

Bond University
Research Repository



The second life of urban planning? Using NeoGeography tools for community engagement

Foth, Marcus; Bajracharya, Bhishna; Brown, Ross; Hearn, Greg

Published in:
Journal of Location Based Services

DOI:
[10.1080/17489720903150016](https://doi.org/10.1080/17489720903150016)

Published: 01/06/2009

Document Version:
Peer reviewed version

Licence:
Other

[Link to publication in Bond University research repository.](#)

Recommended citation(APA):
Foth, M., Bajracharya, B., Brown, R., & Hearn, G. (2009). The second life of urban planning? Using NeoGeography tools for community engagement. *Journal of Location Based Services*, 3(2), 97-117. <https://doi.org/10.1080/17489720903150016>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

For more information, or if you believe that this document breaches copyright, please contact the Bond University research repository coordinator.

The Second Life of Urban Planning? Using Neogeography Tools for Community Engagement

Marcus Foth [corresponding author]

Institute for Creative Industries and Innovation
Queensland University of Technology
130 Victoria Park Rd
Kelvin Grove QLD 4059
Australia
phone +61 7 3138 8772
fax +61 7 3138 8238
m.foth@qut.edu.au

Bhishna Bajracharya

Mirvac School of Sustainable Development
Faculty of Business, Technology and Sustainable Development
Bond University
Gold Coast QLD 4229
Australia
phone +61 7 5595 2655
fax +61 7 5595 1160
bbajrach@bond.edu.au

Ross Brown

Faculty of Science and Technology
Queensland University of Technology
GPO Box 2434
Brisbane QLD 4001
Australia
phone +61 7 3138 9481
fax +61 7 3138 9390
r.brown@qut.edu.au

Greg Hearn

Creative Industries Faculty
Queensland University of Technology
Musk Ave
Kelvin Grove QLD 4059
Australia
phone +61 7 3138 3765
fax +61 7 3138 3723
g.hearn@qut.edu.au

Paper for the special issue on “Neogeography: Theory and Tools” of the *Journal of Location Based Services*, guest edited by Sanjay Rana, University College London, UK, and Thierry Joliveau, University of Jean Monnet-St. Etienne, France.

Abstract

The majority of the world's citizens now live in cities. Although urban planning can thus be thought of as a field with significant ramifications on the human condition, many practitioners feel that it has reached the crossroads in thought leadership between traditional practice and a new, more participatory and open approach. Conventional ways to engage people in participatory planning exercises are limited in reach and scope. At the same time, socio-cultural trends and technology innovation offer opportunities to re-think the status quo in urban planning. Neogeography introduces tools and services that allow non-geographers to use advanced geographical information systems. Similarly, is there potential for the emergence of a *neo-planning paradigm* in which urban planning is carried out through active civic engagement aided by Web 2.0 and new media technologies thus redefining the role of practicing planners? This paper traces a number of evolving links between urban planning, neogeography and information and communication technology. Two significant trends – participation and visualisation – with direct implications for urban planning are discussed. Combining advanced participation and visualisation features, the popular virtual reality environment *Second Life* is then introduced as a test bed to explore a planning workshop and an integrated software event framework to assist narrative generation. We discuss an approach to harness and analyse narratives using virtual reality logging to make transparent how users understand and interpret proposed urban designs.

Keywords: virtual reality; urban informatics; geospatial web; urban planning; neogeography; neoplanning

Introduction

Information and communication technology (ICT) has played important roles in shaping cities and urban planning (Castells 2004; Graham, 2004; Mitchell, 1995; Graham & Marvin, 2001). ICT has contributed to the globalisation of cities and facilitated increased contacts between places and people at both global and local levels. It can play a positive role in the development of knowledge regions and creative cities (Landry 2000; 2006; Florida 1995; 2002; Bajracharya & Allison, 2008). Strong cultural and learning resources supported by information and communication technologies can contribute to developing creative cities (Landry, 2000). However, there is also growing concern about the struggle between networked global economies and social identities of local people (Castells; 2004). There is a danger of local communities getting subsumed under global and technological imperatives. Graham and Marvin (2001) argue that emerging information and communication technologies and privatisation of its ownership can contribute to *splintering* of the cities around the world. There is therefore a strong need to understand how urban planning has evolved with changing technologies in order to appreciate current challenges and future opportunities in planning.

The use of information and communication technology in urban planning has changed over time with both the rapid change in technology itself and shifting perspectives of urban planning. Klosterman (2001) argues that over the last four decades, the planning paradigm has shifted from the applied science perspectives in the 1960s to the political approach in the 1970s, to focus on communication and participation in the 1980s, and to collaborative planning and design approaches in the 1990s and beyond. This parallels the development of ICT and its changing role in urban planning. In recent times, there has been an explosion in the use of digital information with new technologies. Examples include GIS, CAD, 3D visualisation, remote sensing, GPS as well as communication technologies such as the internet, Web 2.0 services and new media, blogs, video and photo sharing and virtual worlds. These emerging sets of technology have the potential to change the practice of urban planning substantially in terms of communication, collaboration and impact.

Additionally, there is a growing movement amongst urban planners to utilise creative narratives in the process of urban planning. Odendaal (2006, p. 36) argues that,

The multicultural diversity of cities, the need to understand differing ways of life, ... and insurgent planning processes where people take their own initiatives with regards to governance, will reveal a diversity of urban experiences... The access to this information is not necessarily through reports and documents, but may have to be gained through oral histories, story-telling, and poetry.

Her claim is also supported by Landry (2007) who points out that,

As urban planners grapple with effective methods to stimulate social sustainability in the 'art of city making', through urban renewal or development projects, more are recognising that history and creativity can make great partners.

This recognition of the role of narratives in urban planning parallels developments in new media which have seen the utilisation of gaming systems, technologies and process applied as a generic interface for engagement with knowledge architecture; work processes; and design artifacts. An emerging suite of new media based ways of developing, recording and reflecting on users' narratives about designs try to capture 'lived experience' – especially experience of place.

In this paper we present and discuss an experimental research approach designed to integrate the creative expression of narratives elicited through a virtual reality environment into the urban planning process. So far, the evaluation of virtual models of urban environments using a simple dialogue, conventional community engagement or questionnaire based approach usually produces uncertain results due to a lack of precision and temporal proximity to the planning environment. Our research employs planning workshops that help generate narratives about the usage of the urban environment with the help of the virtual reality world of *Second Life*.

One of our aims is to use advanced logging techniques to capture the interactions of users with the virtual environment in order to generate a log of the user interactions within the environment. By capturing a number of different types of user events from the electronic representations, this approach creates a model of the usage of the virtual urban environment. We hope that the analysis of the log data will help to approximate and inform expectations and evaluations of the planned environment that is to be built in reality. In addition to the narratives and creative expressions within the virtual environment, the log data allows for a triangulation to confirm and review design and planning ideas and proposals with both lay participants and planners.

In this paper we first trace and review the evolution and development of technology use for urban planning purposes. Second, we specifically look at the impact of current key socio-cultural and technical trends on urban planning with a view to better understand the notion of neogeography. Exploring narrative theory as one 'other way of knowing' in the epistemology of urban planning (Foth et al, 2007), we then present and discuss our findings from a series of workshops that employ an integrated software event framework using the virtual reality environment *Second Life* to assist in the generation of narratives.

The technical evolution in urban planning

Following Levy (2006), Klosterman (2001), Malczewski (2004), Sui (2008), we first provide a short history of the way technology has been employed and utilised in urban planning. Influenced by a positivist paradigm, the focus of urban planning in the 1960s was rational planning. Information technology was seen as providing value free and politically neutral planning support. The technology available at the time – for example, large mainframe computers used primarily by large government departments and universities – was therefore expert-driven, closed-systems, and lacking public participation. Practitioners in the 1970s started questioning the positivist scientific approach to planning in addressing real world problems. The field moved towards a political economy perspective with a focus on addressing social equity and justice issues and the need for people's participation in planning. Information technology during this period was seen as inherently political and reinforcing existing power structures rather than benefiting the local communities.

The planning paradigm of the 1980s strongly emphasised on planning for communication with a focus on participatory planning. Likewise, the role of information technology was seen as facilitating communicative and participatory planning. One of the shifts in planning is thus the move from expert-oriented planning to public involvement in planning and decision making processes. This is parallel to the development of technology from greater access and user friendliness of technology. There has been an increasing trend towards use of GIS for public participation with the development of webGIS and open access GIS. From the 1990s to the present context, the planning paradigm has evolved into a multidisciplinary

pluralistic approach with emphasis on collaborative planning and design and even greater level of citizen involvement in planning through Web 2.0 services, new media and 3D visualisations. Table 1 summarises the links between planning and technology by highlighting the planning approaches and role of emerging technologies from the 1960s to the present context.

Table 1: Evolving links between planning and technology

Period	Approach	Technology	Role of technology
1960s	Planning as applied science (Rational planning)	Large mainframe computers, beginning of GIS	Information technology expert driven, closed systems, lack of public participation
1970s	Planning as politics (Advocacy planning)	advent of desktop computers and development of GIS software applications	criticism of information technology as reinforcing existing power structures
1980s	Planning as communication (Communicative and deliberative planning)	Emergence of public participation GIS, webGIS, CAD, GPS, remote sensing	Emerging role of information technology for community engagement in a transparent manner
1990s and beyond	Planning as reasoning together (Collaborative planning and design)	Planning Support Systems (PSS), Wikification of GIS, Google Earth, Web 2.0 services such as social networking sites, blogs, mobile media, video/photo sharing, digital storytelling, 3D visualisation and virtual worlds such as Second Life. Neogeography.	Role of technology in providing new opportunities for social interaction, deliberations to address common goals/concerns

Adapted from Klosterman (2001), Malczewski (2004), Sui (2008)

With the advent of the internet and the world wide web, new opportunities for collaborative decision making systems became available. Planning Support Systems (PSS) are an example of a collaborative decision support system and geographic information system (GIS) which can integrate both current and future information technologies in planning (Klosterman, 2001). While PSS is organised around GIS, it includes a range of planning tools such as population and economic forecasting, modelling of environment, land use and transport. It can integrate multimedia technologies, optimisation models, multi-criteria decision analysis, and public participation and group interaction.

Malczewski (2004) suggests that there are three stages of development of GIS. The first stage is the 1950-1970s which is the *innovation stage* of GIS with the new beginning of GIS development. The second stage (1980s) is the *integration stage* of

GIS which saw the development of general purpose GIS. The third stage is the *proliferation stage* of GIS which saw growth of diverse user oriented GIS technologies. The first generation of GIS in the 1960s was accessible to only large government organisations and universities with high cost mainframe computers. From the 1970s, with the advent of desktop computers and the emergence of software such as MapInfo GIS, ArcView, Map Analysis Package (MAP), the use of GIS in planning changed slowly with greater access to technology by local councils, non-governmental organisations and individual users. The development of GIS in planning in 1980s has been facilitated by related developments in information technologies such as computer assisted design (CAD), database management systems (DBMS), remote sensing, global positioning systems (GPS), remote sensing, aerial photography and wide availability of digital data.

Until the stage of *integration* (1980s) GIS was a specialised activity of experts in planning. From the 1990s, there was *proliferation* of GIS with the development of user-oriented GIS. There has been massive growth in digital data during this period. This phase saw the development of Internet GIS, Open GIS and multimedia GIS. Open GIS provides greater flexibility in linking GIS with other types of application such as statistical packages, spreadsheets, graphics thus providing opportunity to integrate GIS with spatial analysis models and planning and decision making techniques (Malczewski, 2004). The web GIS (such as ArcView Internet map server, Mapinfo's Map Xtreme Java) and development in multimedia systems facilitated the use of multimedia in spatial analysis and modelling. The webGIS provided opportunity for access to data and models via the internet to multiple clients – providing opportunities for making planning a collective design process. This development of the web has facilitated collaborative and transparent group decision making. Information sharing moved the planning methodology from being a closed system available to experts only to a more open system available to broader community groups (Klosterman, 2001).

The second generation of GIS is what is called Public Participation GIS (PPGIS) which can be used for broader engagement of the public in policy making as well as promoting them to non-governmental organisations. This provided opportunities for the empowerment of people through technology. Issues arise as to who controls technology for decision making and who has access and can afford to use technology. It provides opportunities for collaborative planning processes such as providing planning information online, broadening the stakeholders in planning, ease in analysing the problems through visualisation and developing different options for planning outcomes (Sieber, 2006). Empowering citizens and residents, the advantages of PPGIS are the integration of local knowledge in planning, opportunities for users to interact and provide feedback in response to the analysis of data, and the dynamic evaluation of alternatives.

Although promising progress has been made, the field of PPGIS is still fragmented and limited to single communities usually lacking cross-cultural and cross-national comparison of data at large scale (Sieber, 2006). There are also issues about access to technology with competing organisations controlling data thus sidelining the whole objective of the PPGIS agenda. Emerging sociocultural trends and technical innovation surrounding the 'wikification of GIS' through the use of Web 2.0 services and new media may provide a new way forward for participatory urban planning. This fourth stage in the development of GIS could be called 'neogeography.' In addition to the current range of formal, precise and accurate GIS applications that are used by trained professionals, neogeography describes GIS tools that can be used by lay persons and non-experts without intensive training. The focus of our experiment is to find out to what extent neogeography can complement the portfolio of GIS

applications by introducing everyday views and voices that were previously difficult to capture with more complex software.

Participation and visualisation

Independent of the development trajectory within the field of urban planning, information technology and related services and applications have introduced new socio-cultural trends and in turn been shaped and informed by them to produce new technical innovation. In this section, we focus on two trends: participation and visualisation. We then introduce *Second Life* as an application which combines both of these trends in an interactive environment.

The means to access and use the internet, communicate and interact with others, and create and engage with content are no longer limited to the technically versed or the civically inclined. Scholars such as Jenkins (2006) and Burgess et al. (2006) have identified socio-technical trends towards participatory culture, that is, a wider ('vernacular') ability of people to participate in digital culture through personal expressions of creativity. The implications for planning, and especially participatory planning practice, only start to be realised now. Many examples of how participatory culture is enabled by recent technological innovation rely on so-called 'Web 2.0' applications and services such as blogs, Wikipedia, YouTube, Flickr, and social networking sites such as Facebook, which are arguably more open, collaborative, personalisable, and therefore participatory than the previous internet experience. Bypassing the terminology debate, whether the term 'Web 2.0' is adequate, we seek to examine how the features and the utility of Web 2.0 services can innovate urban planning practice.

According to Kolbitsch & Maurer (2006), the participatory qualities of Web 2.0 encourage ordinary users to make their knowledge explicit and help a collective intelligence to develop. In an urban context, Foth et al. (2007) argue that such capabilities present diverse possibilities for a profound urban epistemology to evolve. The internet thus offers a communication infrastructure for the 'nervous system' of a city that gives rise to applications of collective intelligence and crowd-sourcing using web and mobile technology. Weinberger (2007) provides a rich account of the ways information and knowledge is decentrally and collectively accessed, organised, managed and categorised. Web 2.0 gives rise to new forms of collective knowledge management, and, as Hudson-Smith et al. (2009, p. 278) – the creators of *Virtual London* – argue, with a particular focus on urban applications:

[...] locational information is added either collectively but mostly individually to some web site or web application that enables the user to tag him or herself in space and time. As the majority of users of these systems currently live in cities or at least urban areas, it is not surprising that the city is one of the key metaphors for Web 2.0.

This trend towards participatory culture has also impacted on urban planning practice itself – a trend that Sui (2008) calls the 'wikification of GIS'. In a recent issue of *Planetizen*, it was mentioned that a developer from Washington DC was using the social networking site Facebook to gain feedback on some possible redevelopment options. However, many of these efforts are isolated and fragmented and rather individual cases, but it provides new ways for engaging the community to deal with planning problems. The emergence of systems such as Google Earth, Second Earth and Microsoft's Virtual Earth provides new opportunities for users to contribute to a diverse range of information such as OpenStreetMap, WikiMapia etc. This

phenomena is what Goodchild (2007) calls 'volunteered geographic information' (VGI).

This wikification of GIS with mass participation of people also raises issues about the future nature and quality of urban planning. Questions arise as to whether this is going to lead to a 'tyranny by majority' or indeed a democratisation of GIS (Sui, 2008). This new trend of GIS has led to the term 'neogeography' coined by Di-Ann Eisnor of Platial Inc., which describes a notion of a 'geography without geographers' (Sui, 2008). Turner (2006) refers to existing and emerging standards such as GeoRSS, KML, and Microformats, to the process of adding dynamic maps and locations to personal websites, pinpointing the locations of online visitors; genealogical maps and Google Earth animations of family ancestries; and geotagging travel photographs to explain that, "neogeography combines the complex techniques of cartography and GIS and places them within reach of users and developers." Likewise, questions arise as to whether Web 2.0 and new media technologies can lead to neo-planning approaches where urban planning is led by diverse groups of community members aided by Web 2.0 with limited involvement of professional planners.

Participatory culture is not the only significant trend in neogeography that offers major ramifications to the nature of urban planning. Another trend that goes hand in hand with these advancements is in the realm of 3D visualisation tools. While earlier versions of GIS applications have been primarily two dimensional, there is a growing trend towards three-dimensional visualisation techniques in planning and urban design. While in the past, planners and designers used to depend on physical models of cities and three dimensional perspective drawings, technology has made it possible to generate arrays of three-dimensional computer visualisation of cities and neighbourhoods. This has facilitated a greater understanding of cities by people and provided opportunities for people to contribute to a collaborative design of cities along with architects and developers.

Visualisation tools allow policy makers and lay men to see the consequences of planning choices and public investment decisions. CommunityViz is an example of a GIS software with strong visualisation features combining both 2D ArcView and 3D townbuilding software. It is an interactive PSS with fly-through options showing how changes in community demography affect cities in terms of land use, infrastructure and environment. There are various visualisation software applications such as 3D GIS, 2D and 3D modeling, animation (VRML) and virtual reality models. Key examples of urban visualisation are *Virtual London* (Hudson-Smith et al., 2009) developed by the Centre for Advanced Spatial Analysis (CASA) at University College London and *Virtual Los Angeles* developed by the Urban Simulation Team at the University of California, Los Angeles (UCLA) which allows multiple users to seamlessly fly, drive and/or walk through the real-time virtual model of the Los Angeles basin. Beyond urban planning applications, other potential applications of this model include linking it with Global Positioning System (GPS) transponders for emergency management by locating and remotely managing emergency response vehicles in real-time (Brail & Klosterman, 2001).

In addition, the advent of the games industry and its multi-billion dollar economy (Boyer, 2008) has driven the present ICT technology to new levels of performance, per dollar cost. This has provided cheap desktop computer systems with enhanced graphics and CPU power to support highly realistic collaborative user environments. We now find that with people in gaming averaging 30+ years of age (ESA, 2008), that such 3D technology has gained mainstream acceptance, such that many professional people are comfortable with using 3D environments for interaction

applications. Second Life and its related Open Simulator communities have therefore emerged as contenders to be the disruptive technology for this domain. Despite the reported drop in business usage of *Second Life*, and related environments, there is still a continued increase in participation, especially amongst educators and researchers (Boulos, 2007). This established community of 3D practice, so to speak, is the greatest strength of such environments, as the availability of large numbers of people creating content has begun to make the usage of such environments mainstream.

However, one noted limitation is that of the island model of many environments in 3D worlds, such as *Second Life*. An isolated island model is utilised in order to efficiently host such worlds, by restricting the instance of the virtual space to a particular process in a network. A generalised seamless single world, accessible by all within the environment – and that has highly volatile lag free content – is still the topic of much technical research (Nae, 2008). The present proposal to integrate *Second Life* with Google Earth ('Second Earth') may provide some way forward in this regard (Rouch, 2007), but scalable versions of such worlds for widespread non-trivial applications will prove to be problematic until efficient architectures are developed.

Solutions to overcome visualisation scalability problems may come with the integration of such 3D environments with real-life footage via Augmented Reality. This approach uses overlaid Virtual Environments to create life size avatars within the view of participants wearing special visors, thus cutting down on the need for virtual modeling of everything but the new building artifacts in question (Piekarski, 2002). Likewise, some similar innovative work has been carried out at MIT on urban simulation and multilayered platforms integrating both digital and physical representation of places through use of a luminous planning table that allows direct interaction with artifacts in the virtual world (Joseph et. al., 2001). However, these techniques remain in the research domain for the present time, and for now we will see that in order to maximise impact, urban planning teams will use the presently available virtual environment display technology to develop urban planning projects.

Urban planning with *Second Life*

Narrative in urban planning

A narrative is "inter-subjective as well as communicative, since the plot renders meaning to specific experiences or logical deductions. It is also a powerful means of communicating an argument." (Guhathakurta, 2002). Moreover, narratives shift the interests of design and planning processes towards pluralistic and subjective perceptions of space and its use, emphasizing the fundamental relationships between space and socio-cultural processes (Kallus, 2001). Sophisticated forms of representation and communication can also be used for decision support systems and multimedia to make pragmatic urban modeling tools for public forums (Guhathakurta, 2002). In effect such approaches construct 'stories' of the possible futures of a design to affect the evolution of an urban environment.

Narrative approaches underlie various methods that may be useful in urban planning, (e.g., narrative ethnographies for evaluation) as well as various new media tools (e.g., digital storytelling, scenario development, computer game storyboarding) that may prove valuable in the community engagement process. For example, scenarios are concrete descriptions of life activities that can be used to drive the ongoing design and evaluation of new media systems. They have proved to be valuable research and design tools because, as narratives, they can move from general work

process to detailed and specific interaction in a coherent and systematic way (Carroll, 2000; Manning, 2003).

Narrative approaches can be related to systems thinking and formal systems modelling. For example, Guhathakurta (2002) developed an empirically based urban model of the San Pedro region from narratives about the tension between growth and environmental protection. The advances made in the use of urban development models have transformed this from a static, data-driven, unidirectional process to simulation exercises that seek to understand the underlying interrelatedness of community stakeholders and their perspectives. In another project, Kok and van Delden (2004) combined narratives and quantitative models in building scenarios to combat the desertification of Spain. They ran a series of workshops with a variety of stakeholders to build a number of narrative scenarios (e.g., convulsive change; water shortage, etc). Actual variables that could be measured were then derived from these scenarios and quantitative modeling undertaken. Modeling allowed decision about land use and other factors to be deliberated.

Narratives and story telling are important parts of deliberations in planning which can contribute to transformative learning for communities. John Forester in his book *the Deliberative Practitioner* (1999) explores the importance of “stories as elements of policy advice” and highlights ways of “learning from practice stories.” He suggests the need “to consider history, culture, experiences of citizens” as integral part of participatory planning processes. Community engagement requires appreciation of diversity and difference of communities and participation processes which involve marginalised groups (Sandercock, 2003). There is a growing body of literature in planning which argues that urban narratives and story telling are crucial elements of communicative and collaborative planning (Forester, 1999; Sager, 2002; Healey, 2006; Innes & Bocher, 1999).

In our thinking this holistic frame of reference that a narrative provides is important in setting the context for utilising virtual world technologies in urban planning.

Engaging high school students in urban planning

The emergence of the web based virtual world *Second Life* provides opportunities for people to move through and interact with spaces as virtual representations of people (avatars¹) thus providing new ways to collaborate in the design of spaces. There is growing interest among urban designers and planners to use 3D virtual reality models such as *Second Life* for the design and planning of buildings, neighbourhoods and cities. The city of Boston is recreating parts of Boston in *Second Life* and includes features such as online concerts and discussion forums to encourage more people to participate in civic life². They also see this as a way to evaluate proposed new developments in Boston. Hub2 – an initiative of Emerson College and Boston City Council – is developing teaching resources for the application of 3D virtual technologies as a community engagement tool in urban planning initiatives (Gordon & Koo, 2008).

¹ The term Avatar from the Hindu concept of the manifestation of a god, is used in virtual environments technology to mean the virtual presence of the user of the environment, typically represented as an animated, controllable human body.

² <http://www.planetizen.com/node/25924>

Likewise, in 2007, a consortium of *Accomplir*, a local residents non-profit organisation in Paris, and *Repères SAS*, a French market research agency, organised a contest³ to select the best ideas for the redesigning of the Halles garden (*Jardin des Halles*) located in Paris, using *Second Life*. The aim was to elicit creative ideas for the redesigning of the gardens illustrated by a model produced in *Second Life* to the scale of 1/10th. The organisers found that *Second Life* provided a useful platform for the neighbourhood association to project a real world problem into the virtual arena, and then acting on real data afterwards to help implement the idea by the joint winners of the contest award, Joshua Culdesac and Piper Pitney.

In addition to these examples from Boston, Paris, and – mentioned earlier – London (Hudson-Smith et al., 2009), different use models of *Second Life* in the context of urban planning are being explored: For instance, *Studio Wikitecture* has set up a site in *Second Life* to co-design a virtual reality health clinic in Nepal⁴. The group has also made use of video and photo sharing sites such as YouTube and Flickr to share the process of designing the building.

In another example from the UK, *Virtual Birmingham*, “aims to promote the use of virtual technologies such as 2D / 3D mapping, web 2.0 and virtual worlds to discover their future potential and capabilities for enabling partners to deliver better services, and citizens and residents to experience the city in many dimensions.” The developers of *Virtual Birmingham*, Daden Ltd., review different approaches to virtual urban worlds internationally and their benefits to the future planning of city spaces and services, as well as the technical platforms to operationalise the running and maintenance of these worlds⁵.

On the background of the experiences that Gordon & Koo gained in the Boston case study, they argue that

Second Life allows users to immerse themselves in an environment and engage in synchronous dialogue and production with other graphically represented users. It allows for group authorship, which better enables a sense of collective ownership in a space or object. And unlike professional design programs, it affords users a sense of playfulness and allows them to experiment with designs and concepts that have little connection to empirical reality.

When we’re asked about Hub2, people often question why we would spend our time building a virtual Boston when the real Boston has so many problems. Second Life is a fascinating world unto itself, but in building and inhabiting its spaces, it reveals more about existing social worlds than it does about a virtual replacement to those worlds. And in affording its users the opportunity to build and play in a collaborative environment, it has the potential of generating politically viable groups around almost every element of our designed world. (Gordon & Koo, 2008)

Following on from the work by Gordon et al., we ran a series of engagement workshops using *Second Life* with students of Noosa District State High School in Cooroy, Sunshine Coast, Australia, in March 2009. The Sunshine Coast Regional

³ <http://www.reperes-secondlife.com/co-creation.asp> and <http://www.accomplir.asso.fr/>

⁴ <http://studiowikitecture.wordpress.com/>

⁵ <http://www.digitalbirmingham.co.uk/city/virtual-birmingham>

Council is redeveloping a site in Cooroy that was formerly used as a timber mill. The vision for the new site is “to develop and sustain facilities [...] for present and future generations of the community with balanced consideration to history, culture, education, arts and economics.” At this stage, the master plan of the site proposes the development of a new library building, as well as the renovation of heritage-listed buildings that formed part of the timber mill precinct (Fig. 1). The building of a former butter factory, that has been redesigned as a performing arts centre, is also in close proximity to the site and forms part of the overall master plan.



Figure 1: Lower Mill Site, Cooroy

The Council is interested in exploring new ways to engage diverse and traditionally underrepresented sections of the local community, such as young people. The objective of our workshops with about 30 Grade 8 high school students was to experiment with *Second Life* as an interactive tool to allow them to participate in the project and contribute ideas and feedback for the planned development.



Figure 2: Class excursion inspecting the site in real life

In preparation for the in-class workshop, we re-constructed the site in its current pre-development stage on a stand-alone island using the open source 3D application server OpenSimulator. Although this engine is capable of hosting a wide range of alternative worlds with differing feature sets and multiple protocols, we used OpenSim's compatibility with *Second Life* in order to allow our users to access the study island from within the *Second Life* client. So rather than accessing the commercially available world of *Second Life* (or *Teen Second Life*), the OpenSim dedicated server solution hosting our own island helped us overcome security, ethical and duty of care concerns in working with underage students in that the island was only populated by our own users. In addition to information and consent forms to parents, the ability to demonstrate full control over the island was useful in obtaining ethical clearance for this part of our study from the University Human Research Ethics Committee.

The class was equipped with 25 laptop computers that connected to the OpenSimulator server. Following a half-day excursion to the site on the previous day (Fig. 2), we first started off the workshop day with using Google Earth to allow the students to explore the area in a more photo-realistic environment first, and we uploaded a 3D Google SketchUp rendering of the proposed library building to illustrate certain qualities of a virtual environment. After an initial training phase to familiarise themselves with the avatar controls that the *Second Life* client offers, students were asked to think carefully about both the current and intended usages of the three main precincts (timber mill; butter factory arts centre; library). We then focused on the outdoor areas and the greenbelt in the centre of the site, and students were asked to identify ideas and opportunities for how this space could be utilised to enhance the user experience of each of the three precincts (Fig. 3). Students came up with ideas such as shaded outdoor reading areas, a graffiti wall, outdoor movies, a timber-made playground, tree lights, exhibition displays and a community garden. The class was divided into three groups representing each precinct, and each group was asked in turn to pick their favourite idea that was then

constructed on-the-fly in *Second Life*. This process was repeated multiple times and not only involved learning how to collaborate within each group, but also how to negotiate space claims and conflicting interests.



Figure 3: Workshop with Grade 8 high school students

This first set of workshop activities was aimed at generating various narratives in the form of dialogues between participants, between students and teachers, and between students and the planning team. *Second Life* functioned as a catalyst providing a dynamic 'boundary object' (Star & Griesemer, 1989) to engender and facilitate the development of informed exchanges of ideas and viewpoints.

Furthermore, the game-like interface was novel and fun for students to explore. We found that characteristics of *Second Life* that are usually shortcomings for its use in professional urban planning, such as lack of design and positioning precision, were of little or no consequence for the purpose and success of our workshop trials.

We observed and analysed both the students' use of the *Second Life* client and the narratives that unfolded between groups of students whilst they deliberated their urban planning decision making. Two scenarios illustrate some of the initial observations that we made so far: *First*, it was interesting to witness how the prevalent principles of sustainable growth and development in this area of Australia have been intrinsically adopted by even young people at this age. The area subscribes to a population cap, and is very sensitive and careful in the approval of new developments. Some students initially suggested large-scale developments for the site, such as the type of entertainment parks found on the Gold Coast of Australia. However, within the group discussions, the students immediately considered some of the main implications such developments would cause, such as traffic increase, need for car park spaces, large influx of tourists and day visitors, and they found it difficult to reconcile these impacts with the geographic and socio-cultural qualities presented by the site. Over the course of the discussion, the original idea of an entertainment park thus changed to an innovative playground made of wooden toys supplied by the woodworkers of the old timber mill workshop. To keep the playground exciting, it would need to be replaced regularly with new toys and

features – similar to the addition of new rides that keep the entertainment parks attractive. *Second*, the students' exposure to their local environment in the virtual world at their fingertips not only brought home some of the wider implications of this particular idea, it also subsequently offered a chance to negotiate space claims. The playground had to be scaled and positioned in a way that would be conducive to other usages such as the library's proposed outdoor reading area, as well as not overlap with potentially conflicting interests, such as the movie screening area. The ability to easily and quickly build objects, scale and move them, enabled the students to lead a discussion that was straight away informed by evidence presented through the results they achieved by manipulating objects within the virtual world.



Figure 4: Student ideas are being constructed on-the-fly

Logging techniques in Second Life

As a next step, we want to explore advanced logging techniques to capture qualitative data in *Second Life*. This was not part of the previous experiment, so here we only outline the proposed next phase of our study. The affordance of a particular environment is strongly indicated via its usage, and via the stories that people tell of the environment, represented as a narrative (Foth, Klæbe, & Hearn, 2008). We can extend this concept to show that urban environment usage is modelled and approximated by the use of a *Virtual Environment* (VE), giving simulation information about how the real environment will be used. Thus the assumption is that the emotional and cognitive models of usage map to real usage in a predictable manner; any gap between the two is assumed to be a function of the sensate gap between reality and the virtual representation, and can be factored into any reasoning about its usage. In many areas of design, including urban planning, the use of such VEs has been a key contributor to the simulation, and thus success of the developed artefacts (Gordon & Koo, 2008). However, what has been lacking in the urban design and planning domain is the use of the logging features of an environment to record both *implicit* and *explicit* components of its usage narrative in an integrated manner.

Implicit usage information can be garnered from the internal VE data to extract information, such as the location of the *avatar* in the environment, and its interactions with artefacts. This information, in much the same way as a candid camera scenario, provides insight into the usage of the environment, and generating an implicit user narrative.

The explicit component of the user narrative is garnered from specific interactions and events with the environment that are exposed as components of the user interface, enabling the users of the environment to leave information that is pertinent to their personal narrative. A simple example is the reviewer comments used in Microsoft Word. They consist of visual indicators of embedded text that record opinions of people about a document. In a similar manner, users can embed multimedia comments within a Virtual Environment, to expose the explicit narrative formation by the user.

Explicit narrative is an exposure of the narrative event model to the user, thus enabling them to record narrative events directly into the log data of the environment. Effectively, the environment is recording the usage of its data structures as a continuous process. At any stage the user can insert an event that can explicitly indicate their contribution to the narrative of environment usage.

Most implicit and explicit narrative generation work has been successfully performed in computer games and related virtual environments, with the use of data logging schemes in order to ascertain specific information about the usage of the environment (Brown et al., 2007; Hoobler et al., 2004; Chittaro et al., 2004; Grammenos et al., 2002), as the design factors on a large computer game environment are similar to those faced by an urban planner in reality, as they relate to human usage of the game. Other successful non VE logging usage applications include computer network monitoring (Mansouri-Samani & Sloman, 1993) and business process modelling (Weijters & van der Aalst, 2001). However, data logging techniques to generate urban environment usage narratives in the manner we describe has not been explored so far. We believe that this is a useful opening for computer visualisation and data mining tools to assist planners in their development of environments by simulation log data.

We propose an integrated VE narrative event model that is designed to suit urban planning, which can be used to ascertain, amongst other things, the locations of usage difficulty, interactions with people and items in the environment, and reflections of the users as they traverse the virtual world. Typically, log information is passed through an event model that structures interactions with the environment, and thus enables a filtering and formatting of the data that is generated by the visual simulation for further processing using data mining techniques. The event model becomes a phenomenological mask onto the world to extract salient information regarding behaviours by the virtual presences of the person, and interactions between non-sentient content in the environment. We believe a combination of implicit log information, and explicit narrative commentary from the users, will provide a rich bed of data from which to draw planning inferences.

We combine together the implicit and explicit narrative information, to provide a seamless view of the usage of the VE. We build this event structure on three basic types of events that can be logged within the environment. Further events are based on these three types:

- Time Events (TE) are sampled at an interval in time – eg. location of user avatar sample per unit time;

- Interaction Events (IE) occur with other artefacts and avatars – eg. entrance into spaces in urban environments;
- Emergent Events (EE) emitted by the content/avatar in the environment – eg. insertion of in situ video comment on part of environment.

From these basic events, we derive a set of specific events for Urban Planning Environments:

- Region Location (TE) – logged according to environment structure, storing the name, such as “Reception Area”, and raw X, Y, Z location in 3D space;
- Avatar Gaze Locations (TE) – people look at what interests them, positive or negative, so a logging of the avatar gaze positions will indicate what is interesting to people;
- Artefact Interaction (IE) – usage of environment artefacts, such as picking up objects, opening doors, collisions with obstacles;
- Avatar Interactions (IE) – text chatting and voice interactions with other avatars in the environment can be recorded and analysed;
- Comment Events (EE) – comments left in world as artefacts, such as text, audio or video, tied to locations in the VE.

Figure 5 illustrates the overall conceptual framework for the virtual environment logging process. The major components are the VE Data Log and related Event Model (as previously described), Planner Design Task Model and Narrative Visualisation Component.

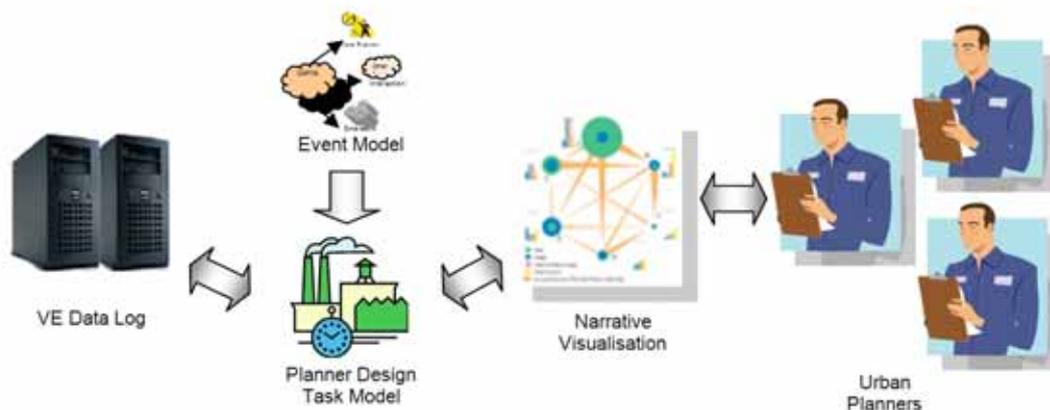


Figure 5: Conceptual overview of the proposed approach to extracting narratives from the usage logs of an environment.

The Designer Task Model facilitates the choice of appropriate visualisations of the event data for urban designers, based upon the event model we have described. Thus a matching of particular designer task with useful Narrative Visualisations facilitates insight into the usage of the urban space. Some mock up examples of

visualisations that can be generated from such event data are shown below in Figure 6.



Figure 6: Illustration of three example visualisations of narrative data. On the far left is an in situ visualisation of implicit location events within a VE environment. In the middle is an overhead map visualising explicit business interactions, chat sessions and comments left in the environment. On the right is an example of a video wall embedded in the environment as a form of explicit commentary by users of a VE, being viewed by a planner avatar. (Embedded video example in the rightmost image is drawn from wiki.secondlife.com/wiki/Video_Tutorials, accessed on 29th May 2008.)

These visual outputs can also be used recursively with used in a guided process of reflection to have them articulate their meaning-making in relation to the space in question. The urban planners can use these visual event representations to interact with users, to elicit more information regarding their narrative, and to attach these responses to the already logged information.

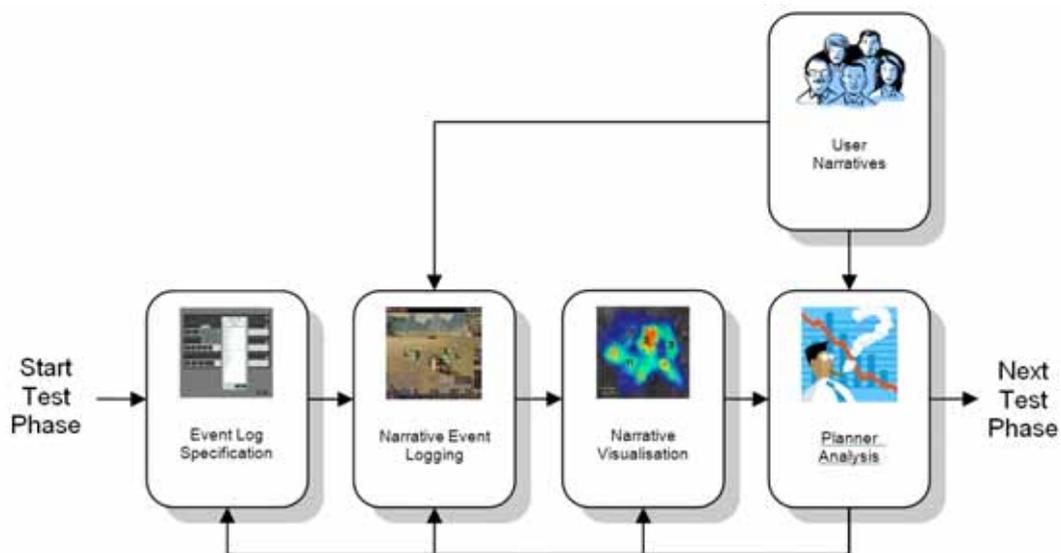


Figure 7 Illustration of an example software workflow for eliciting user narratives.

The workflow of this narrative software framework requires a number of stages, with user interaction as the basic driving factor (Fig. 7). The planners specify the events

that need to be logged, with appropriate parameters to suit the design task, or default specifications will be used. Users enter the environment, and implicit and explicit narrative components are recorded via the event model as they interact with the VE. Designers then view the narrative data using narrative visualisations tools, and engage in a dialogue with the users to extract the nuances of their usage story. For example, they may note that the people are congregating in a particular area via visualisation of the implicit location events, as per the example in Figure 6. Furthermore, they may view the explicit narrative comments left in the area to discover that users are leaving video comments on the sense of privacy they feel in that particular space, enabling social interaction. The urban planners can then follow up with the users either in-world, or via other interview techniques to derive a full narrative of the usage of this space, to inform their planning processes.

Conclusions

Urban planning has evolved in concert with the evolution of ICT. Current technologies offer the possibility of creating distributed, co-created immersive narratives to guide the urban planning process. The challenge of new technology such as *Second Life* is the limited knowledge of people about using such sites for planning and design purpose and training them to be able to contribute to collaborative design outcomes. Likewise, some of these technologies have novelty value which may attract people to use them in the beginning, but sustaining their interest and getting them involved for long term planning could be a challenge. We believe that virtual reality models such as *Second Life* can only complement not replace the face-to-face collaborations among planners and larger communities.

In our work, we found the previously maintained strict dichotomy between the virtual world ('cyberspace') and the real world of little use. Connections between the digital and the real need to be explored further, and people's increasingly seamless transitioning between online/mediated and offline/unmediated modes of communication and interaction has to be examined further. What impact does the seamlessness have on people's ability to navigate and negotiate their lives? It is conducive or deterring? Looking at the opportunities afforded by a migration to mobility, we believe there to be a huge potential for virtual world applications to be embodied in the real environment through the use of mobile phones and other mobile devices. Applications such as Tonchidot's award-winning Sekai Camera⁶ which augments reality in novel and useful ways open new possibilities to combine the advantages of virtual worlds in real-world contexts. This work is not about merging both worlds until they are indistinguishable from each other, but rather to specifically take the agile, networked and real-time features of the virtual components and allow users to harness their power *in situ*.

The proposed next phase of our study will explore logging techniques as a way to add a new data source and enable triangulation between the analysis of log data, creative expression and virtual narratives. In a parallel study, we are also investigating mobile narratives with a view to test how we can move from virtual to digitally augmented planning environments (Wiesner, Foth, et al, 2009). At this stage there is a gap in research on how planners have used Web 2.0, new media and 3D virtual and augmented reality technologies for analysing, communicating and collaborating on urban challenges for the 21st century. We hope that this paper

⁶ http://www.tonchidot.com/Sekai_Camera.html

contributes to filling some of the gaps in the literature by raising pertinent questions and identifying opportunities for use of these new technologies in urban planning.

Acknowledgements

This research is supported under the Australian Research Council's Linkage Projects funding scheme (project number LP0882274). Dr Marcus Foth is the recipient of a Smart Futures Fellowship supported by the Queensland State Government and National ICT Australia (NICTA). The authors would like to thank our partner organisations, Sunshine Coast Regional Council, Noosa District State High School, and FKP, for supporting this research project, and the editor and anonymous reviewers for valuable comments on earlier versions of this paper.

Biographies

Marcus Foth is a Senior Research Fellow at the Institute for Creative Industries and Innovation, Queensland University of Technology (QUT), Brisbane, Australia. He received a QUT Vice-Chancellor's Research Fellowship (2009-2011), and a Smart Futures Fellowship from the Queensland State Government (2009-2011). He was an Australian Postdoctoral Fellow (2006-2008), and a Visiting Fellow (2007) at the Oxford Internet Institute, University of Oxford, UK. Dr Foth's research explores human-computer interaction design and development at the intersection of people, place and technology with a focus on urban informatics, locative media and mobile applications. Dr Foth has published over sixty articles in journals, edited books, and conference proceedings in the last five years. He is the editor of the Handbook of Research on Urban Informatics (2009). He is the conference chair of OZCHI 2009, a member of the Australian Computer Society and the Executive Committee of the Association of Internet Researchers.

Ross Brown works as a Senior Lecturer in the Faculty of Information Technology at Queensland University of Technology, Brisbane, Australia. He is also a member of the Business Process Management Research Cluster at QUT. His research and teaching interests are in visualisation, computer games, computer graphics and related disciplines. In particular, he has recently focussed his research on the application of games technology to business process management for modelling, simulation and communication purposes. He also teaches real-time rendering and games production as part of the new QUT Computer Games and Interactive Entertainment degree.

Bhishna Bajracharya is an Associate Professor of Urban Planning at the Mirvac School of Sustainable Development, Bond University, Gold Coast, Australia. He has previously taught at the Queensland University of Technology (QUT) in Brisbane for twelve years and worked as a post-doctoral fellow at the Australian National University in Canberra for two years. He received a Bachelor of Architecture from the School of Planning and Architecture, Delhi University, a Master of Urban and Regional Planning and a PhD in Geography from the University of Hawaii. He has carried out research on a wide range of topics such as master planned communities, transit oriented development, subtropical design, Local Agenda 21 and mega cities in Asian countries. Dr Bajracharya, together with academics from QUT's Creative Industry Faculty, received an ARC Linkage grant on the use of community narratives and new media in urban planning.

Greg Hearn is Research Professor in the Creative Industries Faculty at QUT. His work focuses on policy development and R and D for new technologies and services in the creative industries. He has been involved in high level consulting and applied research in this field for more than two decades, with organisations including British Airways, Hewlett Packard, and many Australian national and state government agencies. He was a consultant to the Broadband Services Expert Group, the national policy group that formulated Australia's foundational framework for the Internet in 1994. In 2005 he was an invited member of a working party examining the role of creativity in the innovation economy for the Australian Prime Minister's Science Engineering and Innovation Council. He has authored or co-authored over 20 major research reports and a number of books, including, *Public policy in knowledge-based economies (2003: Edward Elgar)* and *The knowledge economy handbook (2005: Edward Elgar)*.

References

Bajracharya, B., & Allison J. (2008). Emerging Role of ICT in the Development of Knowledge-Based Master Planned Communities. In T. Yigitcanlar, K. Velibeyoglu & S. Baum (Eds.), *Knowledge-based Urban Development: Planning and Applications in the Information*. Hershey, PA: IGI Global.

Boulos, M., Hetherington, L., & Wheeler, S. (2007). Second Life: an overview of the potential of 3-D virtual worlds in medical and health education. *Health Information and Libraries Journal*, 24(4), 233-245.

Boyer, B. (2008). MGS4 Dominates June NPD, Drives PS3 Sales http://www.gamasutra.com/php-bin/news_index.php?story=19476, Accessed: October, 2008

Brail R. K., & Klosterman, R. E. (Eds.) (2001). *Planning Support Systems: Integrating Geographic Information Systems, Models, and Visualization Tools*. Redlands, CA: ESRI Press.

Brown, R., Joslin, S., & Drennan, P. (2007). The Gameplay Visualisation Manifesto: A Framework for Logging and Visualisation of Online Gameplay Data. *ACM CIE*, 5.

Burgess, J., Foth, M., & Klæbe, H. (2006, Sep 25-26). *Everyday Creativity as Civic Engagement: A Cultural Citizenship View of New Media*. Paper presented at the Communications Policy & Research Forum, Sydney, NSW.

Carroll, J. M. (Ed.). (2000). *Making Use: Scenario-based Design of Human-Computer Interactions*. Cambridge, MA: MIT Press.

Castells, M. (2004) Space of Flows, Space of Places: Materials of a Theory of Urbanism in the Information Age. In S. Graham (Ed.), *The Cybercities Reader*. New York: Routledge.

Chittaro, L., & Ieronutti, L. (2004). A Visual Tool for Tracing Users' Behavior in Virtual Environments. *Proceedings working conference on advanced visual interfaces, Improving Interaction*, 40-47.

ESA. (2008). Industry Facts <http://www.theesa.com/facts/index.asp>, Accessed: October, 2008

- Florida, R. (1995). Towards the Learning Region. *Futures*, 27(5), 527-536.
- Florida, R. (2002). *The Rise of the Creative Class*. New York: Basic Books.
- Forester, J. (1999). *The Deliberative Practitioner: Encouraging Participatory Planning Processes*. Cambridge, MA: MIT Press.
- Foth, M., Klaebe, H., & Hearn, G. (2008). The Role of New Media and Digital Narratives in Urban Planning and Community Development. *Body, Space & Technology*, 7(2).
- Foth, M., Odendaal, N., & Hearn, G. (2007, Oct 15-16). *The View from Everywhere: Towards an Epistemology for Urbanites*. Paper presented at the 4th International Conference on Intellectual Capital, Knowledge Management and Organisational Learning (ICICKM), Cape Town, South Africa.
- Goodchild, M. (2007, Dec 13-14). *Citizens as Sensors: The World of Volunteered Geography*. Paper presented at the Workshop on Volunteered Geographic Information, Santa Barbara, CA, USA.
- Graham, S. (Ed.) (2004) *The Cybercities Reader*. New York: Routledge.
- Graham, S., & Marvin, S. (2001). *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Conditions*. New York: Routledge.
- Gordon, E., & Koo, G. (2008). Placeworlds: Using Virtual Worlds to Foster Civic Engagement. *Space and Culture*, 11(3), 204-221.
- Grammenos, D., Filou, M., Papadakos, P., Stephanidis, C. (2002). *Virtual Prints: leaving trails in virtual environments*. Workshop on Virtual environments, Navigation and Interaction, Vol. 23 ACM Press, Barcelona, Spain, 131-ff.
- Guhathakurta, S. (2002). Urban Modeling as Storytelling: Using Simulation Models as a Narrative. *Environment and Planning B: Planning and Design*, 29(6), 895–911.
- Healy, P. (2006). *Collaborative Planning. Shaping Places in Fragmented Societies*. New York: Palgrave Macmillan.
- Hoobler, N., Humphreys, G., & Agrawala, M. (2004). Visualising Competitive Behaviours in Multi-User Virtual Environments. *IEEE Visualization*, 163-170.
- Hudson-Smith, A., Milton, R., Dearden, J., & Batty, M. (2009). The Neogeography of Virtual Cities: Digital Mirrors into a Recursive World. In M. Foth (Ed.), *Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City* (pp. 270-290). Hershey, PA: Information Science Reference, IGI Global.
- Innes, J. E., & Booher, D. E. (1999). Consensus building as role playing and bicolage: Towards a theory of collaborative planning. *American Planning Association Journal*, 65(4), 412-423.
- Jenkins, H. (2006). *Fans, Bloggers, and Gamers: Exploring Participatory Culture*. New York: New York University Press.
- Joseph B., Ishii, H., Underkoffler, J., Piper, B., & Yeung, L. (2001). Urban Simulation and the Luminous Planning Table: Bridging the Gap between the Digital and the Tangible. *Journal of Planning Education and Research*, 21, 196-203.

- Kallus, R. (2001). From Abstract to Concrete: Subjective Reading of Urban Space. *Journal of Urban Design*, 6(2), 129-150.
- Klosterman, R. E. (2001). Planning Support Systems: A New Perspective on Computer-aided Planning. In R. K. Brail & R. E. Klosterman (Eds.), *Planning Support Systems : integrating Geographic Information Systems, Models, and Visualization Tools* (pp. 1-23). Redlands, CA: ESRI Press.
- Kok, K. & van Delden, H. (2004). Linking Narrative Storylines and Quantitative Models to Combat Desertification in the Guadalentin, Spain. In *Proceedings of the Second Biennial Meeting of the International Environmental Modelling and Software Society, Manno, Switzerland* (pp. 754-759).
- Kolbitsch, J., & Maurer, H. (2006). The Transformation of the Web: How Emerging Communities Shape the Information we Consume. *Journal of Universal Computer Science*, 12(2), 187-213.
- Landry, C. (2000), *The Creative City: A Toolkit for Urban Innovation*, London: Earthscan.
- Landry, C. (2006) *The Art of City Making*, London: Earthscan.
- Landry, C. (2007). Visual Sensecape of the City. In *Proceedings of the Urban Directions: Seeing the City Conference, Keynote Lecture, 7 March*. Brisbane, QLD: Centre for Subtropical Design, Queensland University of Technology.
- Levy, J. M. (2006). *Contemporary Urban Planning* (7th ed.). Upper Saddle River, NJ: Pearson/Prentice Hall.
- Malczewski J. (2004). GIS-based land-use suitability analysis: a critical overview. *Progress in Planning*, 62(1), 3-65.
- Manning, H. (2003). *The Power of Design Personas* (Report). Cambridge, MA: Forrester Research.
- Mansouri-Samani, M., & Sloman, M. (1993). Monitoring distributed systems. *Network* 7, 20-30.
- Mitchell, W. (1995). *The City of Bits: Space, Place and the Infobahn*, Cambridge, MA: MIT Press.
- Nae, V., Iosup, A., Podlipnig, S., Prodan, R., Epema, D., & Fahringer, T. (2008). Efficient management of data center resources for massively multiplayer online games. In *Proceedings ACM/IEEE Conference on Supercomputing* (Austin, Texas, November 15 - 21, 2008).
- Odendaal, N. (2006). Towards the Digital City in South Africa: Issues and Constraints. *Journal of Urban Technology*, 13(3), 29-48.
- Piekarski, W., & Thomas, B. (2002). ARQuake: the outdoor augmented reality gaming system. *Commun. ACM* 45(1), 36-38.
- Rouch W. (2007) *Technology Review*; Jul/Aug 2007; 110(4), 38-48.
- Sager, T. (2002). Deliberative Planning and Decision Making, *Journal of Planning Education and Research*, 21, 367-378.

- Sandercock, L. (2003). *Cosmopolis II: Mongrel Cities of the 21st century*, London: Continuum.
- Sieber, R. (2006). Public participation geographic information systems: A literature review and framework. *Annals of the Association of American Geographers*, 96(3), 491-507.
- Star, S. L., & Griesemer, J. R. (1989). Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*, 19(3), 387-420.
- Sui, Daniel Z. (2008). The wikification of GIS and its consequences: Or Angelina Jolie's new tattoo and the future of GIS. *Computers, Environment and Urban Systems*, 32(1), 1-5.
- Weijters, A. J. M. M., & van der Aalst, W. M. P. (2001). Process Mining: Discovering Workflow Models from Event-Based Data. In: Kröse, B., De Rijke, M., Schreiber, G., and Someren, M. van (Eds.): *13th Belgium-Netherlands Conference on Artificial Intelligence (BNAIC 2001)*, Maastricht, 283-290.
- Weinberger, D. (2007). *Everything is Miscellaneous: The Power of the New Digital Disorder*. New York: Times Books.
- Wiesner, K., Foth, M., Bilandzic, M., & Krcmar, H. (2009, Sep 15-18). *Restrictions and Constraints in Mobile Narratives for Place-based Community Engagement*. Paper presented at the Community Practices and Locative Media Workshop, MobileHCI, Bonn, Germany.