Reflections on Planning Support

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Resumo

As actividades de planeamento podem ser caracterizadas cada vez mais como excessivamente complexas. Como consequência e em contraste com a sua história a necessidade de suporte ao planeamento e a utilização dos chamados Sistemas de Suporte ao Planeamento (SSP) tende a aumentar. Um estudo recentemente, divulgado na Internet revelou a existência e a aplicação de uma vasta diversidade destes SSP na prática do planeamento. Na minha contribuição vou debruçar-me sobre a lógica e as ilações que se podem associar a este estudo. Mais ainda, gostaria de reflectir sobre os seus resultados e transportar o leitor para o futuro previsível do suporte e dos SSP em planeamento. Para uma leitura mais aprofundada sobre os SSP ver o livro 'Planning Support Systems in Practice', publicado por Springer Publishers, editado por Geertman e Stillwell em 2003 (http://www.springer.de/economics).

Palavras-chave: Planeamento, Sistemas de suporte ao Planeamento, Sistemas de Informação Geográfica

Abstract

Planning activities can be characterized more and more as overly complex. As a consequence and in contrast to its history the need for planning support and the application of so-called Planning Support Systems (PSS) tend to increase. A recent worldwide Internet-based inventory has opened up the existence and application of a wide diversity of these PSS in planning practice. In my contribution I would like to elaborate on the underlying rationale and resulting conclusions that can be attached to this inventory. Moreover, I would like to reflect on the outcomes of this study and take the reader to the foreseeable future of planning support and PSS in planning practice. For a more exhaustive elaboration on these PSS, see the book on 'Planning Support Systems in Practice', published by Springer Publishers, edited by Geertman and Stillwell 2003 (http://www.springer.de/economics).

Keywords: Planning, Planning Support Systems, Geographical Information Systems

1. Introduction

Planning is an activity orientated towards the future that links “scientific and technical knowledge to actions in the public domain” (Friedmann 1987). It normally takes place through formal discourse between the groups, organizations and individuals concerned with particular public or private sector initiatives or proposals. Urban and regional planning encompasses a wide range of activities - many of which are responses to particular societal problems - that impact at different spatial scales. In each context, planning tends to be characterized by the involvement of a plurality of frequently conflicting interests, an explicit future orientation, an emphasis on strategic choices as well as operational decisions (Friend and Jessop 1969) and a necessity to recognize the long term impact of policies and plans.

Over many years, the planning profession has made use of methods and tools to support their planning tasks. Nevertheless, it can be argued that planning practice has never fully embraced the diversity of methods, techniques and models developed in the research laboratory. The tools themselves, and their applications, have changed over time. Geo-information technology itself is characterized by: increased availability of affordable geo-data and geo-information; more user-friendly software and hardware; enhanced capabilities of software tools; exploitation of the World Wide Web as a channel for data capture, analysis and dissemination; et cetera. Planning is changing all the time too: more strategic; more integrative; more region oriented; more participative; et cetera. Despite these trends, most geo-information tools do not readily fit the changing needs of the planning profession: they are far too generic, complex, inflexible, incompatible with most planning tasks, oriented towards technology rather than problems and too focused on strict rationality (Geertman 1999).

Partly as a consequence of this mismatch and encompassed as an answer for the growing complexity of the planning activity, a new generation of novel or renewed tools to facilitate ‘new’ planning practice has materialized under a new generic term, Planning Support Systems (PSS). In the remainder of this article I would like to go deeper into the important issues relating to PSS. In Section 2 I will try to define the term Planning Support System a bit more precise. In addition, in Section 3 I will focus on the worldwide inventory on PSS, performed by John Stillwell of Leeds University and myself. Thereafter, in Section 4 I will elaborate on the main results of the PSS inventory. Finally, Section 5 contains some conclusions, based on the results of the inventory.

2. Planning Support Systems

Planning Support Systems (PSS) are tools that have been developed and are being used to support public or private sector planning activities at any spatial scale. In fact, up till now there is no widespread accepted definition of what precisely PSS are and what not. As a working definition, I consider PSS as geo-technology related instruments consisting of theories, information, methods, tools, data, et cetera dedicated for support of specific professional planning tasks. These systems are primarily developed to support different aspects of the planning process, including for instance problem diagnosis, data collection, enhancing participation, spatial and trend analysis, data modelling, visualisation and display, scenario-building and projection, plan formulation, report preparation and collaborative decision-making.

Underlying the work on PSS is the assumption that a greater degree of access to relevant information will lead to the consideration of a greater number of alternative scenarios, which will result in a better informed public debate (Shiffer 1995). Although the term PSS itself is fairly recent, the ideas go back to the 1950s. Harris (1999) has long been arguing for an approach to planning that combines sketch planning, the rapid and partial description of alternatives, with state of the art modelling of the implications of these alternatives. According to Klosterman (1999a), PSS have matured into a conception of integrated systems of information and software, which brings together the three components of traditional decision support systems - information, models, and visualization - into the public realm.

In the literature, a variety of conceptual or operational prototypes of PSS can be found ranging from the electronic conference board rooms (Group Decision Support Systems) discussed by Laurini (1998) to the GIS-supported collaborative decision making tools outlined by Nyerges and Jankowski (1997) and WWW-based mediation systems for cooperative spatial planning (Gordon et al. 1997; Singh 1999; Kammeier 1999; Klosterman 1999b; Hopkins 1999, Geertman 2001). Last year the book on PSS by Brail and Klosterman (eds.) (2001) has been published by ESRI-Press. And recently, the book on Planning Support Systems in Practice by Geertman and Stillwell (eds.) (2003) was published by Springer Publishers.

3. The PSS inventory

Stillwell et al. (1999a; 1999b) provide an assessment of planning practice at the beginning of the twenty-first century from which it can be concluded that the adoption of geo-information tools is far from widespread and from being effectively integrated into the planning process. Planners and designers remain at best distrustful, or at worst downright antagonistic, toward computer-based models (Harris 1998, 1999).

Klosterman (1998) suggests that tools for planning support are no more developed now than they were ten years ago and is equally pessimistic about the adoption of new tools and computer applications in planning practice in the near future. It appears that many planners now have access to the geo-data and (meta-) geo-information facilities of their organisations, and many are now proficient in using the technology to perform spatial queries and to generate thematic maps. Sadly, however, progress towards the use of geo-information tools beyond these basic activities, in particular to help solve key strategic planning problems through more sophisticated analyses, has been very limited (Nedovic-Budic 1998, Geertman 1999). In fact, it is still the case that the proportions of planners who consider their geo-information tools as an intrinsic and indispensable instrument for performing their job properly (as financial experts use their spreadsheet software and as medical specialists use their ECG technology) remains remarkably low (Geertman 2001).

The reasons for this backward situation are diverse: planners have to perform a diversity of analytical tasks which makes it difficult to build generic instruments; the market for public sector software is relatively small and, as a consequence, the costs of developing and supporting commercial software are high; within the planning profession, there seems to be an ongoing tension amongst those who use the technology for basic information provision and those who conduct more detailed analysis; professional education and training of planners in the creative application of geo-information tools remains at a very rudimentary stage (Brail and Klosterman 2001, Geertman 2001). As a consequence, analytical tools for planning purposes continue to lag far behind those developed for other professions such as transportation engineering.

At the same time, there is evidence that some developments are taking place that will have positive influences on adoption. Within the field of geo-information technology itself, systems are rapidly becoming more and more user-friendly, interoperable, cost-effective, standardized and platform-independent. At the same time, geo-data are becoming more abundant, cheaper, easier to obtain and of a higher resolution and quality. Within planning practice too, ongoing changes are increasing the needs and potential for the application of geo-information tools. The increasing involvement of participants in planning processes is one example, and the increasing sophistication of planning due to the growing complexity of real world dynamics (Geertman and Stillwell 2000) is another. The dissemination of data and plans is changing radically: plans are becoming available in a digital format, although many as CAD files (in the Netherlands all spatial plans should be available in a digital format within five years); (prototyping) systems are entering the market with which plans can be put on the Internet and made easily accessible to a wide audience. Furthermore, computer-based land-use modelling for physical planning has been reinvigorated with the development of new forms of simulation models (Engelen et al. 1999, Stillwell and Scholten 2001), new land-use/transportation packages (Simmonds 2001) and new techniques (from artificial intelligence) for applications such as flood forecasting.

Despite these promising developments and the fact that at the moment, people at a diversity of scientific, research and/or planning institutions worldwide are involved in the development, testing and application of a whole range of PSS, there is no to just little knowledge about the extent of the developments and implementation of PSS in planning practice. As a consequence, a great deal of overlapping work may well be undertaken by different groups of researchers and developers. At the same time, the planning community has little idea of where to look for instruments, advice and support for PSS, beyond the employment of expensive consultants. This is problematic for both the potential consumers and producers of PSS – given that planners possess an increasing need for geo-technology support, but geo-technology vendors have to prove the worth of their products in real world planning situations.

The shortcomings of the current situation and the desire to progress the development of planning practice provide the rationale for the creation of this inventory of applications of geo-technology within planning practice. Therefore, Nexpri (Netherlands Centre for Geographical Information: http://www.nexpri.nl) at Utrecht University in cooperation with the School of Geography of the University of Leeds have produced an inventory on PSS, including those in development, as a prototype or as a commercial product, as well as those PSS now implemented and operational in planning practice. This inventory has been held from June 2000 onwards. As a result of this inventory we received about fifty contributions from 15 countries from all over the world of different kinds of PSS that are applied within planning practice. From these thirty were selected for inclusion into the book on 'Planning Support Systems in Practice' (Geertman & Stillwell 2003). It was hoped by this to improve the insight of the planning community into the state-of-the-art in PSS, their availability and use, the opportunities that PSS provide, and the current limitations that exist. Moreover, it can help developers of PSS to contact others and learn from their experiences.

4. Outcomes PSS inventory

A wide diversity of PSS forms the outcome of the internet-based inventory. Quite some are heading for supporting the phase of analysis and design in a planning process and contain all kinds of tools to perform simulations, sketch functionality, modelling, et cetera. Other PSS are focused on the visualization, communication and interaction of geographical information to a restricted (e.g., professionals) or a much more wider (e.g., the public) audience. Another category of PSS can be categorized as real Decision Support Systems in that they are attuned to help professional decision makers in making and understating their choices. And a last group of PSS is focused primarily on the management, monitoring and/or evaluation of real world processes and/or planning regions. Each of these different categories of PSS possesses – logically – different kinds of functionalities to perform their tasks within planning practice.

To illustrate this diversity in more detail, I will focus more in particular on differences in aims, capabilities, content, structure and technology of the PSS. At the same time it is important to stress that although the number of PSS is increasing world-wide, most of the PSS in the inventory are of a very recent date and, as a consequence, not mature. Congruently, their application in actual planning practice still is very limited and seems to confine to experimental trials, such as educational meetings with students or training sessions with professional planners.

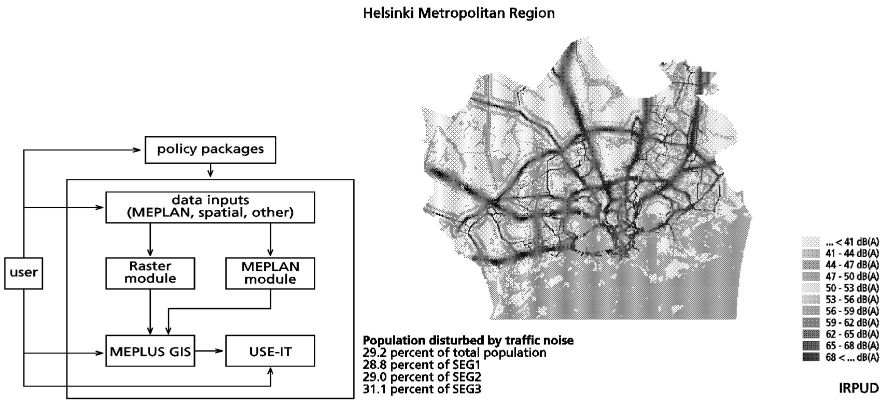
Aims

The PSS contained in the inventory have a wide diversity of aims. Some are dedicated to facilitate and/or enhance participation by the public and/or of stakeholders in the planning process; others can be characterized as tools dedicated to support specific tasks within planning processes like the uniform handling of building permits. Two very different PSS illustrate this diversity of aims in the category of environmental planning. On the one hand, the area-specific Planning System for Sustainable Development (PSSD) is dedicated to support the tasks of professional planners in the Baltic Sea Region to enhance the sustainability of their policies (Hansen 2001). Developed by a consortium of Finnish, Danish and German partners, it contains a wide diversity of instruments, put together on a web site, consisting of best practices, sustainability indicators, associated theories, scientific documents, supporting tools, meta-information, geo-data and dedicated methods. Figure 1 illustrates an outcome of the PSSD, showing the result of an accessibility analysis within the Finnish region of Päijät-Häme (http://www.pssdtoolbox.net/plannertool.htm).

Figure 1 – PSSD interface showing the accessibility of centres near Helsinki

In contrast, the SPARTACUS system (System for Planning and Research in Towns and Cities for Urban Sustainability) on the other hand is more task-specific and has been developed by a consortium of partners from Finland, the UK, Spain and Germany. It is dedicated to support sustainable urban policies at different locations and consists of a land use/transport model (MEPLAN), a set of urban sustainability indicators, a GIS-based Raster method, a MEPLUS database and presentation module, and an evaluation tool (USE-IT) (Lautso 2002). Figure 2 shows both the main modules of the SPARTACUS system and a sample outcome of its noise propagation and pollutant dispersion models applied to the Helsinki Metropolitan Area. (http://www.ltcon.fi/spartacus/default.htm).

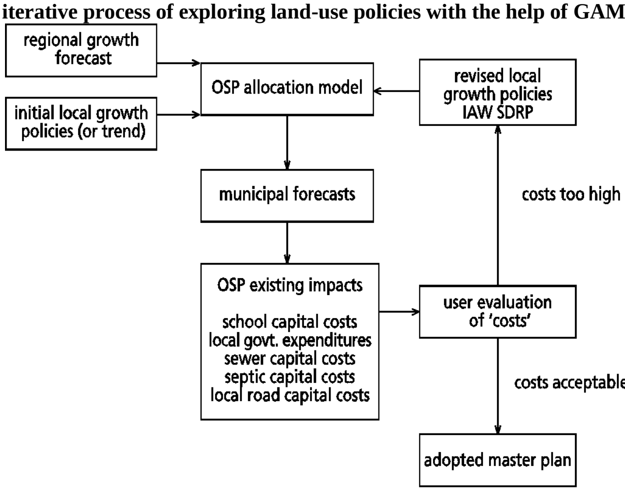
Figure 2 – SPARTACUS system modules (left) and sample noise model output for the Helsinki Metropolitan Area (right)



Capabilities

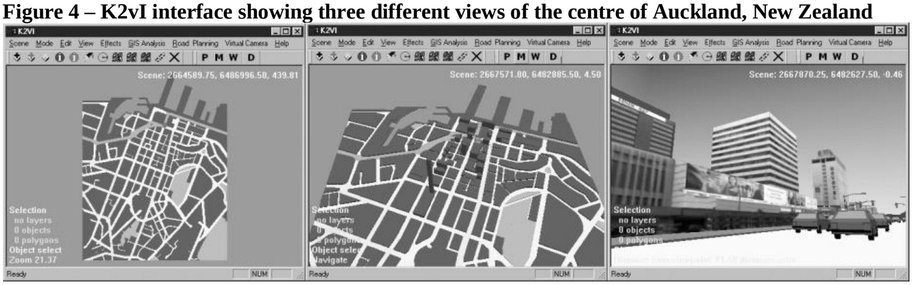
Congruently to aims, the capabilities of PSS in the inventory show enormous variation. Some are dedicated to support modelling activities for future population distributions or land-use patterns, while others provide tools to support the sketching of new spatial structures. Two systems can exemplify this diversity. On the one hand the New Jersey Growth Allocation Model, known as GAMe. This is a PSS designed for interactive use that helps in the identification of the implications of scenarios on land development. It has been developed by the New Jersey (US) Office of State Planning (Reilly 2002) and it allows users to explore various land-use policies in light of both the existing conditions in their town or region and the values and goals of the user. Figure 3 shows the iterative process of exploration of various land-use policies with the help of GAMe.

Figure 3 – The iterative process of exploring land-use policies with the help of GAMe



K2vI (Key to Virtual Insight), on the other hand, is a PSS that allows users to visualise, manipulate and analyse two-dimensional and three-dimensional spatial data within a virtual reality (VR) environment. It was developed initially in the Departments of Geodesy and Technical Informatics at Delft University of Technology (DUT) in co-operation with several engineering companies and the ITC (International Institute for Aerospace Survey and Earth Sciences). Since 1999, K2vI has been further developed for urban, military, sports and forestry applications in a joint effort involving Asset Information Systems in New Zealand and the DUT. Figure 4 illustrates K2vI by providing three different views of the centre of the city of Auckland in New Zealand (http://www.k2vi.com/).

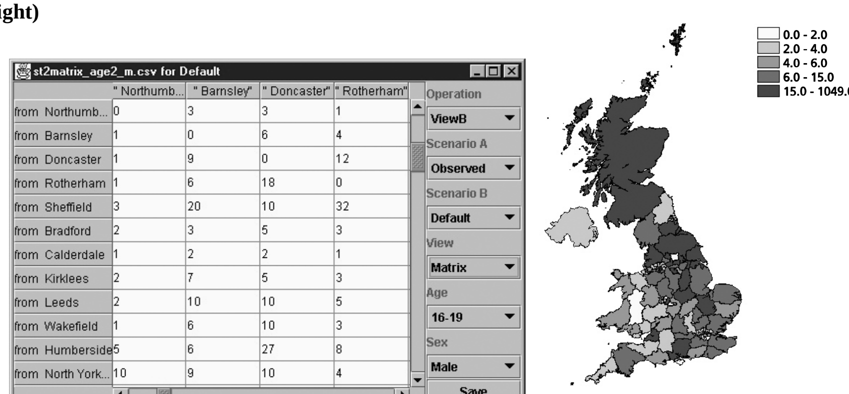
Figure 4 – K2vI interface showing three different views of the centre of Auckland, New Zealand



Content

Some PSS can be regarded as a 'toolbox' containing various components while others are much more specialized and contain only very specific software components to perform specific tasks. Two examples to illustrate such specialized PSS. On the one hand MIGMOD, which is a prototype internal migration modelling system that was built for the Department of Transport, Local Government and the Regions (DTLR) in the UK by a consortium of researchers based primarily at the Universities of Newcastle and Leeds (Champion et al. 2002). Its purpose is to assist in the understanding of the impacts of changes in various determinants on the volume and patterns of internal migration within the UK. Figure 5 illustrates sample outputs of MIGMOD, both relate to predictions of flows of male migrants aged 16-19 in 1996-97 between a selection of regions.

Figure 5: MIGMOD interface showing predictions of out-migration flows in table (left) and map (right)



	" Northumb...	" Barnsley"	" Doncaster"	" Rotherham"
from Northumb...	0	3	3	1
from Barnsley	1	0	6	4
from Doncaster	1	9	0	12
from Rotherham	1	6	18	0
from Sheffield	3	20	10	32
from Bradford	2	3	5	3
from Calderdale	1	2	2	1
from Kirklees	2	7	5	3
from Leeds	2	10	10	5
from Wakefield	1	6	10	3
from Humberside	5	6	27	8
from North York...	10	9	10	4

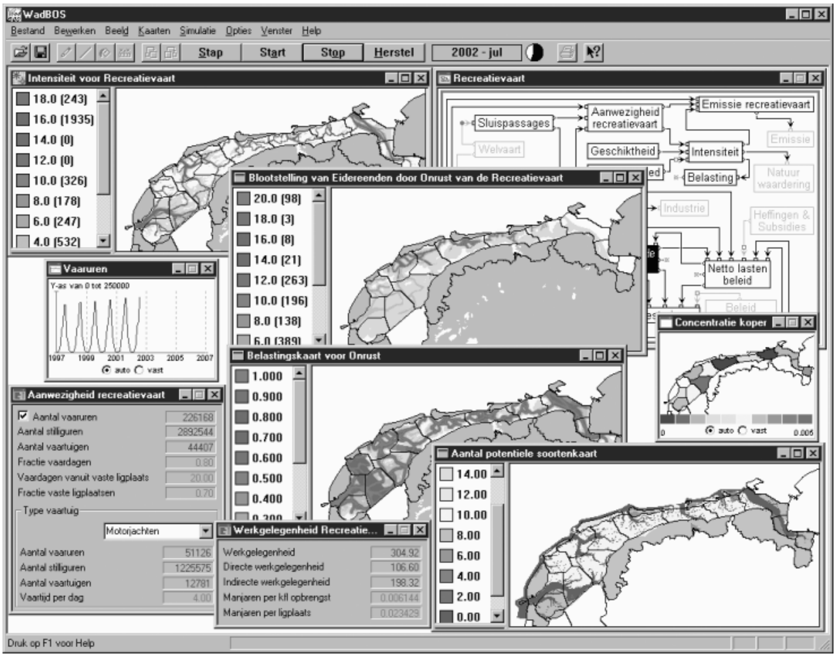
The BIPC model on the other hand refers to the Bulk Infrastructure Potential Cost model and provides a means for the incorporation of bulk engineering services (water, sanitation, and electricity) cost considerations into the strategic planning process during land suitability assessment (Biermann 2002). It has been developed by the CSIR Building and Construction Technology in South Africa as a PSS for planners and development decision-makers to enhance the integration of land-use and infrastructure planning. Figure 6 shows the three constituting elements of the bulk infrastructure potential cost model. The model is based on threshold analysis, which indicates steep rises in the marginal cost curves associated with further development.

Figure 6: BIPC model (left) and its output based on MCA including bulk infrastructure potential costs (right)

Structure

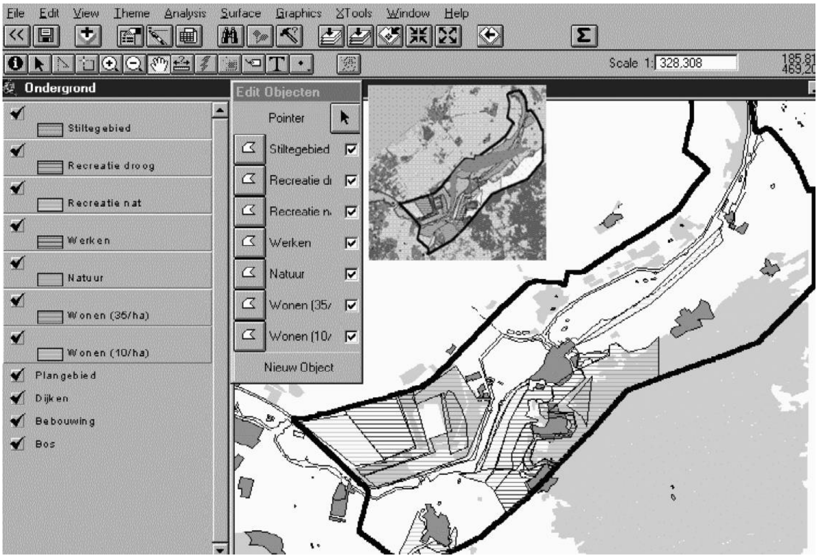
PSS differ too in their structure in that some can be considered fully integrated systems while others have components that are only loosely connected tools within a container. Two examples will illustrate this diversity in structure. On the hand the WadBos system which can be considered an example of the first category. It has been developed for the support of the process of decision making for the Wadden Sea, an important estuarine system in the northern part of the Netherlands. The management of the different activities and functions of the area (for example, fishing, recreation, transportation and gas exploitation) are distributed over a great number of institutions, ranging from the local to the European. In order to streamline the process of fragmented decision-making, WadBos was developed as a highly integrated model representing the ecological and the economic functions of the sea (Engelen 2000). (http://www.netcoast.nl/tools/rikz/WADBOS.htm).

Figure 7: WadBos interface showing disturbing consequences of recreational boating on the Wadden Sea



SketchGIS on the other hand is a stand-alone toolbox developed to support the first phase of a participatory plan-making process, the creation and evaluation of spatial scenarios for the future. It has been developed by a consortium of public and private sector organisations in the Netherlands and it incorporates a diversity of loosely-coupled tools with which associated tasks can be performed (brainstorming; sketching; evaluation; and presentation) (Geertman 2002). With the help of the SketchGIS toolbox participants within a collaborative planning session can design and discuss expectable, potential and/or desirable futures for their own living area. Figure 8 illustrates the design tool as part of the SketchGIS toolbox with the help of which spatial scenarios can be sketched freely on a background map.

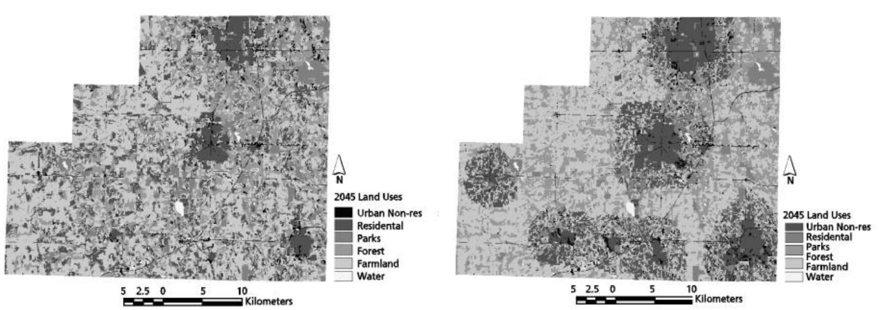
Figure 8: SketchGIS toolbox for interactive and participatory spatial scenario building



Technology

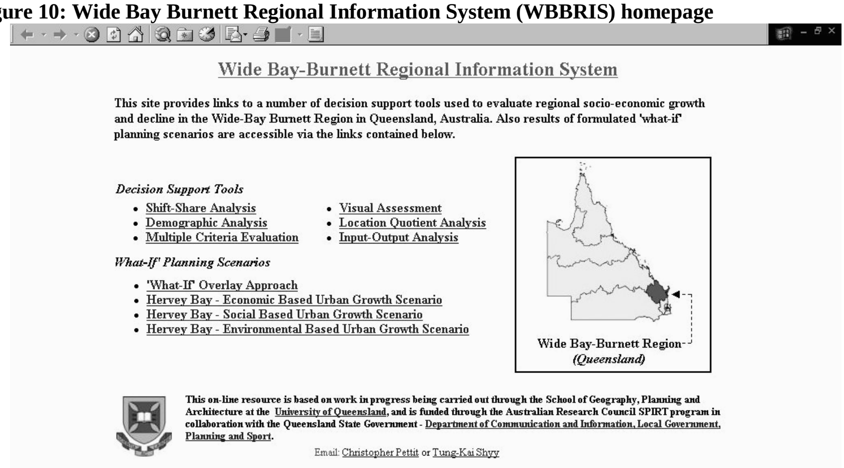
In the case of applied technology, some PSS are stand-alone programmes while others are developed solely for the Intranet or Internet. Two examples will illustrate this diversity of technology. On the one hand What if? TM is a stand-alone policy-oriented planning tool that can be used to determine what will happen if certain policy choices are made (e.g. spatial restriction on urbanization growth) and certain assumptions concerning the future (e.g. population growth rates) prove to be correct (Klosterman 1999b). Figure 9 illustrates What if? TM by showing several projected land-use scenarios (http://www.what-if-pss.com/).

Figure 9: Output of What if? TM showing restricted and unrestricted land use growth control scenarios in Medina County, Ohio, US



On the other hand, for the Wide Bay Burnett region of Queensland, Australia, WBBRIS (Wide Bay-Burnett Regional Information System) was developed which is an Internet-based PSS (Pettit et al. 2002) that incorporates a suite of SDSS tools to undertake multi-scaled planning analysis. For instance, users can review the results of a number of 'what-if' planning scenarios with the help of a MCA (Multi-Criteria Analysis) approach. Figure 10 shows the homepage of WBBRIS in which the area under study is identified, accompanied by several tools like shift-share analysis and input-output analysis, and the various scenarios (economic; social; environmental) that can be applied (http://www.ahuri.uq.edu.au/wide_bay/default.htm).

Figure 10: Wide Bay Burnett Regional Information System (WBBRIS) homepage



The selected examples provide insight into the diversity of PSS that can be found in contemporary planning practice. In addition, other criteria could have been applied like age, professionalism, stage of commercialisation, or targeted populations. Assessment of the utility of these PSS for actual planning practice still has to be fully and properly evaluated. This however, will require a much longer period for practitioners to work with these systems and to gain experience with their practical application. The recommendations in the next section can be of help in this evaluation.

5. Conclusions

Based on the relatively small number of real world experiences with PSS, some conclusions and recommendations concerning future PSS development and application can be drawn. First, PSS should be an integral part of the planning process and context. The Shaping Dane Project website (http://www.lic.wisc.edu/shapingdane/) is an excellent example of this where different planning and participatory activities are linked to each of the planning phases. Second, related to the first recommendation, PSS should meet user and context requirements too, besides the conformation to requirements of the planning process and context. For example, PSS should be developed that reflect the (diversity of) knowledge and skills of their direct applicants, which may involve meeting multiple levels of expertise. Third, PSS should take its users seriously into account and leave them with the feeling that they have been taken seriously. Although this sounds very much like a statement of the obvious, experience suggests that this is not always the case for sure. Fourth, one should be aware of the fact that people – in contrast to the specialization in science – address issues from an interdisciplinary perspective. In practice, people encounter problems and ask for solutions and usually neither the problems nor the solutions will be confined to the artificial boundaries of scientific disciplines. Fifth, PSS should be focused in particular on the planning problem at hand. For example, for strategically oriented planning tasks, this means the incorporation of tools for sketching, modelling and/or impact analysis. Sixth, PSS are allowed to be appealing too; they should fulfil participants' needs and wishes, and allow the participants to enjoy using them. Finally, the user-interface of the PSS should be sensitive to the characteristics of the user, to the kind of information that it communicates to that user, and to the types of intended use that will be made of the information provided. So, although maps can be very appropriate in some instances, in other instances they can be highly inappropriate, for instance when they distort reality purposefully to achieve selective or biased interests.

In summary, the application of PSS is currently still in its infancy and there does not yet exist a reservoir of real-world experience with PSS with which to conduct a detailed evaluation. However, there is little doubt that the development of PSS is on an upward trajectory, that new and exciting tools are being created and applied in different parts of the world and that future innovations will be stimulated as the awareness of contemporary systems, as exemplified in this paper, becomes more widespread in planning practice. I hope, you agree on start working together on that mission.

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References

Biermann, S. (2002) An Infrastructure Potential Cost Model for Integrated Land Use and Infrastructure Planning, in Geertman, S. and Stillwell, J. (eds.) Planning Support Systems in Practice, Springer, Heidelberg.

Brail, R. and Klosterman, R. (eds.) (2001) Planning Support Systems: Integrating Geographic Information Systems, Models, and Visualization Tools, ESRI-Press, Redlands.

Champion, T., Bramley, G., Fotheringham, S., Macgill J. and Rees, P. (2002) A Migration Modelling System to support Government Decision-Making, in Geertman, S. and Stillwell, J. (eds.) Planning Support Systems in Practice, Springer, Heidelberg.

Engelen, G. (2000) The Development of the WadBOS Decision Support System. A Bridge between Knowledge and Policy in the Wadden Sea, National Institute for Coastal and Marine Management, The Hague, pp. 38.

Engelen, G., Geertman, S., Smits, P. and Wessels, C. (1999) Dynamic GIS and strategic physical planning support: a practical application, in Stillwell, J., Geertman, S. and Openshaw, S. (eds.) Geographical Information and Planning, Springer Verlag, Heidelberg, pp. 87-111.

Friedmann, J. (1987) Planning in the Public Domain; From Knowledge to Action, Princeton University Press, Princeton.

Friend, J. and Jessop, W. (1969) Local Government and Strategic Choice: An Operational Research Approach to the Processes of Public Planning, Tavistock Publications, London.

Geertman, S. (1999) Geographical Information Technology and Physical Planning, in Stillwell, J., Geertman, S. and Openshaw, S. (eds.) Geographical Information and Planning, Springer Verlag, Heidelberg, pp. 69-86.

Geertman, S. (2001) Planning Support by PSS: an Inventory, Paper presented at the CUPUM-2001 Conference, Honolulu.

Geertman, S. (2002) Participatory planning and GIS: a PSS to bridge the gap, Environment and Planning B: Planning and Design, 29: 21-35.

Geertman, S. and Stillwell, J. (2000) Geoinformation, geotechnology and geoplanning in the 1990s, Working Paper 00/01, School of Geography, University of Leeds, Leeds.

Geertman, S. and Stillwell, J. (eds.) (2003) Planning Support Systems in Practice. Springer Verlag, Heidelberg.

Gordon, Th., Karacapilidis, N. Voss, H. and Zauke, A. (1997) Computer-mediated cooperative spatial planning, in Timmermans, H. (ed.) Decision Support Systems in Urban Planning, E. & F. N. Spon, pp. 299-309.

Hansen, H. (2001) PSSD – Planning System for Sustainable Development. The Methodological Report, NERI Technical Report No 351, National Environmental Research Institute, Denmark.

Harris, B. (1998) Optimization and design, Environment and Planning B: Planning and Design; Anniversary Issue, pp. 23-28.

Harris, B. (1999) Computing in planning: professional and institutional requirements, Environment and Planning B: Planning and Design, 26: 321-331.

Hopkins, L. (1999) Structure of a Planning Support System for Urban Development, Environment and Planning B: Planning and Design, 26: 333-343.

Kammeier, H. (1999) New tools for spatial analysis and planning as components of an incremental planning-support system, Environment and Planning B: Planning and Design, 26: 365-380.

Klosterman, R. (1998) Computer applications in planning, Environment and Planning B: Planning and Design, Anniversary Issue: 32-36

Klosterman, R. (1999a), Guest editorial: New perspectives on planning support systems, Environment and Planning B: Planning and Design, 26: 317-320

Klosterman, R. (1999b) The What if? collaborative planning support system, Environment and Planning B: Planning and Design, 26: 393-408.

Laurini, R. (1998) Groupware for urban planning: an introduction, Computers, Environment and Urban Systems, 22(4): 317-333.

Lautso, K. (2002) The SPARTACUS system for defining and analysing sustainable urban land use and transport policies, in Geertman, S. and Stillwell, J. (eds.) Planning Support Systems in Practice, Springer,

Nedovic-Budic, Z. (1998) The impact of GIS technology, Environment and Planning B: Planning and Design, 25: 681-692.

Nyerges, T. and Jankowski, P. (1997) Adaptive structuration theory: a theory of GIS-supported collaborative decision making, Geographical Systems, 4(3): 225-259.

Pettit, C., Shyy, T-K. and Stimson, R. (2002) An on-line planning support system to evaluate urban and regional planning scenarios, in Geertman, S. and Stillwell, J. (eds.) Planning Support Systems in Practice, Springer, Heidelberg.

Reilly, J. (2002) The New Jersey (USA) Growth Allocation Model: development, evaluation and extension, in Geertman, S and Stillwell, J. (eds.) Planning Support Systems in Practice, Springer, Heidelberg.

Shiffer, M. (1995) Interactive multimedia planning support: moving from stand-alone systems to the World Wide Web, Environment and Planning B: Planning and Design, 22: 649-664.

Simmonds, D. (2001) The objectives and design of a new land-use modelling package: DELTA, in Clarke, G. and Madden, M. (eds.) Regional Science in Business, Springer, Heidelberg, pp. 115-157.
Singh, R. (1999) Sketching the city: a GIS-based approach, Environment and Planning B: Planning and Design, 26: 455-468.
Stillwell, J., Geertman, S. and Openshaw, S. (1999a) Developments in geographical information and planning, in Stillwell, J., Geertman, S. and Openshaw, S. (eds.) Geographical Information and Planning, Springer Verlag, Heidelberg, pp. 3-22.
Stillwell, J., Geertman, S. and Openshaw, S. (eds.)(1999b) Geographical Information and Planning, Springer Verlag, Heidelberg.
Stillwell, J. and Scholten, H. (eds.) (2001) Land Use Simulation for Europe, Kluwer, Dordrecht.