Usage of Planning Support Systems

Combining three approaches

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Abstract: Although a wide range of Planning Support Systems (PSS) exists, their actual utilization in planning practice, to support planners in doing their planning tasks, stays behind. This is problematic since many see PSS capable of aiding planners to handle the complexity of their planning tasks. Our current study explains under usage of PSS from three different angles: the instrument, the user and the transfer of the instrument towards the user. The main conclusion is that usage of PSS is hampered by lack of awareness of and experience with PSS in planning practice as well as by instrumental quality problems and hampered user acceptance and diffusion. The main recommendation to enhance usage of PSS is that it should be made transparent which PSS types should be used for what planning tasks, by which kinds of users, in which kinds of organizations and under which external conditions.

1. INTRODUCTION

Regional planning of land use concerns the development of long-range strategic-level structure plans that organize land use functions. It is one of the most complex tasks of public organizations. Regional land use planners firstly need to deal with a wide range of objectives that occur at different spatial and temporal scales. Secondly, they need to handle large amounts of information of various qualities to serve as a basis of solutions for planning problems. Thirdly, they need to weigh and add up all this information to

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synthesize planning solutions with a high degree of synergy and that leave little conflict. Fourthly, they need to communicate this all in such a way that their plans receive the support required to make them feasible (Faludi 1973; Friedman 1987; Forester 1989; Hall 2002; Archibugi 2004). Planners demand support to handle these aspects of complexity of planning, but have so far only utilized few of the opportunities for computer support (Stillwell, Geertman et al. 1999). The majority of planners use little more than generic office software to support them in their daily work that tends to be extended with simple spatial capabilities.

Since long, geo-information technology developers have focused on supporting planners dealing with various aspects of complexity. In particular support of information management and scenario analysis have received a great deal of attention. Nonetheless, the large-scale urban models from the 1960s and 1970s have failed to meet expectations and have failed to become widely accepted as planning support instruments (Lee 1973; Batty 1979; Openshaw 1979; Lee 1994). The Geographical information systems (GIS) from the 1980s and 1990s have also not become a great success in supporting planners (Croswell 1991; Innes and Simpson 1993; Stillwell, Geertman et al. 1999). Although many planners use them for basic information functions, most GIS are general-purpose tools that make a poor match to the demands and capabilities of planners in the planning process. A new generation of geo-information technologies known as Planning Support Systems (PSS) is much more dedicated to the demands and capabilities of planners in planning processes (Geertman and Stillwell 2004). These PSS may be better suitable to assist planners in handing the ever-increasing complexity of planning. They have been defined as a subset of geo-information technologies, dedicated to support those involved in planning to explore, represent, analyze, visualize, predict, prescribe, design, implement, monitor and discuss issues associated with the need to plan (Batty, 1995). PSS bring together the functionalities of GIS, models and visualization and take the form of "information frameworks" that integrate the full range of information technologies useful for supporting the specific planning context for which they are designed (Geertman and Stillwell, 2003b; Klosterman, 1997). Inventories show that PSS cover a wide diversity of tools that are readily available for planning support purposes that have not yet become widely applied in planning practice (Brail and Klosterman 2001; Geertman and Stillwell 2003).

In our studies we have taken three different approaches to explain the problem of many PSS not reaching planning practice. The approaches overlap in the sense that they all look at the same problem but each approach emphasizes slightly different aspects of the problem. The 'instrument' approach, explains the problem mainly from the instrumental quality of the PSS, thereby focusing particularly on fitness for use and user friendliness of

the PSS (Vonk, Geertman et al. 2006). The 'user approach' explains the problem from the extent of user acceptance of PSS, thereby focusing on a broader set of factors related to the accepting environment (Vonk, Geertman et al. 2005). The 'transfer' approach explains the problem from the extent of diffusion, thereby focusing particularly on the flow of information on and experiences with PSS from sender to receiver (Vonk, Geertman et al. 2006).

In the following we will first describe the three approaches that have been followed to study usage of PSS in general and subsequently describe the explanations found in following these approaches.

2. THEORETICAL FRAMEWORK

2.1 Instrument Approach

The first of three approaches to our problem explains usage of PSS in planning practice from characteristics of the PSS instruments themselves. It does so by focusing on those characteristics of the instrument that determine their instrumental quality. The underlying assumption is that poor instrumental quality of PSS hampers users from using PSS. This approach takes PSS themselves more or less as a dependent variable. It emphasizes in what sense they should change in order to enhance usage. We define instrumental quality as consisting of a judgment of: a) how well the instruments are capable of carrying out the tasks that they were made for; and b) how well they fit to the capabilities and demands of intended users. Googhue and Thompson (1995) showed the importance of these characteristics as determinants of usage of information technologies in their model of task-technology fit (Goodhue 1995; Goodhue and Thompson 1995; Dishaw and Strong 1999; Dishaw, Strong et al. 2002). In terms of this model, under usage of PSS is explained by insufficient fit of PSS to user characteristics and planning task characteristics in comparison with other options that have a better fit. The latter options then may have a relative advantage over using PSS in terms of instrument quality, depending on costs of the options.

2.2 User Approach

The second approach to our problem explains usage of PSS in planning practice from characteristics of the user, focusing on characteristics that determine acceptance of PSS. This user approach is related to the instrument approach as it incorporates user perceptions of instrument characteristics as determinants of acceptance. Furthermore the approach incorporates a much

broader set of acceptance factors to explain usage than the instrument approach. The underlying assumption of the user approach is that non-acceptance hampers potential users from using PSS. This approach takes the user as a dependent variable. It emphasizes in what sense users should change in order to enhance usage of PSS. We define the acceptance process as "the process through which an individual or other decision-making unit passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of his decision" (Rogers 1995). We see this acceptance process influenced by user characteristics, instrument characteristics, organizational characteristics, characteristics of the social environment, characteristics of the external environment and facilitating conditions. These factors that influence acceptance have been framed in the 'Technology Acceptance Model'. Since its first publication in 1986, the model has been refined numerous times and applied for a broad range of information technologies (Davis 1986; Compeau and Higgins 1991; Mathieson 1991; Keil, Beranek et al. 1995; Dishaw and Strong 1999; Karahanna and Straub 1999; Venkatesh and Davis 2000; Frambach and Schillewaert 2002; Venkatesh, Morris et al. 2004; Beaudry and Pinsonneault 2005). In terms of this model, under usage of PSS is explained by a hindered acceptance process due to problems with acceptance influencing factors.

2.3 Transfer Approach

The third approach to our problem explains usage of PSS in planning practice from characteristics of the transfer of PSS towards planning practice. It does so by focusing on those characteristics of the transfer that determine PSS diffusion. Innovation diffusion has been defined as "the process by which an innovation is communicated through certain channels over time among members of a social system" (Rogers 1995). It is concerned with the transfer of an innovation into a practice context, through the acceptance by individuals, groups and organizations. The approach is different from the user approach as it emphasizes the course of the innovation in its diffusion among users instead of a single users acceptance process. The assumption that underlies this approach is that diffusion problems hamper users from using PSS. This approach takes the transfer processes as a dependent variable. It emphasizes in what sense they should change in order to enhance usage of PSS. Diffusion is regarded as a process that takes the innovation from the system developers towards widespread usage in practice over the various levels of aggregation: individual, group, organization, and branch of organizations. In diffusion, the aggregation of individuals within groups, groups within planning organizations, and

planning organizations that have adopted the innovation follows a path such as described by the innovation adoption curve (Rogers 1995). The curve describes that a group of so-called 'innovators' are the first individuals, groups or organizations to see opportunities and are most likely to perceive the complexity of adoption as a challenge or perceive to be capable of handling the complexity, followed by 'early adopters', 'early majority', 'late majority' and finally the 'laggards' who cannot but accept the innovation after having been confronted with it all over by individuals, groups and organizations who adopted the innovation before they did. The fact that PSS are not used widespread in planning practice indicates that their diffusion has not evolved beyond the early stages.

2.4 Conceptual Framework

Figure 1 shows the three approaches to explain the under usage of PSS in planning practice.

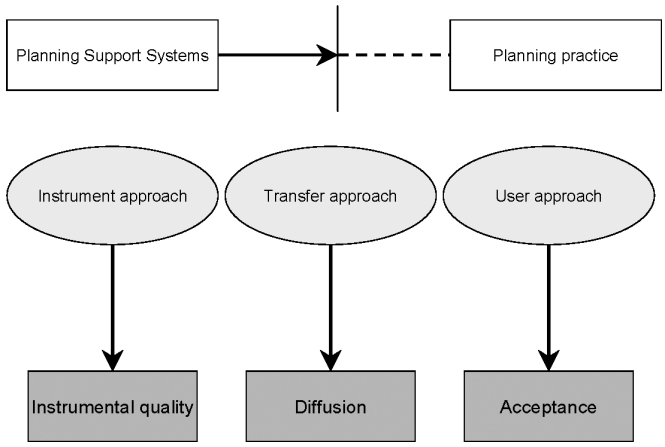

Figure 1. Three approaches to explain usage of PSS.

3. METHOD

To achieve our aim, we combine user perspectives, system developer perspectives and expert perspectives. We realize that these three groups are not fully distinct in their knowledge and experience and account for this in our analysis. The knowledge and expertise of these three groups has been gathered between June and December 2003. User views of PSS have been gathered by holding a series of interviews among 43 employees of 12 highly

comparable Dutch regional planning organizations commanded with the task of regional strategic land use planning, which they do by developing plans for water, traffic, environment, economic etc. and integrating these into a comprehensive structure plan for the area governed. In particular we interviewed three archetypes of users that currently have an important role in using and evaluating PSS: the geo-information specialist, the planner, and the manager. We expect these to be capable of providing us with a good and representative overview of user perspectives on PSS-technology in most of the developed world, particularly since evidence suggests the existence of more or less similar planning organizational environments in these societies and since we do not focus on specific aspects of the planning style. In the end, most of the participants were geo-information specialists (15), planners (12) and managers (3), but also people with strongly related specializations such as environmental planning, economic planning, social planning and general IT joined in (13). The interviews were carried out in groups, during 12 sessions of several hours each.

System developer views of PSS have been quite well recorded in scientific literature. Therefore, we tracked their perspectives on task-technology-user fit by conducting a literature survey. For the selection of suitable literature we applied a broad definition of PSS. In this way we account for the discourse among experts on the content of the PSS concept. We furthermore limited ourselves to literature published after 1998 to account for the shifting meaning of PSS with advancing technological possibilities. We included books on PSS, papers of geographic information science related conferences and journals. The two main sources were the two edited books on PSS by Brail and Klosterman (2001) and Geertman and Stillwell (2003a). In total views of 58 PSS were included, which constitute a good overview of system developers perspectives on task-technology-user fit of PSS.

Expert views of PSS have been gathered by means of conducting two worldwide web-surveys. Via several PSS-related listserv e-mail networks 800 PSS-interested persons were asked to participate. The first survey had 96 respondents; the second had 40 respondents. 86 respectively 30 of these respondents were considered experts, since they indicated to know at least 2 PSS from a list. The majority of the expert respondents were university researchers and employees of public planning bureaus dealing with planning support in their work. Although many users from planning practice were asked to participate, among the respondents they were a minority. The first survey consisted of a series of bottlenecks that potentially block widespread usage of PSS, to be judged on importance by the experts. The second survey consisted of open questions on strengths, weaknesses, opportunities and threats of PSS, as well as closed questions to express the perceived fit of a range of combinations of planning task, PSS and user and to state experience

with these combinations. Respondents could judge the importance of potential bottlenecks as well as the fit by selecting from 'not useful', 'neutral', '(very) useful' and 'don't know'.

We combine the findings of the literature survey, the interviews and the web-survey to find what underlies the under usage of PSS in planning practice. The underlying explanations are found from the results by analyzing the bottlenecks that block widespread usage of PSS in general. We identify bottlenecks in instrumental quality by evaluating PSS on the fit to planning tasks, fit to user competences and relative advantage. We identify bottlenecks for acceptance by evaluating PSS on perceived user friendliness and usefulness, their users' awareness of, experience with and intention to use these instruments, and the presence of social influences and organizational facilitators that affect acceptance. We identify bottlenecks in diffusion by evaluating PSS on their take up from the organizational environment, and feed forward and back through the organization by means of initiation, decision and implementation. These bottlenecks were interpreted in terms of our conceptual framework.

4. RESULTS

4.1 Instrument Approach

Results show that one of the primary reasons for the under usage of PSS in planning practice is that PSS technology is in an early stage of development. The large diversity and little standards associated with this development stage cause large differences in instrumental quality between instruments.

Results furthermore show that there exists a large dichotomy between PSS demanded in practice and supplied by system developers: while practice demands rather simple PSS for exploratory tasks such as making an inventory of conditions, the majority of PSS focus on more analytical tasks, especially modeling. These on their turn are seen as making a poor match with the demands of planning practice. The instrumental quality of simple instruments is considered acceptable while that of advanced instruments is generally considered to be poor. Results suggest that simple instruments have a relative advantage over doing it all by hand, while for many currently existing advanced instruments the advantage is doubtful at the least.

Results furthermore show that planning practice regards PSS as hardly suitable for direct usage by decision makers themselves. Decision making itself is seen as a game of politics and power, in which PSS hardly have a place. PSS are seen as more promising to support the other planning stages that require information management, communication and analysis rather than politics.

4.2 User Approach

Results of the user acceptance approach show that there exists a large diversity of bottlenecks blocking widespread acceptance of PSS in planning practice, the main of which are lack of awareness of the existence of PSS and for which purposes they can be used, lack of experience with PSS, which makes users unaware of the benefits of PSS and the conditions under which they can be used and low intention to start using PSS among possible users. Also high scoring bottlenecks are insufficient user friendliness and usefulness, the absence of the required organizational facilitators and social influences and data quality and accessibility problems (Vonk, Geertman et al. 2005).

Results clearly show that while system development is continuing at a rapid pace, development has remained largely unnoticed by the intended users. If the planning community remains unaware, it will not acquire experience and develop a demand side, which causes insufficient pay-off in the investments in PSS development. Furthermore a process of improvement of existing tools by learning from practice will remain at a low pace. In terms of a product lifecycle, the product will not get a chance to mature and to reach the point after which its development and proliferation becomes self-enforcing. If no marketing action is taken, it is therefore likely that PSS will not get a good chance to prove its worth as a means for improving spatial planning practice.

4.3 Transfer Approach

Results show that many managers and planners are hardly aware of the existence and potential of PSS and have so little affinity with these technologies that they cannot develop a good strategy. Geo-information specialists are often the only ones in the organization capable of initiating adoption and implementation from the bottom up. Their diffusion-oriented actions are often motivated by an experienced opportunity.

Results furthermore show that lack of opportunity for innovation allowed by the management and lack of the required personal characteristics often causes geo-information specialists to be unable to initiate adoption and implementation of PSS. Furthermore, exploratory activities of those geo-information specialists that do possess the required personal characteristics to be initiators are often repressed instead of nurtured.

Results also show that regional planning organizations often exploit management-supported strategies on geo-information technology diffusion. These strategies often hold back significant steps in diffusion, since they are based upon a persistent negative image of geo-information technology that

exists among many managers. Geo-information specialists that do take up their role as initiators of diffusion, often face a wall when trying to convince managers of the worth of new developments in geo-information technology such as PSS. Showing examples in real projects has proven to be a good means of convincing managers, but their preparation requires innovation time, which geo-information specialists often do not have. This traps diffusion in a stalemate.

Results show that geo-information specialists themselves are hardly ever able to reach spatial planners and cooperate with them. If they do, they often encounter a discrepancy between planners' questions and geo-information specialists' offers that obstructs successful cooperation. This hampers development of useful innovations that are applied in planning practice, since these are likely to evolve from cooperation of geo-information specialists and spatial planners (Vonk, Geertman et al. 2006).

5. INTERPRETATION

Figure 2 shows the results of our current study in terms of the theoretical framework of our study. It shows: 1) the problem of many Planning Support Systems being blocked from reaching planning practice and being widely used; 2) the perspectives to look at this problem that correspond with an instrument approach, a user approach and a transfer approach; 3) the main focus of these approaches: instrumental quality, user acceptance and diffusion; and 4) the main reasons explaining under usage of PSS in general that were found in our studies using these approaches.

6. CONCLUSIONS AND RECOMMENDATIONS

We conclude that usage of PSS in general is hampered by a broad range of bottlenecks. These bottlenecks are related to instrumental quality as well as user acceptance and diffusion issues. Results show that lack of *experience* with PSS, lack of *awareness* and lack of *instrument quality* of PSS are the main bottlenecks blocking user acceptance. Results show that the effects of these main bottlenecks on usage are enhanced by hampered *user acceptance* and *diffusion*.

The main recommendation to enhance usage of PSS is that it should be made transparent which PSS types should be used for what planning tasks, by which kinds of users, in which kinds of organizations and under which external conditions. More in particular, to enhance primarily *awareness* of PSS we recommend spreading the news of the existence and potential of PSS

in planning practice. Awareness generation should not to stop after a single rejection since innovation in PSS may be a timely process of human and organizational adaptation. To enhance primarily *experience* with PSS we recommend applying best practices of PSS application that will maximize chances that the gained experiences will be positive. To enhance primarily *instrumental quality* of PSS we recommend system developers and geo-information specialists to improve communication with practice in order to be capable of actively analysing the tasks that may be supported by PSS and the application environments. To enhance primarily *user acceptance* and *diffusion* of PSS we recommend managers to adopt the management paradigm of the learning organization.

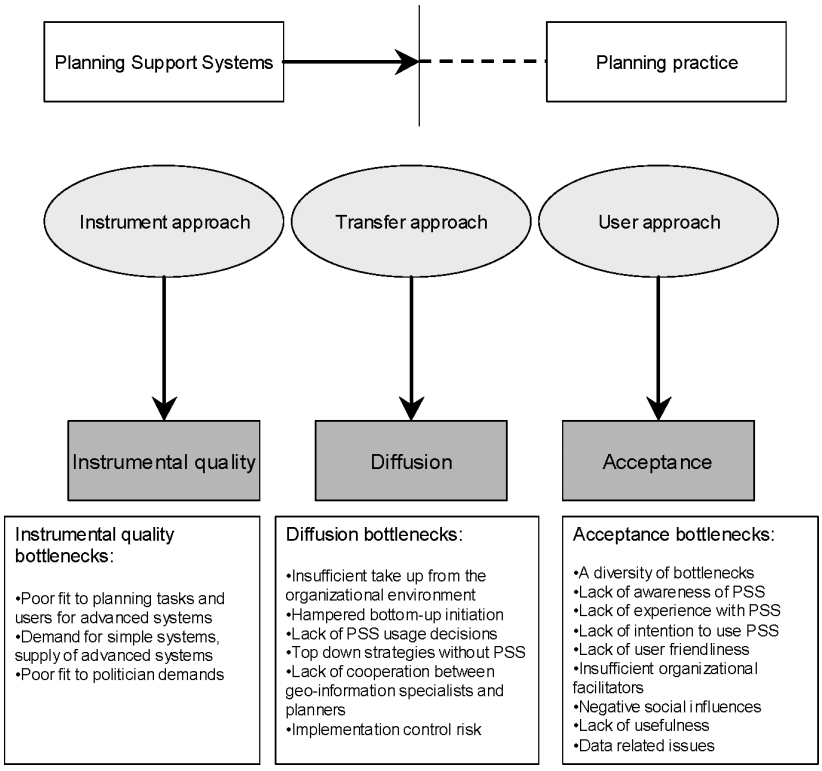

Figure 2. Framework explaining under usage of PSS from three different approaches.

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