Diversity in Virtual Reality Landscape Modelling

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Abstract

This paper examines the range of decisions that landscape architects need to consider in communicating the future of the landscape. The objective of this research paper was to investigate the issues affecting the landscape modelling process. It also aimed to provide a better understanding of the creators of landscape visualisations and the role they play in determining what audiences, often from many disciplines, see and debate. Interviews were conducted to gather ideas from practice and academia. The paper acknowledges that this was a limited exploration with the intention of establishing a base for a further study. Issues relating to the diversity of audiences, diversity of interpretation, appropriate levels of representation and representing the passage of time in VR models and technologies currently available for VR modelling were the focus of the interviews.

1 Introduction

Landscape visualisation, whether it is a perspective drawing, a built physical model, a photomontage or a Virtual Reality (VR) model of a proposed scheme, focuses on what the future landscape is going to be and how the proposed scheme will impact on the existing features. Within landscape visualisation the most important two elements therefore are being able to understand the existing-*the reality* and envisage the future-*the intended reality*. As ORLAND B. et. al, (2001) point out, "the ability to imagine the reality of a design concept depends on the viewer's experience". As a result, any sort of visual communication where this experience is enhanced by presenting a combination of reality and the intended reality would improve, not only the lay person's, but also the expert's understanding of the effects, implications and opportunities of the proposed scheme. The landscape modeller therefore needs to make decisions on diverse issues to make this understanding clearer for the viewers.

2 Background

2.1 Visual Communications in Landscape Architecture

Before the digital age and the use of computers in design and design representation, visual communications such as paintings, plans, sections and perspective drawings were used to provide the opportunity to observe the proposed developments. Although the use of the computer as a drawing tool was born in the early 60s with Ivan Sutherland's "Sketchpad[1]" and the origins of VR can be traced back to the Morton Heilig's "Sensorama[2]" in 1962 and also to Ivan Sutherland's first "head-mounted display[3]" in 1968, the landscape gardener Humphry Repton[4], (1752-1818), can be seen as the true ancestor of today's interactive visualisations for Landscape Architecture. Repton gave his clients the opportunity to interactively evaluate his design by flipping between before and after perspective drawings in his famous "Red Books". Repton not only offered the chance to see the proposed developments in his "Red Books", he also gave detailed information on the condition of the ground and his thoughts about it. He supported his drawings with information in order to provide solutions to the design problems in hand. Fundamentally he compiled an inventory of information available for his client's use.

Nowadays landscape modellers are increasingly taking advantage of the "computer generated three dimensional interactive environments[5]"- VR environments, to help find solutions for the real-world problems by using the wide range of possibilities that these environments offer. Since it is not feasible to try what-if scenarios and possible solutions for a design problem by experimenting in situ, three-dimensional models, animations, fly-throughs, simulations and VR models are increasingly used for representing design solutions and to facilitate the decision-making process in landscape architecture. As ERVIN and HASBROUCK (2001) point out "the power of digital models is that from a single model, multiple views can be rendered, at will…Not only various different perspective viewpoints be tried out, but also different drawings altogether: plans, sections, axonometrics, as well as non-graphical views like parts lists and cost estimates can be produced".

These immersive and interactive digital models are being used for decision making purposes in landscape design and planning and many other allied disciplines such as forestry, mining, agriculture, architecture, construction, urban design, and urban planning. They are used for environmental impact assessment studies, reclamation studies, planning applications, design approval applications, plant growth assessments, construction management/cost analysis, user satisfaction studies, urban regeneration proposals etc. Consequently VR models need to be suitable to the problem in hand (i.e. level of detail, scale etc.), and ought to equip the viewers with the necessary understanding and knowledge of the proposed scheme.

2.2 Methodology

The aim of this study to review the diverse choices landscape architects/modellers need to make regarding the VR models they create. This study is based upon literature review, documentary source analysis and interviews. Qualitative research methods were seen as the most appropriate way of collecting, analysing and reporting data for this study. Semi-structured interviews were conducted in order to get an understanding of the issues both

1 Ivan Sutherland at MIT developed his thesis, "Sketchpad: A Man-machine Graphical Communications System", the first Graphical User Interface. (B_of_IS).

2 WIKIPEDIA

3 WIKIPEDIA

4 DANIELS, (1999)

5 WANN et al, (1996)

practice and academia are facing. The interviews took 45 minutes to an hour, during which time four open-ended questions were asked. Interviews were tape-recorded and later transcribed and analysed. The diverse data structure and the issues affecting the landscape modelling process were explored with three interviewees-one from practice (Peter McGuckin) and two from academia (Andy Clayden and Professor Claes Wernemyr). Interviewees were approached for their knowledge, experience and understanding VR and VR modelling and digital technologies in landscape modelling. The scope of this study was kept very limited in order to establish a foundation for a more detailed study. Therefore the resulting information from this study should be considered as a pilot study for future research.

3 Landscape: A Complex Structure

As LANGE (2002) highlights "landscapes are highly complex structures covering large areas" and this complexity by itself forms one of the challenging constrains in landscape modelling. In architecture, as GIDDINGS and HORNE (2002) explain, "artist's impressions are drawings and models of design for a building that does not exist at the time of their preparation" however in landscape architecture artists' impressions-drawings-sketches-models are much more related to the existing formation whether it is natural or man-made. And, in general, landscape models represent larger land areas which would serve greater numbers of people. Although ever faster graphics cards and increasing processing power allow modellers to experiment with bigger and more detailed models, it can be said that it is neither appropriate nor possible to represent this complexity in its entirety nor it is an essential factor for every single model regardless of its purpose.

ERVIN (2001) describes the complex structure of landscape by dividing it into six essential elements -landform, vegetation, water, structures, animals, and atmosphere. The combination of these elements originates the diverse decisions that the landscape modeller needs to make regarding "time, space and place[6]". According to DISCOE (2005) the "basic steps in creating three-dimensional visualisation of landscape are to acquire raw geographical data, process them into an appropriate form, then use them as inputs to software which will construct the three-dimensional geometry". Apart from the geographical data, as in the design process, modelling requires other visual (photographs, sketches, etc.) and non-visual knowledge (history, social-economic characteristic etc) of the modelled world. "Landscape planners [landscape architects] need to make decisions about the best possible mix of land uses and their spatial arrangements in the landscape based upon accurate, detailed and spatially explicit information" (BRYAN, 2003). Communicating this diverse and some times conflicting data on a model requires not only realistic modelling but also at times supplying non-visual information alongside or within the model itself. This complex structure becomes even more composite when the "ecological, social and aesthetic missions of Landscape Architecture[7]" are considered in the modelling process (Fig 1).

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6 MACFARLANE et al, (2005)

7 THOMPSON, (1999)

VR models are great tools for the continual process of consultation, decision making and revisions of a proposed scheme. However as ERVIN and HASBROUCK (2001) point out "when a VR model will be used as a basis for a decision-making process by others, the responsibility of the modeller become greater". SHEPPARD (2005) suggests six principles (*accuracy, representativeness, visual clarity, interest, legitimacy, access to visual information*) in order to meet three fundamental objectives (*to convey understanding of proposed project, to evoke unbiased responses to the proposed projects, and to demonstrate credibility of the visualisations themselves*) for landscape modelling. Although designers, and modellers have their own way of expressing themselves in their drawings "if an architectural representation [any representation] is to be effective in demonstrating to a client what the results of his investments will be, the process of its production needs to be reliable, and the final image credible" (GIDDINGS, HORNE, 2002). It is crucial that virtual reality models are valid and impartial to the cause and explanatory enough to illustrate design solutions to the parties involved. Other issues related the use of VR models raised by WHYTE (2002) such as "those related to misrepresentation, intellectual property rights, data security, appropriate financial models and ownership" are also important factors to be considered in landscape modelling.

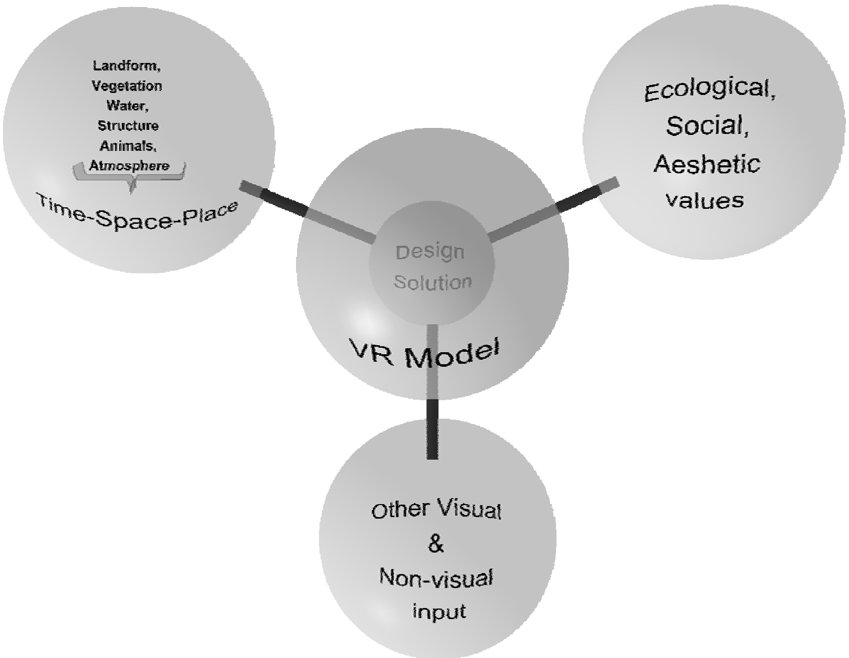


Fig. 1: The complex data structure of Landscape VR Modelling and diverse issues that Landscape models and modellers need to address (Information gathered from BRYAN, 2003, DISCOE 2005, ERVIN 2001, ERVIN 2003, MACFARLANE et al 2005, THOMPSON 1999)

4 Results and Discussion

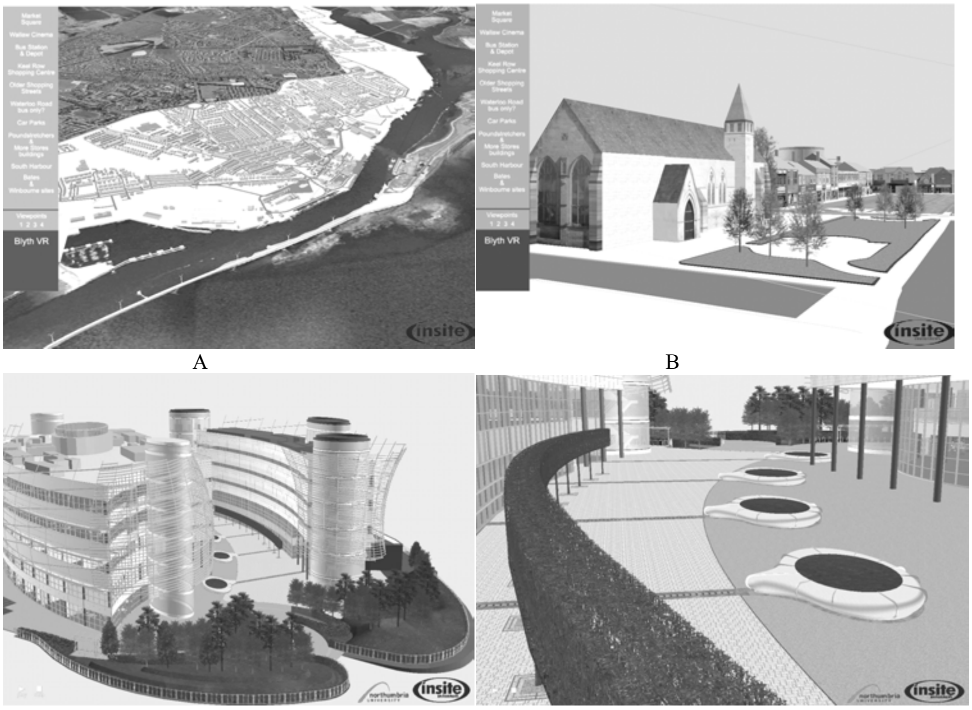
VR models are great tools to support public understanding of environmental characteristics and to allow debate on landscape issues. As one of the interviewees (A.CLAYDEN) expressed "it [VR] gives us the opportunity look at a place not only from our eyes but potentially from other people's eyes" and this gives us a powerful tool in terms of modelling and design decisions. From the analysis of the interviews it can be said that the use of VR technology in landscape architecture practice is becoming more accepted and the opportunities this technology can provide to landscape architecture education is great in terms of being able to provide 4D and nD experiences to the younger generations. During the interviews discussions mainly focused on "changing landscape over time / seasonal change etc, size of the VR models, appropriate levels of representation and supplementary information requirements". These themes corroborated with the information gathered through the literature review. It should also be pointed out that themes that are mentioned above are directly related to the concerns on being able to deliver the accurate and clear representations of the existing and future landscapes.

4.1 Time

"Most aspects of most landscape are not static; they move and change at time scales varying from seconds to centuries" (ERVIN, 2003) and unlike buildings, landscapes schemes are evolving rather than finished products. It can be said that decisions about what point in time of the proposed scheme should be represented or whether to represent various times and/or seasons in a model is really dependent on the client's (and specific scheme's) requirements. P.MCGUCKIN gives an example regarding the time factor in opencast coal mine reclamations; he believes that "using VR technology and 4D opportunities having a timeline along-side the model can explain to a client a lot of the changes that the landscape will go through during the reclamation process which can last as long as 20 years". He also explains that "the decisions on which season the model needs to be modelled or showing seasonal changes in a VR model is the clients choice and depends upon how much they want to spend on the model". From an educational perspective VR can give foresight to the inexperienced eye to examine and understand the time factor of the design decisions in landscape architecture. A.CLAYDEN believes that "VR would enable students to develop senses of the way in which spatial configuration change over time". Furthermore he thinks that, "VR allows designers, modellers to start having representations on how landscape might develop, and how it might change especially in terms of plant material".

4.2 Size

"Landscapes and landscape phenomena are large, continuous, indefinite, not easily bounded" (ERVIN 2001) and try to limit this "continuous geometrical constructs expanding over kilometres in length and width" (BOURDAKIS, 2001) in any type of model is a big challenge. Regarding the model size C.WERNEMYR explains that "the modelling team would try to identify what the natural boundary for that specific scheme is by experiencing the area, and of course if there is a natural boundary like a mountain that will define the limit". He also emphasize that "it is always important to show how the scheme will interact with its surrounding". As a functional solution P.MCGUCKIN indicates that it is better to work with the client regarding decisions on the model size and suggests that "the size of the VR model depends on the purpose of the model". As WHYTE (2002) points out "the effective use of virtual reality is task-dependent" and P.MCGUCKIN emphasizes this by explaining model size issue in an example: "when creating VR models for the National Grid power line that spread across to the country side, the modellers needed to decide how much of the country side they needed to model". He explains that the decision was made by taking into consideration the potential impacts of the proposed scheme. In a more urban context, A.CLAYDEN explains that "more and more cities in the UK are developing their digital models[8]" therefore there are opportunities here for the models of new developments to fit in with that spatial data structure. This "Google Earth" approach might therefore eliminate all the concerns regarding the size of the VR model in time especially in urban realm. Other issue regarding the size of a VR model is as P.MCGUCKIN puts it, the never ending entity of a VR model, and he gives an example of Blyth[9] regeneration VR model and how the client gradually understood that, just like the development and re-development of the real Blyth will never finish, the model will never be finished, the VR model will develop both in context and size (Fig 2).



A B

C D

Fig. 2: VR Models: A) Ariel view of the Blyth model, B) A view from Blyth model, C) New campus developments of the Northumbria University, D) A view from the new campus model (Insite Environments)

8 London, Bath, Glasgow, Edinburgh, Sheffield, Cardiff, etc.

9 Blyth, is Northumberland's largest coastal town in the North East of England.

4.3 Appropriate levels of representation

It is still difficult if not impossible to duplicate the total character of an environment around us with its wealth of information in a computer (NOTHHELFER, 2002). As SHIODE (2001) explains "...the more details there are in the model, the more cost is incurred", emphasising this, P.MCGUCKIN describes client's approach regarding the appropriate levels of representation as "The appropriate is generally determined by how much the client is going to spend on the model". Although he believes that "populating models with cars, people, cyclists etc. especially in an urban context is essential", he also thinks that populating the model sometimes might cause distraction when the model's purpose is to address the visual impact. C.WERNEMYR has a different approach when it comes to this subject. He believes that "everything should be shown on the VR model realistically". He adds that "although professionals who are used to see models less realistic and who got used to not seeing everything quite right on the VR models, it is very important to have a realistic model and right levels of details at the right time for the different types of viewers". Because he says "different viewer will focus on different details". A.CLAYDEN emphasizes that with the appropriate levels of representation some of the ownership of the design decisions can be handed over to the user groups and/or clients with the opportunities that VR technology offers. He states that "the opportunity to investigate and to explore a design through a setting which is understood by the user groups etc., related to their day-to-day experiences in a more spatial and three dimensional ways would form much better consultation process". As LANGE (2005) points out "even the 3D-visualisations are abstractions of the real world, despite having the potential to process a much higher degree of realism", A.CLAYDEN takes this one step further and highlights the issue of appropriate levels of representation during the design process by explaining "how students need to learn abstraction in order to engage with the design. By this they will leave some of the representational decisions for later on in the process and in this way students will be able to see various solutions for the design problem in hand. He believes that "students' digital representations often tend to focus on how that particular object looks rather than informing others about that particular object in the model". From a different standpoint as KIM and KIM (2006) explains "most of the 3D modelling systems of WIMP[10] style do not match many benefits of traditional tools such as pencil on paper to communicate design ideas at an early stage" and A.CLAYDEN also believes this and explains that "some of the software in use is extremely difficult to become competent in. Current VR technologies do not support early stages of design" and this affects the design options that students would consider.

4.4 Supplementary information

Since "Landscape visualisation is often used for communicating complex information about the state of a landscape and how it might change" (SHEPPARD, 2001), IT can be said that supplementary information brings together the logical bases for these complex information sets. Also WHYTE (2002) points out that "whilst virtual reality can be used to enhance understanding of the built environment, there may not be a one-to-one translation between an object in the built environment and its representation in virtual reality…same object may lead to multiple representations. Conversely the same representation may be

[10] Windows, Icons, Menus, and Point-and-click

interpreted in multiple ways”. Therefore it is sometimes necessary to use supplementary information to support the VR model. As LANGE (2005) points out “the words accompanying the visualisation, either written or spoken, potentially have a very high influence on the way the visual information is perceived”. Supporting LANGE’s view on the supplementary information theme, P.MCGUCKIN explains that he supports the VR models with verbal explanations where possible or prepares written descriptions regarding the VR model. He emphasize that especially the technology needs to be explained briefly in order to focus on the design solution in a consultation process. A.CLAYDEN adds that although supplementary information is essential, the type and the depth of the information would be different for different people. He explains this need as “different stories for different people” and emphasize that the story you would tell to a Quantity Surveyer for that project will be different than the story you might tell to the client. With a different perspective C.WERNEMYR believes that using sound will be a good supplementary support for the overall experience of the VR model. He explains that “soundless models got complaints that the VR experience of that specific scheme is so quiet”. Therefore he suggests that “perhaps in an urban context, birds and background noise of the real world would make the experience more real”.

5 Conclusions & Outlook

As a result of our study to encapsulate the diverse decisions landscape modellers face in modelling, it can be said that time, size, level of representativeness, and supplementary information requirements are the issues focused by our interviewees. Although it is always very important to see the environment in context including those aspects that are new or changing, a visualisation, whether it is a 2D or a 3D drawing or a VR model is hardly ever the conclusion for the decision making process. The dialogue-interaction between the prospective user of the proposed scheme, modeller-landscape architect, client and the model itself needs a medium that is flexible enough to handle changes and/or see other possible solutions at ease. Digital representations and especially VR models have the ability to do that.

It can be said that during the interviews when interviewees were explaining their thoughts, feelings on the modelling issues were always given by real-life examples and explaining these examples by their purpose. Therefore “*the purpose of the model or the scheme*” can be considered as a starting point for any kind of modelling decisions. Purpose of the model will determine the size, time, appropriate level of representation-level of detail, required additional information etc in the model. It should also be pointed that there can be different models for the same proposal with different purposes, approaches and requirements. Digital modelling enables us to do this. Furthermore with the technological developments in Augmented Reality, Mixed Reality realm and the ability to integrate 3D GIS data, texts, animations, etc. will enhance the viewer’s experience greatly.

We are arriving in an important era where landscape design and the way representations are produced (and therefore landscape architecture education) will be altering dramatically with the use of more sophisticated but more user and design friendly smart technology. Although the diverse decision requirements and the issues affecting the modelling process might change a little, design solutions for an n-Dimensional world will be more effectively processed in multidimensional environments.

6 Acknowledgements

Interviewees Peter McGuckin (Director of Insite Environments, Newcastle upon Tyne), Andy Clayden (Lecturer at the Department of Landscape, University of Sheffield), and Professor Claes Wernemyr (Visiting Professor at the School of the Built Environment, Northumbria University – Director of Visualisation Studio at the Chalmers University of Technology, Sweden) for giving their views openly and for their time.

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