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Computers, Environment and Urban Systems
29 (2005) 341–359
Computers, Environment and Urban Systems
www.elsevier.com/locate/compenvurbsys

Peering through the smoke? Tensions in landscape visualisation

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Abstract

Landscape visualisation using three-dimensional modelling and virtual reality techniques has emerged as a significant element of research into the environmental impacts of both location specific developments (e.g. a new windfarm) and more widespread environmental change (e.g. climate change). As a technique it has much to commend it, bringing the ability to inform and encourage participation and debate. Within the context of Information and Communication Technologies (ICTs) as a whole, visualisation techniques are becoming more user-friendly, with at least an appearance of entertainment as well. However, the techniques of landscape visualisation remain highly expert-oriented in spite of some recent moves to more directly involve users in aspects of scene preparation. Technical experts remain at the core of the process which raises significant points about the intersection of values about landscape and change and the processes by which these are communicated and understood by a wider audience.
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Keywords: Landscape visualisation; GIS; Positionality; Public participation

1. Introduction

This paper stems from the authors' previous work in three separate areas: (i) landscape scenario visualisations on the Hadrian's Wall World Heritage Site in the

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doi:10.1016/j.compenvurbsys.2004.05.006

aftermath of the 2001 Foot and Mouth Disease epidemic (MacFarlane, Stagg, & Turner, 2002; Stagg, 2001), (ii) a landscape ecology perspective on whole landscape management (MacFarlane, 1998, 2000a, 2001) and (iii) a conceptual framework for multimedia development over time (Centre for Design Research, 2004). What these three areas provide is (i) an appreciation of the potential gains and pitfalls of landscape visualisation (LV), something that is the subject of a rapidly growing literature in itself (for example Fisher & Unwin, 2002; Wherrett, 1999, 2000), (ii) a sensitivity to issues of scale and human agency in the perception and management of landscapes, and (iii) a broader conceptual framework of fun and function in physical and digital products. The aim of the paper is to combine the findings and concepts of each body of work to critically evaluate the purpose and practice of landscape visualisation. As all of the authors are professionally involved in landscape visualisation the purpose of this is not to undermine previous work in the area, but to argue for a greater level of critical awareness and transparency in the process of visualising landscapes, following Sheppard's (2001, p. 183) argument that "the preparers of visualisations—whom we can think of as the "crystal ball gazers" who conjure up and interpret the imagery—need to be governed by a code of ethics for defensible landscape visualisation". We would, however, contest that the landscape visualisers are the main *interpreters* of such imagery; their primary role is one of providing LVs to a wider, often non-expert audience of stakeholders and other interested individuals. Specifically this paper focuses on the following:

- Parts and the whole: the tension between reductionist and holistic approaches runs through the wider subject of landscape design, and many of the difficulties and tensions are mirrored in the process of digital landscape visualisation.
- Diverse interpretations: there are a huge range of decisions which LV developers need to take, all of which can imbue the scenes created with very different meanings to different individuals and groups.
- Positionality: visualisation developers occupy a critical role in communicating what are sometimes highly contingent and poorly understood landscape futures to a highly diverse audience and their significance in determining what groups see and then respond to has been insufficiently acknowledged.
- Fun or function: are emerging techniques of LV simply too absorbing an experience in a technological sense to be really effective as a tool for engaging a diverse section of the population in the more substantive concerns of landscape futures?

2. From parts to the whole

Landscapes are integrated wholes. Whether they are seen in aesthetic, ecological or human-functional terms or in a more fully holistic sense, they are comprised of interlinked parts with a synergy that elevates the significance of the whole as greater than a simple assemblage of the parts (Bell, 1993; Nassauer, 1997; Naveh, 1995). Landscapes of nature conservation, cultural and economic significance develop over long periods of time, through the interaction of environmental constraints and resources and human imperatives (e.g. food and fibre) with culturally determined priorities (e.g. conservation of rare species and protected areas). There is of course a separate and extensive field of process modelling as it relates to economic and environmental change. This field, what Sheppard (2001) terms 'conceptual simulation' (as distinct from 'experiential visual simulation') is not covered here, although outputs from such models may inform landscape visualisations as they are required to communicate and evaluate the aesthetic and cultural implications of alternative futures (Simpson, Parsisson, Bullock, & Hanley, 1997).

Landscape visualisations are typically developed through draping thematic layers and/or individual elements over digital elevation models (DEMs) which represent the topography of landscape, and then attributing the drape files with shape, size, colour, texture, orientation, species characteristics and other variables which help to define (with variable levels of detail and realism) what they represent. It is necessarily a highly reductionist approach to create a virtual landscape that people will see, relate to and interpret as a whole. This is of course a fundamental tension in any design process, but the role of the visualisation developer is a powerful one and the vision that is created through the technical process of locating and attributing features in the landscape scene is to a large degree that of the developer. The degree to which the LV developer is working to a more broadly defined agenda and design framework is variable between cases and the issue of public participation and LV is returned to later.

To develop what may seem an unrelated parallel, the Apple Macintosh computer was not initially conceived of in terms of a catalogue of required functions, but rather in terms of a relatively general vision which placed emphasis on style and form as well as function. In the initial development process function was sacrificed repeatedly to launch the paradigm-shifting interface and hardware on time. Alan Kay, a member of the Apple Macintosh design team (quoted in Levy, 1995, p. 9) has observed that:

> As with most media from which things are built, whether the thing is a cathedral, a bacterium, a sonnet, a fugue or a wordprocessor, architecture dominates material. To understand clay is not to understand the pot. What a pot is all about can be appreciated better by understanding the creators and users of the pot and their need to inform the material with their meaning and to extract meaning from the form.

This raises two significant points in the context of landscape visualisation:

(i) 'architecture dominates material', that is, however reductionist the creation process the users will primarily engage with the meaning of the whole (although some partial exceptions to this will be introduced later); and
(ii) an understanding of what the developers want you to see and what the users want to see is critical in understanding the process and outcomes of dialogue about those landscape scenarios.

So, the parts which make up the whole in an LV do not develop in an organic or more directed and planned fashion over many years, rather they are situated and attributed with a ‘look’ to fashion a landscape that may be a digital representation of a current landscape or a future scenario. In both of these the construction of the generalities and details of the landscape is critical in imbuing that landscape with meanings that individuals may respond positively to or react against. The literature on human responses to landscape is extensive (Kaplan & Kaplan, 1988; Porteous, 1996; Thompson, 1999; Williams & Cary, 2002) but there has been little attention within the much narrower literature on LV on the role of the developer (although see Ervin, 2001; Lange, 2001): just as ‘users’ seek to imbue objects with meaning, so do ‘developers’ (Levy, 1995).

3. Time, space and place

There are a huge range of decisions which visualisation developers need to take, such as geographical extent, colour, lighting (seasonality and time), texture, species selection, detail and degree of generalisation (which help to define *Genius Loci* or sense of place), all of which can imbue the scenes created with very different meanings to different individuals and groups. These individuals and groups may be involved in different ways and with different levels of influence in the process of landscape valuation, management and planning. To develop LVs, at the current state of technology, requires a large measure of what may be termed ‘expert input’. Leaving aside the process by which LVs are informed, which may be founded in scientific research around environmental processes and change or more broadly referenced perspectives on what is more or less desirable (e.g. Lovett et al., 2002), the process by which the scenes are designed, or built is not at all straightforward (Ervin, 2001; Lange, 2001). Thus technical experts need to be central to the whole process of LV, which raises the issue of how that/those individual(s) may mediate the inputs (e.g. science or consultation) through their own perspectives. The issue of positionality is dealt with in more detail in the next section, but this part emphasises the need, as an LV practitioner, to be aware and transparent about the sheer range of decisions in:

- rendering the form of a landscape (e.g. vertical exaggeration of landform, resolution and viewpoint selection);
- colouring facets of the landscape (e.g. land cover, water and seasonal selections);
- populating the landscape (e.g. the inclusion, characterisation and placing of people, animals and other ‘point features’ such as vehicles, buildings and individual trees);
- lighting the landscape (e.g. weather and seasonal selections).

As a simple example of the first of these, rendering the landscape, consider Figs. 1 and 2, both created from the same viewpoint.

It is clear that Fig. 2 offers a much more satisfactory image in that the scale of resolution is higher, the level of smoothness is greater and the inclusion of individual point features, in this case trees, lend a more realistic texture to the landscape. Fig. 2

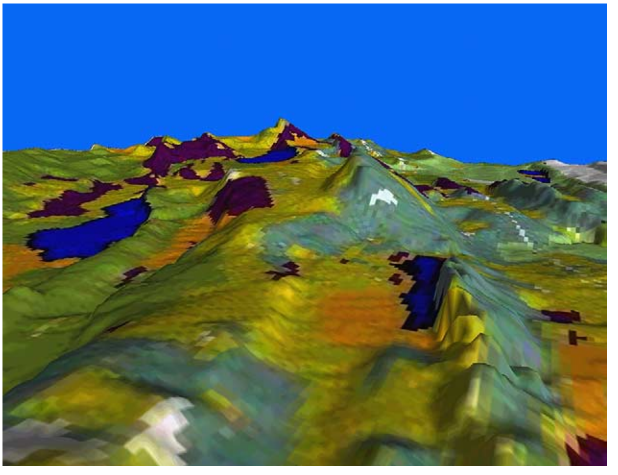

Fig. 1. Post-FMD scenario on Hadrian's Wall created with ERDAS Virtual GIS, utilising a coarse scale of resolution in the DEM and land cover drape file (Stagg, 2001).

Fig. 2. Post-FMD scenario on Hadrian's Wall created with Genesis II, utilising a finer scale of resolution in the DEM and land cover drape file. This image also includes point features, in this case trees (Stagg, 2001).

still falls a long way short of photorealistic landscape visualisations (for example see Tress & Tress, 2004), but the data, time and processing demands are a fraction. What is clear is that decisions about technical options and landscape features can manifestly alter the look and meaning of a digital landscape representation, not to mention the trade-off between computing demands and image resolution and complexity (Chen, Bishop, & Abdul Hamid, 2002). As with error in digital data, the real issue is not one of obscuring the problem, but is one of making the issues transparent to aid effective use of the data and information (Appleton, Lovett, Sünnenberg, & Dockerty, 2002). Lange (2001) provides a thorough review of the technical and perceptual issues around attaining realism in digital 3D visualisations, albeit with a focus on the representation of contemporary rather than future landscapes, and concludes that very detailed 3D object data and associated texture information are central to the realism of digital scenes. This is especially the case when the audience is intimately familiar with the visualised scene as it really exists.

Nicholson-Cole (2004) provides a useful overview of the ways in which visual images can interest and engage people in landscape issues and also help people understand relatively complex issues in terms that are accessible to them, elaborating that images:

- are easy to remember;
- form a visual basis for an accompanying narrative and discussion;
- can reinforce potential changes—'seeing is believing';
- can effectively condense extensive and complex information;
- are accessible to many people;
- can be appraised in a short period of time;
- fit within an increasingly image-laden culture within which people have accelerating expectations of the way in which information is served.

This is a powerful justification for continued attention to developing visualisation techniques for understanding and communicating information about future landscapes, whether they are tightly defined in space and time (e.g. a specific planning proposal in an urban-fringe setting) or less clearly bounded in terms of the certainty of the future landscape, a timescale for possible emergence and its geographical expression. To pursue the analogy in the title, that of peering through the smoke, there are circumstances in which our navigation is more sure and informed than in others. So, there are potential gains through using landscape images as a tool to gather information about peoples' responses to different scenarios, but there are also dangers of misinterpreting the future scenarios which could lead to inappropriate decision making. These dangers should not prevent their continued use and ongoing development, but the interests of rigour and transparency in the process of facilitating information transfer and stimulating dialogue demands that practitioners are fully aware of the shortcomings (Nicholson-Cole, 2004). In summary these are that:

- landscape visualisations are necessarily generalised and the level of detail, although variable, is never equal to that of reality;
- diverse interpretations are possible;
- there is a level of dependency on prior knowledge to interpret images of landscape scenarios where an 'informed' choice is required, although this raises difficult issues of different kinds of knowledge and power relations in policy making;
- images can trigger strong emotional responses, sometimes inadvertently, which can focus attention on issues which the LV team would regard as secondary or incidental;

- there is a potentially trivialising effect by viewing landscape scenarios through an interface that is more usually associated with 'fun' than 'function', a point that will be developed further in a later section;
- the background, and especially the age, of the sample being exposed to LVs in a multimedia or a VR setting can have significant implications for the kind of interaction people will have with the images. Some groups are more accepting than others of ICTs as an information interface and others have high expectations that some LVs may disappoint.

Appleton and Lovett (2004) elaborate on some of these implicit dangers, especially focusing on the level of detail that is appropriate in different contexts, the selection of viewpoints or pathways for LVs to take (and the significance of that decision which is taken away from the user) and the need for auxiliary information to support the images. All of these are technically straightforward issues but assessing the most appropriate choices for a given audience, even where the composition of the audience is known, is complex. This area has attracted little attention relative to the technical thrust to develop applications and may relate to Hacklay's (2002, p. 53) suggestion that "it is possible to identify an implicit motive in much work in [Virtual Reality GIS] which is the 'Hammer looking for a nail' ".

4. Positionality

While many of the scenarios which landscape visualisations attempt to address are not explicitly driven by nature conservation or cultural landscape conservation, for instance climate change scenario modelling, much work in this area has been concerned to demonstrate the 'landscape costs' of policy choices (or the failure to make policy choices). Given this, it is important to note that conservation (nature and/or landscape) as an activity is not politically or culturally neutral. Evans (1996, p. 8) has provocatively suggested that "conservation is seen by some as protecting the Nature we like, from the Nature we don't". This is significant in the context of landscape visualisation for supporting informed debate about future landscapes and the choices that may lead to them, as the individual or group that produces the scenes are in a critical position in the whole process and "despite increasing use of visualisation there has been little development of guidance for the appropriate choices and implementation methods of visualisation techniques" (Orland, Budthimedhee, & Uusitalo, 2001, p. 147). Positionality, which may be defined as self-awareness in the analysis of processes, distributions or outcomes where one's values promote certain conditions over others, has tended to be the concern of humanities and the social sciences, although there is a literature on what may be termed positionality in cartography (for example, Monmonier, 1996). Furthermore there is the risk of simply getting it wrong (Sheppard, 2001). Visualisers may fail to appreciate aspects of what is to be portrayed, giving rise to visualised scenes that differ from the intended one in respect of both point details (e.g. wind turbines of the wrong height or number of blades) or more general characteristics (e.g. vegetation type).

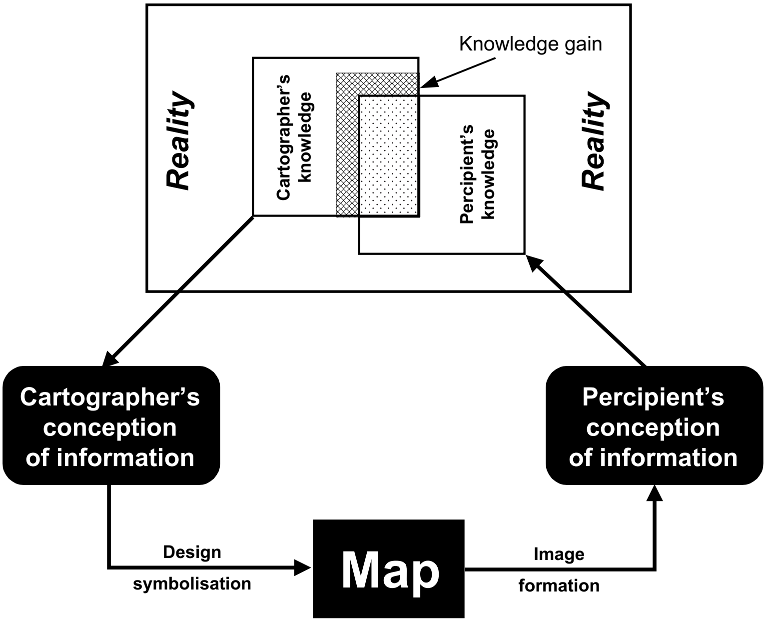

Fig. 3. The cartographer is interposed between external reality and the map user (MacEachren, 1995).

While landscape visualisations are much more than maps, they are a form of cartographic communication, and the wider process defined by MacEachren (1995) is relevant (Fig. 3). Put simply, the cartographer is positioned between the 'reality' of the environment and the map user whose conception of that reality, and the layers of meaning attributed to the symbolisation employed in the map will be highly variable between individuals and different socio-cultural groups. This is relatively simple where a time-static map is being produced, that is to say a map of a state of affairs at a given date. Where the map, or visualisation, is an attempt to portray a future state of affairs, or a range of potential scenarios, the reality that the cartographer/visualiser is attempting to convey is in itself conditional on 'scientific' and 'cultural' (to use a rather unsatisfactory duality) understanding about the transition from the present to the future(s). In the transition from cartography to VR a significant boundary is crossed: the object in VR is not necessarily driven by adherence to particular spatial forms and frameworks, although most LVs retain direct geographical referents (Kitchen & Dodge, 2002). That is to say LVs, whether static or navigable, are visualisations of specific localities under specified future conditions and there is usually a close attention to the appropriate location of elements within the future landscape. Kitchen and Dodge (2002, p. 346) explore the spectrum of VR spaces that have been developed that have greater or lesser connections and reference to physically definable localities and argue that:

> VR spaces have spatial and architectural forms that are dematerialised, dynamic and devoid of the laws of physics; spaces in which the mind

> can explore free of the body; *spaces that are in every way socially constructed, produced and abstract* (our emphasis).

Writing in the same volume Cheesman, Dodge, Harvey, Jacobson, and Kitchen (2002, p. 229), drawing on a broader literature relating to cartography and GIS (Pickles, 1995) argue that:

> VR is not an objective, neutral space... VR spaces are imbued with the values and judgements of those who construct both the technology and the medium.

This reflects broader debates around GIS, and specifically the emergence of a Critical GIS forum [1] which attempts to trace the development of the software as a business and ICT sector, the methodology of its applications in a range of different contexts and more specific issues that may increase its accessibility as a tool to a wider group of stakeholders in specific applications (Jankowski & Nyerges, 2001). Issues of software design and data models, the exclusivity of significant information and the expert orientation of tools and interfaces have been key concerns of the Critical GIS forum. In this literature positionality (although the actual term may not be used) is a key theme, emphasising the need to extend critical reflection and self-awareness into more 'peripheral' GIS application areas, including LV.

5. Are LVs 'functional' or just 'fun'?

The question posed in the introduction was whether emerging techniques of LV, especially those which employ immersive media, are simply too absorbing an experience in a technological sense to be really effective as a tool for engaging a diverse section of the population in the more substantive concerns of landscape futures? Many of the three-dimensional rendering techniques now available have come about as spin offs from the sizeable and lucrative computer games market. The key advances in scene rendering and data compression for detailed and moving backdrop images have come through this avenue. There are two key, if simple, axes considered here: one is between fun and function and the other is between physical and digital products and services (Figs. 4 and 5). In respect of the latter, early LVs were physical entities and can be found in visitor centres throughout the countryside; whether using clay, moulded plastic or more contemporary techniques such as CAD-driven precise wax moulding, the output is a tangible 3D representation of the landscape. Such landscape models have been used to stimulate debate around landscape futures in both the developed world (e.g. the Planning for Real approach;

[1] 'Forum' is used here in a loose sense. The Critical GIS literature was perhaps crystallised with the publication of *Ground Truth* (Pickles, 1995) although the antecedents go back some way (Lake, 1993; Pickles, 1991; Taylor & Overton, 1991). More recently, additional volumes have been published (Craig, Harris, & Weiner, 2002; Curry, 1998) and an international e-mail discussion group has been established (Critical GIS Homepage, 2004).

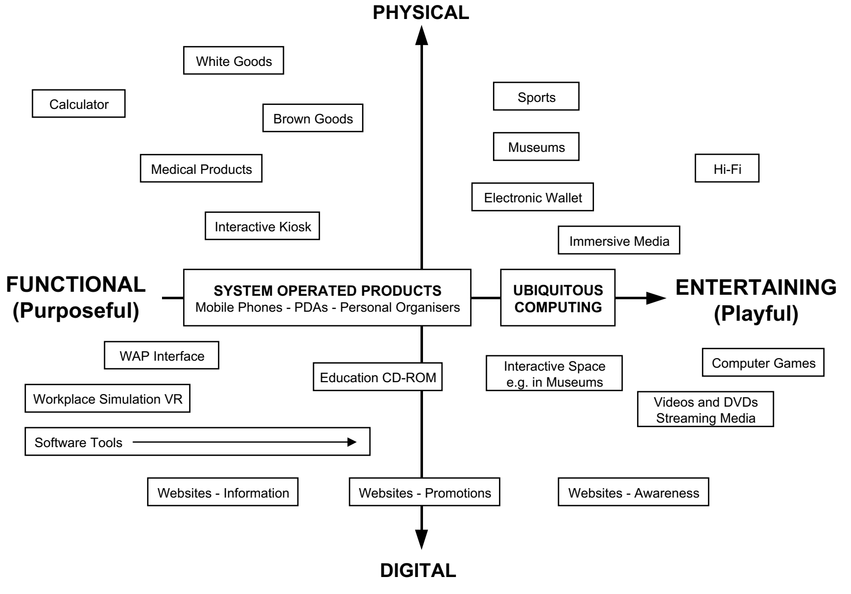

Fig. 4. Products and services across the functional-entertainment and physical-digital spectrums (© Centre for Design Research, 2001).

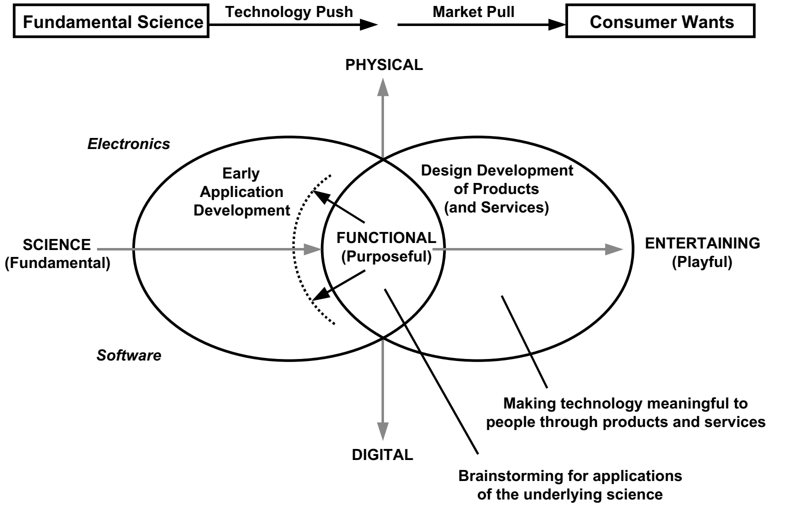

Fig. 5. An overview of digital media and media (© Centre for Design Research, 2001).

Kingston, 2002) and the developing world (Integrated Approaches to Participatory Development Agency, 2004) where an audience of potentially very mixed levels of literacy and cartographic skills can be more equally included in a process of informed debate. Such physical models are not frivolous, nor are they dull; there is usually an effective balance between fun and function.

With technological developments and rapid shifts in consumer demands and expectations, a wider range of products and services have emerged that are either wholly digital (e.g. websites and on-line GIS) or hybrid (e.g. VR, immersive media, WAP phones). These are spread across the fun–function spectrum (see Fig. 4) and a general trend to integrate levels of entertainment around the fringes of basic user-friendliness can be identified (e.g. the Apple Mac interface, mobile ring tones and educational multimedia), designed to appeal to customer segments who take functionality as a given, and expect high quality, evocative and emotional experiences in addition. Thus boundaries between the digital and the physical, and the purposeful and the playful are increasingly blurred.

So, where does this leave LV? Fig. 5 illustrates the same axes as before, but identifies a conceptual framework for locating both emerging products and services (such as LV). Hacklay's (2002, p. 53) suggestion that VRGIS is, or at least has been, a "hammer looking for a nail" has already been noted, but it is undoubtedly the case that early 3D landscape rendering and analysis was technologically driven to a high degree. In respect of analytical applications (e.g. the viewshed analysis of ski lift pylons for the Aonach Mor development by Fort William in Scotland; Davidson, 1992) this was not a significant problem, but such work was computationally and time intensive and of limited aesthetic appeal. Concurrent with hardware, software and data advances, the 'market pull' has strengthened considerably. New threats and opportunities in the landscape such as windfarms, climate change, sea level rise and afforestation are more in the public eye than ever before. All such developments have multifaceted impacts, but the aesthetic impact is one which requires no special training to relate to (Williams & Cary, 2002) and as such LVs have become increasingly significant as part of the Environmental Impact Assessment process. This may be problematic as LVs are often commissioned as part of an Environmental Statement for a proposed development such as a windfarm by the actual developer. The significance of this in respect of positionality is self-evident.

Fig. 5 identifies a conceptual zone behind the front of early application development that is where the basic research into histories, problems, processes, outcomes, futures, techniques, tools and interfaces is functional, that is clearly focused on a significant issue. Extending pressure to the right of this zone is the process of R&D into interfacing this functionality to make it more useable, accessible and appealing. It is here that a fundamental tension in LV emerges: underpinning the scenes is 'hard' research into the form and future form of landscape, combined with R&D to ensure a level of impact and realism in the scenes, which is required to engage the defined audience. Making technology meaningful to people through products and services requires a fine line to be followed between the substance of the issue being communicated and the entertainment effect (however unintended this may be) of the product/service. The key point of this is not to suggest that LVs are 'just a bit of fun', but that LV developers need to walk a careful path between making the experience too playful and retaining a clear focus on the substantive purpose of the experience they are giving to people. As Orland et al. (2001, p. 147) observe, "in interactive games... the goal of immersion is to induce the visitor to *suspend belief*" (our emphasis) and Sheppard (2001, p. 190) comments that "there is now a seamless transition from modelled landscapes of pure fantasy to actual landscapes being modelled with high accuracy, with the two being almost indistinguishable".

With reference to Fig. 5, the 'market pull' element is the demand by local authorities and other actors and agencies in countryside planning and management to tease out usable and well founded information on people's wants, expectations and aspirations of future landscapes. The technology push, riding in no small part off the back of the games industry which funds much of the cutting edge development work in VR and user-virtual environment interaction, is geared towards the experiential elements and the implicit danger in this is that the virtual experience of the LV shunts the more substantive experience of interacting with forms of knowledge about potential landscape scenarios into second place. Sheppard (2001, p. 185) argues that "childhoods dominated by video arcades or Nintendo will furnish an entire generation of users not only trained in computing but familiar with and expectant of interactive, virtual reality capabilities". The need is not to resist the ever wider use of visualisation techniques, but to acknowledge that visualisations can rarely if ever be value neutral (Luymes, 2000) and to be as transparent as possible about the technical processes and socio-cultural framework within which the LVs are created and interpreted for specific purposes. Sheppard has established both general principles for project level LVs (1989) and an interim code of ethics for LVs (2001) in response to the demonstrable capacity for the new techniques to affect policy and planning decisions.

6. Issues in visualising UK rural landscapes

Although landscape change has been profound, and has accelerated, over the past five decades, rural environmental policy has remained at least one step behind the driving forces (Selman, 1996). It is now nearly 20 years since McInerney (1986) published a piece entitled 'Rural Policy at the Crossroads' and although there have been a number of significant manoeuvrings since that time (see DEFRA, 2002; MacFarlane, 2000b) there are currently many uncertainties regarding the implementation of reforms in the Common Agricultural Policy (see DEFRA, 2004) and no definitively new direction has been embarked upon. This is unsurprising in many respects. Firstly, the rural environment is managed by many hundreds of thousands (in the UK alone) of farmers and other land managers, the vast majority of whom are conforming to the economic imperatives of farming and forestry. Secondly, the financial requirements of schemes to reorientate even a significant proportion of those land managers are considerable and public finances are ever tighter. Thirdly, it is not entirely clear what a 'better' future would entail, or look like, in spite of extensive research programmes to elucidate this. In combination these factors induce a high level of inertia within which free thinking about future landscapes is difficult.

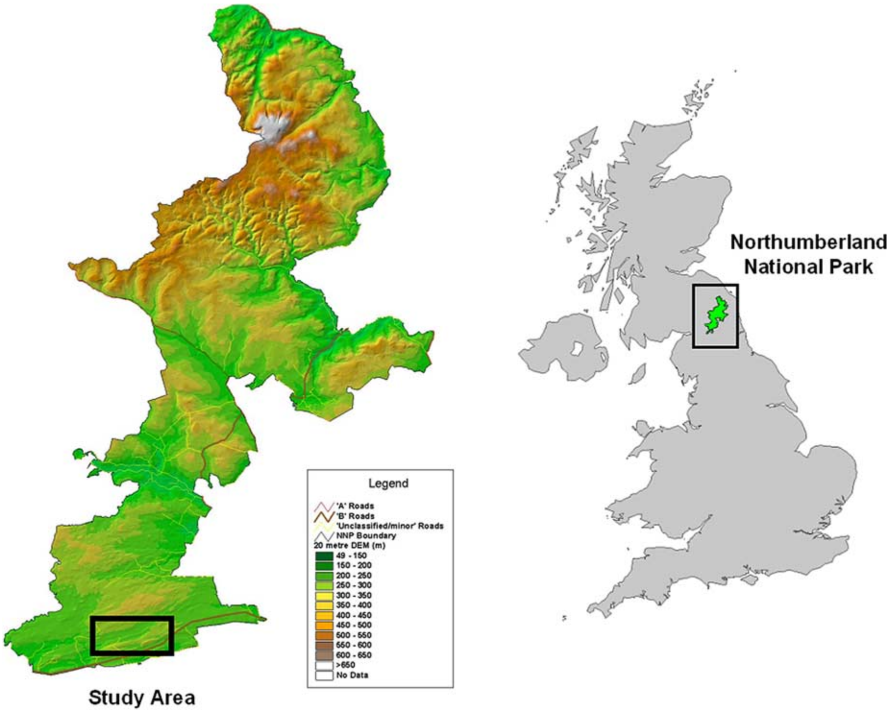

Fig. 6. Study area for the post-FMD landscape visualisation study.

In some respects the aftermath of the 2001 Foot and Mouth Disease (FMD) epidemic in the UK presented local areas with an imperative as much as an opportunity to think in terms of alternative future landscapes. Within the Hadrian's Wall World Heritage Site, falling within the Northumberland National Park, the short term consequences of the FMD outbreak were severe. Twenty-five contiguous farms had their livestock culled as a result of either confirmed infection or the contentious 'firebreak' policy pursued by the Department of Environment, Food and Rural Affairs (DEFRA). Stagg (2001) developed future landscape scenarios for this area of land (Fig. 6), informed by the Northumberland National Park Authority (NNPA) recovery plan and less formally stated aspirations and suggestions of NNPA staff. The NNPA FMD recovery plan, launched on 16th August 2001 clearly bites the bullet of change. It states in the first paragraph that:

> There is wide consensus that the foot and mouth outbreak has underlined the challenges facing rural development and the continuing crisis in agriculture. The disease has put these issues in the public eye and created a momentum for change… A return to 'normal' would be a costly and wasted opportunity for the economy, rural society and the environment (NNPA, 2001).

Visualising landscapes to promote discussion in a context such as this has much to commend it (Saunders, 2001): minds may be focused by the need to make decisions with far-reaching landscape consequences, but help may be required to establish alternatives around which details and specific landscapes may emerge. In addition to the reservations previously identified (Nicholson-Cole, 2004), there is also the danger of the 'menu-approach' whereby LVs are perceived as set options rather than pointers or even possibilities intended to provoke discussion about negative outcomes and consequences of change (e.g. Figs. 7 and 8). Stock and Bishop (2002) have

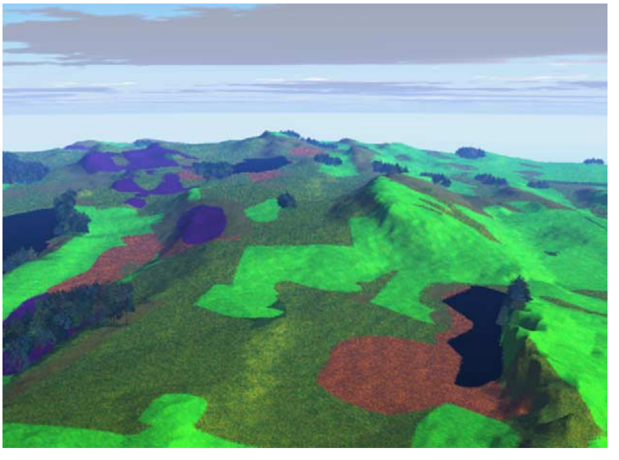

Fig. 7. Genesis II visualisation of the present day landscape in the Hadrian's Wall post-FMD study area (Stagg, 2001).

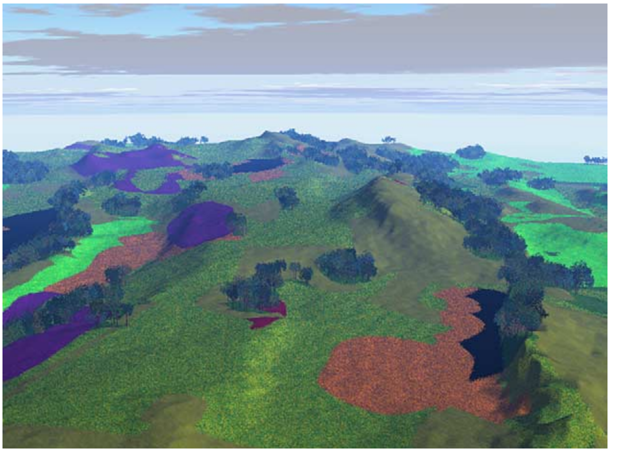

Fig. 8. Genesis II visualisation of an Agri-Environmental Policy landscape in the Hadrian's Wall post-FMD study area (Stagg, 2001).

addressed this issue to a certain degree with their work on permitting direct 'audience' interaction with a simulated landscape. Against a pre-defined terrain backdrop and pattern of management units, stakeholders can determine land cover types which are associated with specific objects such as trees and buildings. Elsewhere the Virtual Reality Centre at Teesside (2004) has experimented with user interaction that allows individuals to place and size wind turbines in a rendered landscape scene, and then navigate around the scene to view the results from different perspectives. Such developments are in line with "the trend in systems of public consultation [which] is away from those that simply provide information for public reaction towards more participatory models where information is developed jointly" (Orland et al., 2001, p. 140) although there is a long way to go to realise this in (virtual) reality.

For much of the productivist (and increasingly post-productivist) rural environment landscape medium-term futures can perhaps be identified with a greater degree of confidence than in urban spaces. In the countryside, research suggests that certain crops will become economically viable, certain landscapes may be dominated by biomass cultivation, commercial forests will extend into new areas and community woodlands into others. For the more fragmented and less clearly policy-driven (in terms of form and function) urban green spaces the range of potential scenarios is far greater, especially where previously developed or derelict sites present what is effectively a blank canvas for landscape works. Roe and Rowe (2000, p. 244) comment that:

> In many community projects local people will commonly have an idea that they want to 'do something' with a piece of land, but little conception of what to do or how to do it... Difficulties arise because issues deemed 'real' by the community may seem insignificant to professional and management authorities.

Given this tension between local and external and 'lay' and 'expert' perspectives on such sites virtual LVs can have a potentially overly suggestible effect, presenting local people with a menu of 'looks', without a currently accessible toolkit for them to combine, redraft or replace the LVs with options of their own. This echoes a wider debate around Public Participation GIS (PPGIS) which questions the control of the tools, the data and the processes by which forms of knowledge are utilised to arrive at decisions (Weiner, Harris, & Craig, 2002). In essence the debate over the 'best' way to apply GIS to give some level of parity to local interests considers three, not necessarily mutually exclusive, options:

- 'better inputs': consult with local groups to find out what their concerns, agendas and aspirations are and then combine these into pre-existing decision models;
- 'better consideration of outputs': carry out analyses and then go to greater lengths to present the findings to a wider range of stakeholders and thereby facilitate wider debate around the same evidence;
- 'sharing the technology': make the tools accessible and permit local groups to perform their own analyses of the available data to reach conclusions that have local legitimacy.

In the context of LV the first of these could follow the Planning for Real model, potentially in a virtual sense as attempted by the Centre for Computational Geography at the University of Leeds (Kingston, 2002), with zones for more trees, building conservation works, new access pathways or scrub clearance identified during consultation, but actually created in the LV by a technical expert. The second pathway is relatively well established in the context of landscape visioning (e.g. O'Riordan, Wood, & Shadrake, 1993) and may be successfully combined with pre-model research into what people want and then verification or testing research afterwards. Approaches to PPGIS which release, or at least share, control of the technology with groups that are usually outside the machinery of decision making are rare. Groups such as Friends of the Earth have established their own GIS and are experimenting with on-line GIS to allow people to perform their own mapping and basic analysis (FoE, 2004), but not commonly on the same datasets as the key decision makers. Under pressure to render their processes more transparent and match such developments by environmental protest groups some landscape agencies in the UK are experimenting with internet GIS packages to permit 'outsiders' (they are usually protected by a comprehensive security shell to prevent access to 'internal' datasets) to explore various layers of data about their environments (e.g. the 'Nature on the Map' site developed by English Nature, 2004). However, most on-line GIS are relatively limited in respect of their functions and fully-interactive analysis of complex datasets to create three-dimensionally rendered outputs is several years away.

Some current LV packages are relatively quick to use if much of the required background data processing (e.g. DEM creation, assembly of a library of fill colours and textures to represent different land covers and species mixes) has already been done, but they are some way from being particularly intuitive and accessible (Appleton et al., 2002). Perhaps the most usable and interactive style of landscape future generation and assessment is to use web browsing techniques to hyperlink pages and images together in such a way that a decision pathway can be followed. Users can choose futures from a list and then link through to pre-prepared images for evaluation and response (e.g. Tress & Tress, 2004). However, the user is still on a pre-defined pathway without true interaction with the data to tailor outcomes.

So, the upshot of this is that truly participatory LV is not yet available. More inclusive approaches to gather information on landscape preferences and future alternatives are being increasingly thoroughly explored. However, the technical expert, the actual LV developer remains at the core of the creative process, or at the values/design interface to put it another way. Dependant upon the context of the LV application, values may be channelled through the developer or scientific findings about landscape futures may be translated into visual form by the individual or technical team. This calls for a sharpened focus on how inputs are mediated through LV developers into landscape scenes or scenarios. This is not to imply misdemeanour, bias or errors in the process, but just to ensure due transparency in what is inescapably a value-laden process.

7. Conclusions

Jankowski and Nyerges (2001, p. 103) make the point that "methods and tools for participatory spatial decision making, just like methods and tools used in GIS, come from many different disciplines, including cartography, computer science, operations research, psychology, cognitive science and management information science". In this paper we have drawn upon a number of seemingly disparate areas of literature and research, but as Jankowski and Nyerges (2001) make evident, we have stopped well short of the true range of disciplines that landscape visualisation for public information, policy support and community involvement requires a grasp of. However, leaving aside the space constraints of a journal paper and the demands of such an inter-disciplinary team approach, we did not seek to integrate all the intellectual strands that a full and grounded critical application and evaluation of LV requires. Rather we sought to develop an agenda that needs attention for the very difficulties inherent in LV applications to be made transparent. As we stated at the outset, this is not driven by a desire to undermine LV applications, but rather to encourage their application in a setting that does not prioritise technical expertise above the values, orientations and preferences that make landscape appreciation so conditional.

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