed to provide a resource for education, linking into the National Curriculum through subjects as diverse as geography, civics and history. This will be co-ordinated firstly by the education department at Camden and then on a wider basis by the GLA and the Hackney Building Exploratory. Education is a key aspect of digital planning as it reaches out to an audience which is often not part of the consultation process. Educational visualisation would be through a multi-user collaborative system such as that used in *30 Days in ActiveWorlds* which we presented in Chapter 7. This would form part of a secure closed educational network in which schools would met up and discuss issues relating to the National Curriculum in a virtual environment. The model would also be able to link in with university-based education for urban planning, architecture, and virtual environments. In the same way as professional usage, students would be able to load in their own models in closed sections of the networked site for visualisation and evaluation of design in the London context.

We will now turn to the elements in its construction and identify the various options involved.

9.5 Technical Development

The development of Virtual London pulls together many if not most of the ideas documented to date realising their potential to develop a truly virtual city which can be occupied, queried and manipulated by citizens within a collaborative environment. Its 'Citizens' will be professional interested parties, those using it for education, and those from outside London using the virtual environment for other interests. As such the technical development is based on the visualisation of not only London's physical built environment but also the integration of underlying data and the production of bandwidth-friendly multi-user models. A number of these issues have already been examined through our examples presented in earlier chapters. However the backing of the GLA will enable data providers to use and input their data that has not been available previously; we illustrate the development route in Figure 9.7.

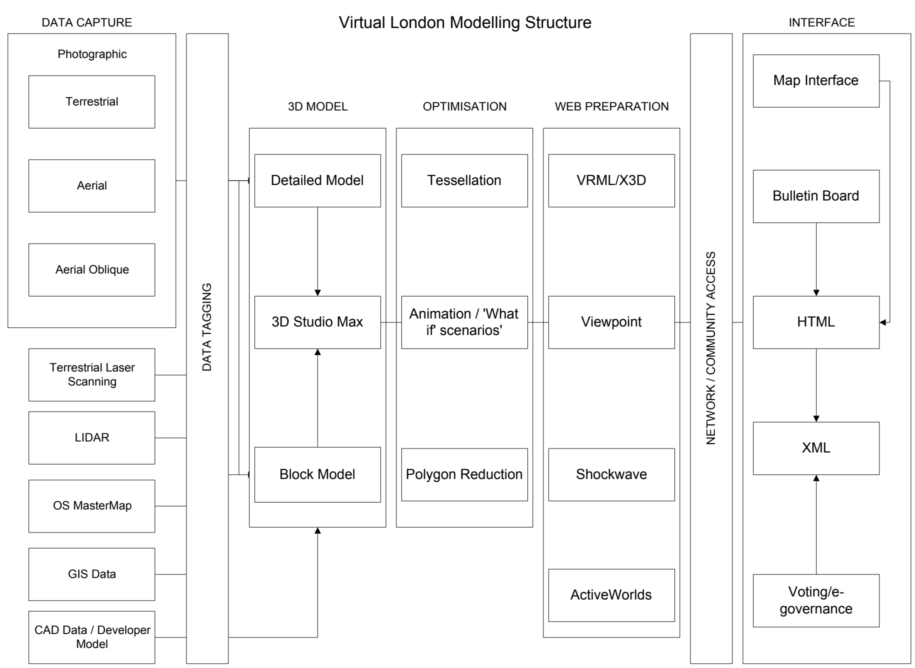


Figure 9.7. The Virtual London Modelling Structure.

9.5.1 Digital Map and Height Data

The acquisition of suitable digital data is central to the development of virtual models. A number of the academic prototypes developed as part of the *Shared Architecture* project were built from simple postcard images resulting in low resolution texturing. The use of high quality aerial image data is important if quality is to be maintained in the sections of the model focused firstly on the Kings Cross regeneration area which will be photorealistically rendered. Oblique aerial data will be acquired from the use of the Ordnance Survey blimp, which is being donated to the data capture section of Virtual London. Blimps are suitable for the capture of oblique aerial photography for a number of reasons. Firstly they are able to fly at a lower level than aircraft and helicopters over urban areas, and secondly they are able to achieve a slow and steady flight path, suitable for purposes of data capture.

To ensure that the model is geo-referenced and constructed in a manner which makes it applicable to capture additional data, the Ordnance Survey is contributing its MasterMap data for London. MasterMap data is layered into nine themes: roads, tracks and paths; land; buildings; water; rail; height; heritage; structures and boundaries (Ordnance Survey, 2002). Each feature has a unique Topographic Identifier, known as a TOID with the data supplied in Geographic Mark-Up Language (GML). TOIDS provide a unique 16-digit code for each feature enabling easier data analysis and data sharing (Ordnance Survey 2002). Previous examples such as the *Dounreay Nuclear Power Plant* model used Ordnance Survey Landline merely as background for this data is topographically unstructured. MasterMap is a cleaner, richer version of this dataset. As a result, the data is presented as series of closed polygons where each feature is referenced as part of the TOID system. This in turn linked with GML, makes data directly taggable to features with an ‘unique code’, which, in terms of three-dimensional modelling, allows integration of a common database feature and thus the ability to change the visualisation on-the-fly as a result of the shared attributes.

An example of this would be the ranking of rental levels in London. Data could be ranked according to TOIDS in two dimensions that would be directly linked to the third-dimension through the use of Extensible Mark-Up Language (XML) thus creating a direct data link. Extensible Mark-Up Language is the basis for the Viewpoint modelling format as discussed in Chapter 8, thus allowing two-way communication between the two- and three-dimensional data sets. In a similar fashion, GML currently in version 2.0, provides the route to integrate geographic data with the three-dimensional models of Virtual London. The Geographic Markup Language is defined as an XML encoding for the transport and storage of geographic information, including both the spatial and non-spatial properties of geographic features. This specification defines the XML schema syntax, mechanisms, and conventions that:

- provide an open, vendor-neutral framework for the definition of geospatial application schemas and objects;
- allow profiles that support proper subsets of GML framework descriptive capabilities;
- support the description of geospatial application schemas for specialized domains and information communities;
- enable the creation and maintenance of linked geographic application schemas and datasets;
- support the storage and transport of application schemas and data sets; and
- increase the ability of organizations to share geographic application schemas and the information they describe (OGC, 2001).

The sharing of data is often problematic due to varying standards but the focus of GML, linked to the Ordance Survey TOIDS allows us to take data supplied and present it in a common form based on a three-dimensional geographic location. Such data provides a level of accuracy to the proposed model which has not been present in many of the applications we have so far documented. With examples such as *Woodberry Down Regeneration,* it has been argued that the most important factor is a sense of location and space in the move towards cyberplace which we explored in Chapter 4. To allow a wider audience and a range of professional activities, any large scale city model needs to be accurate to allow analysis such as line-of-site analysis for the telecoms industry, to name but one example. As such, not only building outlines and locations need to be geo-referenced but so does the three-dimensional height data. To achieve this aim, a number of routes can be explored using the data available.

For the non-photorealistic sections of Virtual London, simple prismatic models will be extruded from the footprints of MasterMap data. Basic height data is available from a number of sources. Cities Revealed for example have average height data for Central London, extending in a circle from the City to the northern edge of Hackney. This data was used to create the UCL Computer Science model and involves a simple case of linking height data to building outlines. Average height data can also be derived from LIDAR provided by InfoTerra. LIDAR is data rich, providing a high number of points for each building; these points can be averaged out, again by overlaying MasterMap data and thus extracting average height. Work is also being carried on extracting roof morphology from LIDAR data at UCL. Such research links are important to the success of such a data-rich project; the ability to tap into graduate student projects from specialist departments allows a broadening of the research while maintaining the aim of digital planning. Roof morphology is key to a sense of location and place from the birds-eye level, yet it proves the most difficult to obtain if the model is not derived from photographic data. Cities Revealed have categorised their average height data with a range of roof types and while this will not provide a true representation of London, it will provide a rapid prototype for producing surrounding context into which more detailed models can be inserted.

Although primarily funded as a system for digital planning, the model would consist of a number of layers of data linked to the third-dimension. Data such as aggregate deprivation data from government, property, building use and condition, land use and so on can be tagged to the model using the TOIDS system. Camden would first aim to integrate their GIS data with the model for analysis, linked via XML to achieve on-the-fly visualisation of data queries. To achieve a high detail of precision for existing key buildings, the project also has access to terrestrial laser scanning technology. The system works in a similar fashion to LIDAR, bouncing lasers off the building to build up a point cloud of its external structure. Combined with photographic data captured from the same point as the laser scan, a highly accurate model can be produced of key buildings. However because of the amount of data captured, again similar to LIDAR, the models are not suitable for Internet distribution. This is an emerging area of research. Although such data may not at first sight be applicable to internet models, new optimising methods are being developed which may extend the way our ability to scan local areas and extract basic texture mapped geometry, in a way similar to the current capture of panoramas illustrated earlier in Figure 5.7 and used throughout this thesis.

9.5.2 Software and Hardware

This research has aimed at the development of three-dimensional models for the low-end-user, i.e. using standard home and office-based computer systems with equivalent low-bandwidth networking. We have documented the examples developed of virtual cities which require high-end computers to both produce and render fly-throughs and this is a known development path. However although with the level of funding available, it would be possible to utilise such systems and their hardware, thus straying into the traditional CAD approach, this is not suitable for digital planning. Software used for the development of these models will be based on the technologies we have already explored as well as new ones that are emerging, placing the emphasis on new developments which do not build on the tried and tested but somewhat limited techniques of CAD. While this approach may seem contradictory, it is viewed as essential if the ethos for developing digital planning is maintained. This research has not been about utilising known routes as these have often ignored the network and the interface requirements of users. They have also used established software aimed at the planning, design and architecture market which is dominated by a few software companies. By continuing to research emerging software and finding ways to link them as was the case for linking photorealistic visualisation with *ActiveWorlds* in the *CVDS*, we can push forward innovative methods for modelling and communication. As such, although available to the project, it will not be focused on the typical Virtual Reality Centre approach of showing city models in CAVE type situations, but on the desktop with standard modem communications. A second phase will move this research towards broadband networks.

9.5.3 Interfaces

The modelling structure which we illustrated in Figure 9.7, allows for the development of innovative interfaces. When integrating GIS data with three-dimensional models, the simplest route is to present the two-dimensional map data alongside the three-dimensional data. This is how the first prototype for Virtual London was presented which we illustrate in Figure 9.8.

The left hand side of the screen held the GIS data which was provided through the use of ESRI's ARC Internet Map Server. Data was layered in such a way as to trigger both a three-dimensional model, in this case the Houses of Parliament developed in the *Shared Architecture* project, and an interactive panorama. Although this allows the linking of GIS data to such a three-dimensional model, data communication is only one-way. Models can be hotlinked to the three-dimensional models but not vice-versa. In effect, the models are only 'eye-candy' and do not contain any data which can be queried. Such a system is simple to develop as it utilises off-the-shelf packages but this results in running both the GIS and the three-dimensional model independently. This places severe computational demands on the end-user's machine, decreases the available space to display data, and increases the amount of bandwidth required to successfully use the system. It does not comply with Brutzman's (1999) requirements. The technical development route allows us the opportunity to effectively integrate the functions of the GIS into the three-dimensional model. The implications of this are that it removes the requirement for the traditional two-dimensional plan, the current basis of the planning system. We illustrate this move away from the two-dimensional interface in Figure 9.9.

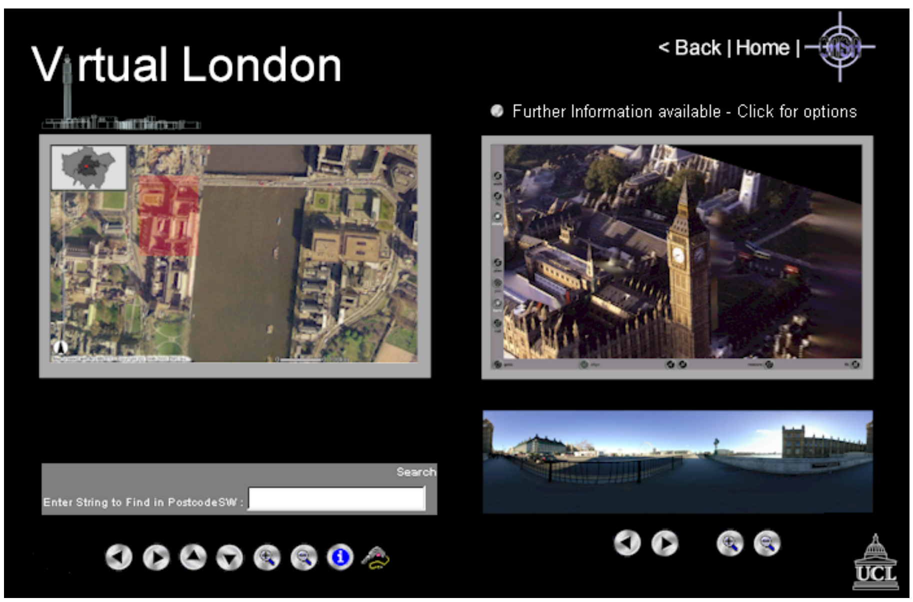


Figure 9.8 Prototype Interface to Virtual London.

Data is integrated via XML which allows effective multi-way interaction between both the underlying data set and the three-dimensional model. Whereas the GIS is often viewed as a separate section to the model, using XML the data is an integrated part of the solution with the third dimension used to display information. Additional information such as websites from outside sources and other visual data, for example panoramas, can be displayed in a separate window. This window would be optional, allowing the full browser environment to be given over to the three-dimensional model with data displayed via XML 'hotspots' and icons. We are not saying that there is no requirement for a two-dimensional plan for as we have noted this is an integral part of the planning process. Instead plans would be loaded simply as an additional layer in the three-dimensional model that can be moved to the second dimension for plan viewing using top-down views. Data analysis would take place via a series of options and tools built into the browser which would send queries to the external database modifying the XML code accordingly, thus allowing changes to the three-dimensional model on-the-fly.

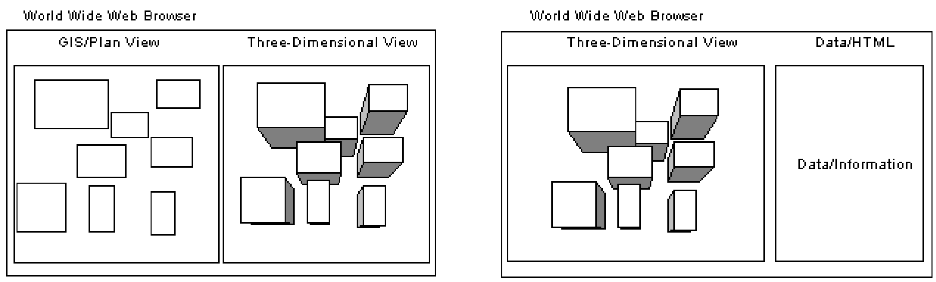
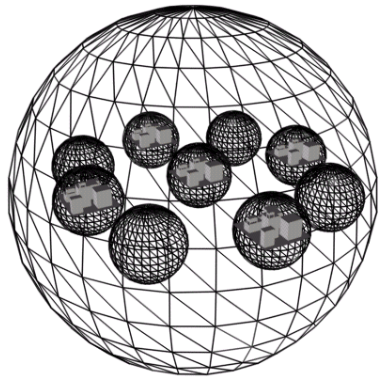
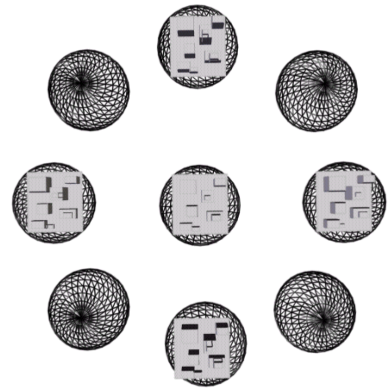


Figure 9.9. GIS Linked to a Three-dimensional model and the Proposed Integrated Three-Dimensional Model Allowing Information to be Displayed.

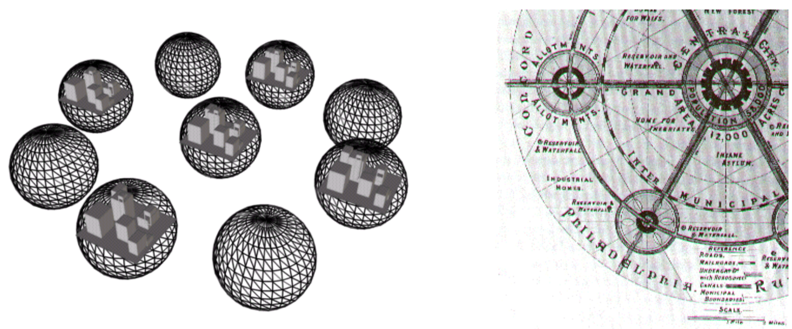
The multi-user interface would be based around the ActiveWorlds browser. The multi-user aspect will enable collaborative design as well as an environment which acts as a teaching resource for a network of schools in the Camden area. Moving into a collaborative environment changes the technical requirements of the model. ActiveWorlds is not XML compatible, and thus to enable data and the three-dimensional model to be updated in real-time, the environment would be linked via a database, in turn linked to the GIS system running in the background. Utilising ActiveWorlds technology enables the possibility of developing the true virtual city which we detailed in Figure 7.21. The first phase of development would be based on the Kings Cross area of London which represents one of the developed 'globes' in Figure 9.10.



9.10a Sections of Virtual London held in an overall Virtual World.



9.10b Top down view illustrating the sections, both developed and non-developed.



9.10c Oblique view drawing comparisons with Ebenezer Howard's (1898) Satellite City Network.

Figure 9.10. Sections of Virtual London Forming a True Virtual City.

As Virtual London develops, each photorealistic section would be built within its own geographic area enclosed within the collaborative environment. Each of these sections would be linked via a series of teleports, similar to Howard's (1898) Inter-Municipal Railway as discussed in Chapter 7. The key to the development of an occupied Virtual London is the placement of non-developed areas within the virtual environment. These areas would be open for free building as in *30 Days in ActiveWorlds*. The object set would be custom developed to represent 'typical' London housing and street furniture, allowing a higher level of realism of the environment than possible in previous research. The non-developed areas would allow a non-grounded satellite virtual city to develop. Due to the nature of virtual space, there would be no specific constraints on size. The non-developed areas would act as sprawl outside of the geographically correct model of Virtual London. These satellite non-developed areas would act as the space for citizens of Virtual London. Citizens who would be able to embed their own information in the model in the form of HTML links. The central developed sections would be password protected for development allowing 'what if' scenarios to be carried out by the various parties involved, thus providing an integrated system linking grounded and non-grounded initiatives.

Although the inclusion of *ActiveWorlds* means a two-tier system in part, the development path of the model illustrated in Figure 9.7 results in a simplified route with the optimised three-dimensional output being ported to RenderWare format. It also provides a unique opportunity to allow a true Virtual City to develop with digital planning central to its theme in the wider context of citizen experimentation through participation.

Chapter 10

Conclusions

We now draw together our research detailed throughout the previous chapters with the aim of taking stock of the current situation in digital planning as well as speculating on the future.

10.1 General Conclusions

Conclusions in such a field as this one are often difficult to draw, as the technology is constantly changing. This has been evident in our research examples when we compare *Wired Whitehall* with *Woodberry Down Virtual Regeneration.* During the course of this research, the level of interaction and what it is now possible to communicate over the web has changed almost beyond recognition. However this research has not been technology led, the methodology has remained the same but technological changes have allowed our notion of a Public Planning Support System to become a realisable goal.

The thesis has trodden a fine line between planning theory, cyberspace, the web, and virtual reality. Within these realms, it is all too easy to fall into the trap of speculation bordering on science fiction. Indeed the introduction to Chapter 1 starts with the quote from Neal Stephenson's' 1992 novel **Snow Crash** with the description of people being pieces of software called avatars in the Metaverse. Along side this stands the quote on public participation by the leading planning academic, Peter Hall, and it is the jump between these two quotes that this thesis has aimed to bridge. Whether planning is ready for such a jump is arguable, but there is a middle way between the slightly speculative avatar-based work we examined in Chapter 7 and what can be developed for a local authority planning website, as we demonstrated in Woodberry Down. It is possible to use cutting edge technology to inform the public and gain the all-important sense of location and place as long as it is hidden behind a user-friendly interface.

One of themes running through our Chapters is based on Klostermanns' (1998) view on academic prototypes and the reasons why research rarely makes the leap to mainstream usage in planning. In part this has been a result of the ideology behind the University system itself, especially in the United Kingdom. The system puts up barriers which makes the whole process of moving research outside of the University environment a frustrating experience. Issues over ownership, overhead costs, and consultancy contracts are to be expected but not to such a level that they restrict the research becoming useful and usable, thus completing the research cycle. Without the ability to find other paths, the Woodberry Down Virtual Regeneration work would not of taken place, thus leaving the thesis with a series of interesting prototypes but not a full working example. Working examples can then have a snowball effect which we have seen leading to the take up of Virtual London by the Greater London Authority (GLA). The model, once produced, will be a standard for all future model integration for development in London. It is at this point where this research begins to affect how we might design the built environment in a much wider context than was possible in Woodberry Down. With a digital model in place, the GLA will encourage developers to submit their own models as part of the planning process, models which can then be viewed and commented upon over the web. This is digital planning with models at the heart of a wider communication system, allowing many interested parties a say in the process.

Such a drive by the GLA is not of course purely as a result of demonstrating the work contained in this thesis. It is a combination of timely interest from the Government in e-democracy and the current wave of hype surrounding web-based technologies. We noted at the outset of this thesis that technology arrives on a wave of hype, rarely living up to its promise. Computers have been seen as changing the planning process since the introduction of the main frame in the 1960's. Batty's quote in 1991 that '… technology affects what we plan, how we plan, who plans …' stands true but the emphasis is now on 'who plans'. Computers to date have no doubt revolutionised the planning system, but this is only internally with the production of digital maps, word processing, database organisation and such like. They have not had much influence on who plans; it is in addressing this change where the fundamentals of the thesis lie.

Public participation in the planning process is often controversial due to the nature of how people react to changes in their environment. Since the Skeffington Report in 1969, planners have embarked on a series of well meaning but somewhat amateurish exercises in information-giving (Hague, 1999). Such exercises have developed distrust in the planning system in the eyes of the public, a distrust implying that peoples' views are not noted and issues not openly debated. We have argued that the only way to improve the planning system in a democratic manner is to open up to delegated power and even citizen control in accordance with Arnstein's (1969) Ladder of participation. Non-digital methods of participation can be innovative, although the innovation often comes from outside parties rather than the planning department itself. The involvement of The Architecture Foundation in the development of the Teviot Community Centre in Tower Hamlets (London) is testament to that. Purely non-digital in nature, it combined the best aspects of participation; firstly by having an open 'fun day' for the local residents to come onto the redevelopment site and talk through ideas with the planners and architects involved; and secondly by following it up with focus groups and 'Planning for Real' type exercises. If these ideas had been supplemented with a digital version viewable via the web, the participation exercise could have been on-going throughout the site's development. The site is now of course digital in the form of *The Glasshouse*, which we developed. Although it was not technically feasible to produce the level of interaction digitally at the time of the participation exercise, it is now online as an example of best practice, courtesy of The Architecture Foundation.

In Chapter 3, we argued that a media shift in planning communication is required as part of the bigger picture in the successful use of computers in planning. For a media shift to happen requires a realistic communication of the built environment via mass distribution methods, in our case the web. The basis of this communication is visual of course, moving our perception in physical space to the digital realm. In Figure 4.1, we drew comparisons to the physical and the digital attributes of space. As these attributes of space are increasingly transferred into digital form via advances in technology, we are able to create a digital space. With increasing levels of realism and online communication, the boundaries between physical and digital space are increasingly blurred in terms of the space we defined as CyberPlace. CyberPlace is a populated digital space; it is in this space that digital planning can take place. This is at the edge of the current examples we have developed and as yet, is only of use in a University teaching context for distributed lectures. As part of the MSc course in Virtual Environments, for the last three years we have bought together students from the US and the UK for collaborative design within a virtual environment. Using the same principles behind our project *30 Days in ActiveWorlds,* students have been able to design and build regardless of location. It is a large leap between these virtual worlds and online public participation but we have demonstrated that it is possible to import our digital photorealistic models into such environments and manipulate them remotely using groups of participants.

Such systems hark back to the development of computer games and indeed a number of research initiatives have been taking a cue not from the planning or architecture profession but from the gaming standpoint. It is only by thinking outside the box of planning and architecture that innovation can be introduced into visualising the environment and this is especially true when aiming to communicate it via the web. By moving away from the tried and tested methods of public participation and visualisation, we are producing a blueprint for a new planner's toolkit, which involves various digital methods to ensure authorities can effectively communicate planning issues in digital form. 'Planning for Real' systems come as kits containing cardboard and glue to construct models whereas our kit is digital. However an expert-user is required to construct such digital systems. This switches around the emphasis commonly encountered with geographically orientated software in that an expert-user is required to operate them. In contrast, digital planning is aimed at communication, thus ensuring they are easy to operate despite the expertise required to build them.

The level of expertise needed to construct the examples produced throughout this thesis is a considerable constraint on rolling out a system in toolkit form such as 'Planning for Real'. A number of software packages have been utilised and part of the expertise is in moving models and visuals back and forth between these packages until the desired outcome is achieved. It would obviously not be possible to replicate this within a routine planning department. As such, digital planning may well become an off-shoot of the current planning system with small companies specialising in providing visual planning data via the web, CD-Rom or through information booths. As the software is further refined, the level of hand coding required is diminishing. With the Woodberry Down example, the software was in Beta testing and required considerable coding by hand to make the required functions operational but the process now involved a simple 'click to add' process in its current software form.

There is no doubt a developing interest in the production of three-dimensional models to aid planning. The town of Swindon in the United Kingdom has recently advertised its desire for tenders in relation to building a model of the town, aimed at a number of users and applications distributed throughout the local authority. The acknowledgement that such models can aid a local authority is reassuring. During the initial stages of Virtual London and the worldwide review carried out on virtual cities by CASA, the Corporation of London were sceptical on the benefits of a three-dimensional digital London. Of note though is Swindon's requirement not to have the model integrated with their GIS system. Such a model is likely to be in CAD developed in a similar vein to the model of Bath we examined. As such, it may well suffer the same pitfalls of being fixed and not suitable for web-based distribution. The focus is once again on the traditional CAD output rather than using new technologies and allowing a web-based model which could in addition be linked into a GIS.

We have criticised the effectiveness of GIS in terms of planning departments and this criticism still stands true. GIS are expert systems which require trained users and thus planning departments are not able to make full use of their features. A lot of research is going on in the GIS field but mainly in university research departments such as CASA and thus the impact of such research on planning is small. This may require a new insight into how things are planned. If the emerging field of 3D-GIS holds up to its initial promise, it could open up many valuable new uses and applications of GIS. Within Virtual London, part of the task is to link the three-dimensional model to unique identifiers so data can be integrated from within GIS. This allows each section of the model to be unique and tied to a database of information, allowing spatial analysis to be carried out as well as allowing updates or changes to the model to be easily integrated. To some extent, this is now possible via the emerging 3D-GIS packages such as ESRI's ArcScene which has the ability to import models in CAD formats where three-dimensional queries can be carried out. The next line of research in Virtual London is to transfer this to the web. All the different elements for this transfer are already feasible, many components of which have been presented and developed through this thesis. The difference between packages developed here and those such as ArcScene and web-based 3D-GIS are of note too as the former allow the use of photorealistic models as well as the ability to network them over the web.

The key to digital planning is not the computer as such but the network. It is the rise of the web that first led to the notion of Online Planning and it is the technologies that have evolved to be run over the network that have allowed this research to generate the level of success it has had. Without the network, computers in planning are restricted to stand-alone machines running traditional desktop software adapted to planning and architecture. Once the network is introduced, new and innovative software becomes available as well as the many obvious benefits of distributed communication. The most beneficial non-visual aid to the planning system of the digital network is arguably the bulletin board. Although not widely utilised to date, the potential it holds for participation that could reshape the planning system. The concept is simple and such boards allow people to have a free and open say in any developments, be they local, national or global. Of course the communication of bulletin boards is multi-way and for them to have any impact on the planning process, those who plan need to listen to the views posted and post back. It is at this stage that the Woodberry Down application ran into problems although a growing number of residents are now using the board to discuss wider issues such as the area's drug abuse problems. As such, the biggest constraint on digital planning is not tied into computers or software for these can be overcome. It is the planning system itself.

The Woodberry Down Redevelopment Team initially aimed for the bulletin board to be central to the consultation process. The problems experienced in maintaining the site should be seen as only a short term blip in the wider regeneration process. Political and organisational changes inevitably took their toll on the supply of information and a website is only of use if the information is up to date. Such problems can be rectified but it is the legal stance on posting information to a bulletin board which is of more concern. If a local authority department is unauthorised to post messages to a board due to legal ramifications, it jeopardises the whole concept of digital communication, whether that be via a bulletin board, email or other messaging systems. The only way around such issues is to use a disclaimer at the bottom of any message (although these are of dubious legal standing) or to post information anonymously. Anonymous messaging or posting under a pseudonym, however, results in information based on rumour with no official authorisation. This is obviously no way to run a system which is central to the consultation process but it is a major issue which, at the time of writing, is still to be resolved.

The portrayal of space has been divided between the second dimension in the form of zoomable maps, the third dimension with panoramic imagery and interactive modelling, and with the addition of time a fourth which charts development options. The most effective method to communicate spatial information over the web is debatable. Woodberry Down has the potential to use all of the dimensions and techniques developed from augmented reality through both interactive models as well as panoramic images, as in the Wates Built Homes example. The choice of whether to use full three-dimensional photorealistic models as in *Shared Architecture*, non-photo mapped models as in *The Glasshouse* or simple panoramas has not been closed off. Panoramic imaging has been used since the early days of photography and with digital techniques, it can be augmented to provide 'what if' type scenarios. These provide a rapid way to communicate the built environment over the web and since the development of *Wired Whitehall* and later *Woodberry Down Virtual Regeneration,* new 'single shot' panoramic lens technologies have become available. This allows a full 360-degree scene to be captured in a single photograph, effectively eliminating the need to stitch together multiple images and the problems which arise from this technique with moving objects. Although such lenses do not allow the sort of 'urban bubbles' as used in Woodberry Down to be produced, they do provide the same output as Wired Whitehall. The ability to capture a scene in a single photograph is a notable advance in the technology, both in terms of the cost of developing panoramic coverage of a site as well as the technical ability required. Panoramic imagery is now available to the non-professional-user and as such could be widely adopted by local authorities to enhance, to name but one example, development plans.

One such example of rapid panoramic imaging is the work for the Bloomsbury Improvement Group (http://www.bloomsburygroup.org.uk/). We are developing a series of panoramic images taken at each road junction for the group to provide a virtual tour of the area. It will also act as a location reference for the reporting of crimes in the area. This is an on-going project but one which would not have been possible without the use of panoramic lens technology. It aims to act as a further example of how local authorities can use imagery to rapidly provide a sense of location for an area which can be augmented if any new developments are planned. Therefore the question we are posing in the conclusion is whether there is actually a need for a full three-dimensional model. This in some ways goes against much that has been research in this thesis, but it is an important question to raise having developed the various research examples.

Three-dimensional models are required if any spatial analysis is to be carried out as in the plan for Virtual London. They also add the ability to view design options from any angle and interactively change the landscape as in our Tottenham Court Road example. Such options are not necessarily required however in terms of public participation. Visualisation of various regeneration options for Woodberry Down could be carried out in a similar way to the Wates Built Homes work The place where three-dimensional models are of unquestionable value is in the professional planning and design stage and as such, the models used in public participation would be a by-product of the original design criteria.

The use of three-dimensional models finally moves us on to conclusions with regard to the virtual city. As we have noted to date, a true virtual city has not been produced as yet. There are virtual world systems such as ActiveWorlds and gaming systems such as Ultima Online, but none of these replicate a real world city. We have shown that it is possible to import our photorealistic buildings from Shared Architecture into ActiveWorlds. This ability holds the prospect of building a true virtual city in the guise of Virtual London. The export of models into such an arena is straightforward and benefits from being non-fixed so each object can be linked to a central database and new models imported as and when needed. In addition to this, data can be tagged to each model. Combine this with the avatar-based exploration of the system and a true virtual city develops. It is in this arena that the concept of digital planning moves up a step from the Woodberry Down example to a populated CyberPlace. The research and technologies to build such a system are in place; with the backing of the GLA, the production of the virtual city is now a real possibility.

10.2 Future Developments

Speculation on future technology in digital planning is of course hit and miss. The current wave of hype in home-based digital technology is wireless communication linked to personal digital assistants (PDA's). Such technology has a unique place in digital planning as it is location aware and portable. Linked with a global positioning system and a simple GIS such as ESRI's ArcPad, it is possible to plot your location and more importantly launch additional functions according to the user's geographic standpoint. We have already managed to run photorealistic three-dimensional models and augmented panoramas via PDA's. It is only a simple step in ArcPad to launch an augmented panorama or model when the user reaches a set geographical location which has a pending planning application. This results in the user obviously being able to see the site as well as seeing its impact. This is dependent on GPS technology which due to its inability to transfer through the built environment, is not suitable in built up areas such as Central London where it is difficult to get a satellite signal. A solution to this is local wireless networks which send information to a suitably equipped PDA within range. While this offers the same solution, it requires computers to be placed in each location and is therefore not practical. Such solutions are more suitable for retail usage providing customers with details of products when they enter a store. Although with the expansion of Wi-Fi networks especially as part of local community networks, it would be possible cover a wide area with a single source of information.

Such technology is obviously not mass market and linking digital planning to PDA's, GIS and GPS could be seen as using technology for technology's sake. We have already moved into this area of research although it should be noted that the methodology remains the same, to provide mass access to visual planning information, to inform the public, and to encourage participation in the planning process. PDA's are not mass market and are not likely to become so in the near future but to extend digital planning to as wide an audience as possible requires a mass-market hardware solution. In Woodberry Down, we got round this by installing computers in the residents' homes, thus providing access to information. Future mass-market mobile communications solutions need to turn to mobile phones which have a high market penetration. The next generation mobile phones promise streaming video and applications which could be adapted for digital planning. The small size of the screen however makes practicality questionable although solutions may be found.

In terms of more standard computing advances, the development of graphics cards, pushed forward by the gaming industry, is set to continue. Increases in processing power and bandwidth availability will allow an increasing complexity in three-dimensional models on standard home computers. This is a continuing process, clear from the time scale of the research examples developed to date. The question that needs to be posed is will computers become a mass-market appliance in the future? 'Wiring residents' homes to allow access to information is not possible for the majority of projects so where does this leave the digital planning process in the future? Digital television provides one route although the current level of technology is not suitable for interactive three-dimensional modelling. The focus therefore will remain on personal computer-based for the foreseeable future, although with ever increasing technological advances, the foreseeable future is ever shortening.

10. 3 And Finally

This research has contributed to knowledge of planning, architecture, and geography as well as the wider field of virtual worlds. Digital planning is a wide-ranging research area, wider than the planning process itself. Planning needs to keep up-to-date with technology to ensure it remains a proactive rather than reactive discipline. Whether the planning system openly adopts such a communicative and visual approach to public participation remains to be seen but the initial signs are reassuring. E-government has the potential to lead the way to adopting the technologies we have explored. Indeed without the current political climate, it is doubtful whether the GLA would have taken steps to fund Virtual London and thus continue the research started here.

By carefully applying digital technologies, we have the chance to fundamentally change the planning process, not by academic prototypes but by fully working examples. Although the future of the planning system is digital, paper maps and public meetings may still have a role but these roles are increasingly showing their limitations when compared to their digital counterparts. Through tools and applications, this thesis has demonstrated how strong the case is for this kind of digital planning.

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