Transportation Research Part A 104 (2017) 70–76

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

PSS: Beyond the implementation gap

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ARTICLE INFO

Article history:
Received 11 September 2015
Received in revised form 31 August 2016
Accepted 20 October 2016
Available online 1 November 2016

Keywords:
Planning Support Systems (PSS)
Implementation gap

ABSTRACT

In the last couple of decades, a large number of papers on planning support systems (PSS) have been published in national and international, scientific and professional journals. What is remarkable about PSS is that for quite some time their history has been dominated by an implementation gap, that is, a discrepancy between supply and demand: despite the availability of a growing number and diversity of potentially valuable PSS instruments, planning practitioners are rather hesitant to buy, implement or apply them. This implementation gap leads to the question whether PSS are a valuable tool for planning practice. In this commentary, I answer this question by taking a closer look at the PSS debate from four perspectives, namely those of PSS history, PSS research, PSS education and PSS in practice. Although these perspectives are closely related, I show that they also reveal different aspects of this issue. For each of these perspectives, I start with a hypothetical conclusion and present some of my underlying considerations. At the end of this contribution, I summarize the situation, finalize the hypothetical conclusions and provide some recommendations concerning the implementation gap. These include focusing on the positive rather than the negative: we should look at the success stories (successful or best practices) and try to learn from them; after all, the proof of the pudding is in the eating. Furthermore, PSS are by no means a panacea for all our problems or challenges in planning practice. In my opinion, selectivity in their application in actual planning practice evidences a growing maturity of the PSS field.

1. The problem statement

In the last couple of decades, a large number of papers on planning support systems (PSS) have been published in national and international, scientific and professional journals. Although PSS have been defined in that literature in quite diverse ways, in general there is some agreement that PSS are instruments that are based on geo-information technology and are dedicated to supporting those involved in planning in the performance of their planning tasks (Geertman, 2006, 2013). A typical PSS will integrate into a single framework planning-related theory, data, information, knowledge, methods and instruments, all with a shared interface (Geertman and Stillwell, 2003).

What is remarkable about these instruments is that for quite some time their history has been dominated by an implementation gap, that is, a discrepancy between supply and demand: whereas the market is providing a growing number and diversity of potentially valuable PSS instruments, the intended customers (planning practitioners) are rather hesitant to buy, implement or apply them – even though they are confronted with an increasing complexity of planning tasks, and one would

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http://dx.doi.org/10.1016/j.tra.2016.10.016
0965-8564/

expect that any dedicated form of support would be welcomed. And PSS, as dedicated instruments attuned to the support of specific planning tasks, would be expected to cope with this complexity.

There are several reasons why complexity is constantly increasing. First, more and more of today's spatial planning issues have a multidimensional nature (Goedman and Zonneveld, 2007). For instance, one current challenge in policymaking is achieving the ideal balance between the ecological, economic and social sustainability effects of a planning project. This requires insight into these dimensions of the problem at hand, and an instrument to establish those dimensions and the expected consequences of the potential solutions. A range of PSS (e.g. What-If and CommunityViz) can do just that.

A second source of complexity is related to the fact that planning is closely associated with people's behaviour. For instance, Helen Couclelis (2004) stressed that activities in post-industrial societies are becoming more 'person-based' (occurring at dynamic times and places) rather than being 'place-based' (occurring at fixed times and places). As a consequence, and due to the increase in the flexibility and variability of people's behaviour in space, the predictability of intended policy measures in space is diminishing, which increases the complexity of the planning activity. An agent-based PSS like UrbanSim can help planners to deal with this actor-oriented nature of problems.

A third contributor to the increasing complexity is the growing involvement in planning of a wide variety of persons and organizations with diverging interests; this is usually referred to as collaborative or participative planning (e.g. Healey, 2007). All of these persons and institutions want to have a say in spatial policymaking and will try to influence the decisions at stake, basing themselves on divergent and often conflicting views on the issues at hand. PSS based on surface tables (e.g. MapTable) are dedicated to the explicit handling of a multitude of divergent opinions.

In summary, however, despite the availability of appropriate PSS to deal with the growing complexities, planners are still hesitant to use them. Thus, because of the growing complexity of the planning task and the slow uptake of appropriate PSS instruments in planning practice to deal with this complexity, the implementation gap can be considered a real challenge.

In fact, the PSS implementation gap leads to the question whether PSS are a valuable tool for planning practice. To answer this question, I present the hypothesis that PSS were not, are not and probably will not become a valuable tool in planning practice, given the tool's history. For that, I take a closer look at the PSS debate from four perspectives, namely those of PSS history, PSS research, PSS education and PSS in practice. Of course, these perspectives are closely related. However, I show that they also reveal different aspects of this issue. At the end of this contribution, I summarize the situation, finalize the hypothetical conclusion and provide some recommendations concerning the implementation gap.

2. PSS history

Over the years, the planning profession has made use of methods and tools to support its 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 laboratories (Batty and Densham, 1996). In the 1960s and 1970s, computer-based planning tools, including the early generations of geographical information systems (GIS) and spatial decision support systems (SDSS), were intended primarily for data management, spatial modelling and strategic planning support. Although these systems and models offered opportunities to support various aspects of the planning process, the planning profession did not readily adopt them. Douglas Lee (1973) identified the reasons for this by looking specifically at the failure of the large-scale models developed during these decades. The reasons included their complicated nature ('black box') and 'data-hungriness'. In response, the 1980s saw a change in emphasis from the analytical application of geo-information technology to the more routine-based management and graphical display of spatial datasets. As a consequence, more sophisticated analysis, simulation and modelling remained on the back burner as far as planning practice was concerned (See also Lee, 1994).

Towards the end of the 20th century, Klosterman (1997) suggested that the tools for planning support were no more developed than they had been 10 years earlier. He also predicted that despite the prospects, it was most likely that the adoption of new tools and the development of computer applications in planning would remain disappointing for some time to come. The reasons he gave for this were primarily associated with the diversity of the analytical tasks that planners perform, the relatively small market for public sector software, and the high cost of developing and supporting commercial software. As a consequence, he concluded, analytical tools for planning purposes would continue to lag far behind those of other professions, such as transport engineering. More or less at the same time, Harris (1999, p. 7) noted that 'planners and designers have remained at best distrustful, or at worst downright antagonistic, toward computer-based models of support'. Harris thus added to the reasons given by Dick Klosterman for the generally negative attitude towards computer-based tools for support within planning practice.

To put this a bit more into perspective, a distinction should be made between planning professions, foremost the groups of transport planners versus spatial (land-use) planners. Transport modelling PSS have a long tradition and a well-established position in planning practice, in sharp contrast to the position of land-use planning PSS. Underlying this are differences both in educational background (I return to this later) and in classes of outcomes and their easiness of understanding and thus their level of acceptance. Calculated trip generations are more straightforward to understand and thus easier to accept than calculated land-use changes over time, which will more easily lead to heated discussions on the underlying assumptions of, or the political choices made regarding, the land-use models. However, given the interconnectedness of transport planning and spatial land-use planning, discussions on the outcomes of the latter will be reflected in the former, and vice versa: land-use modelling is essential input to transport modelling in terms of trip generation, as is the feedback

from transport modelling to land-use modelling. In general, one has to conclude from these developments and expert statements that PSS were not a very valuable tool for especially spatial planning practice for a very long period of time; and moreover, given their long-lasting marginal position, it can be expected that this marginality will continue for the foreseeable future.

3. PSS research

Despite the negative tone of statements concerning the potential role of PSS in planning practice in the second half of the 20th century, it can be argued that the turn of the new millennium saw the dawn of a new PSS era. Several new and positive PSS developments underscore this. First, looking at the content of a wide range of books and readers that provide overviews of PSS studies, one can conclude that 'a lot is going on in this PSS field of research' (e.g. Stillwell et al., 1999; Brail and Klosterman, 2001; Geertman and Stillwell, 2003, 2009; Brail, 2008; Geertman et al., 2011, 2013, 2015), and that a wide range of PSS (variety of aims, functionalities, content, structure, technology, etc.) are on the market and are being applied in a wide range of PSS application studies. Furthermore, new textbooks cover the relationship between PSS and planning practice (e.g. Laurini, 2001; Nyerges and Jankowski, 2010). Finally, a huge number of Master's and PhD students throughout the world have studied PSS and their relationships with planning practice. Thus, PSS research has been a focus of scientific debate and performance for the last 10 years.

However, a worldwide inventory of PSS research in spatial planning practice at the beginning of this century showed that a lot of the PSS instruments on the market were prototypical and that most of the PSS research was quite experimental and case study oriented (see Geertman and Stillwell, 2003). The situation concerning the PSS instruments has improved substantially: now, about 15 years later, most of these instruments have matured into professional software packages (e.g. CommunityViz, Online What-If, UrbanSim). However, the PSS research itself shows a mixed picture. On the one hand, there is still an important amount of PSS research being carried out *on* PSS (e.g. about 'bottlenecks' or 'potentials'). However, this kind of research can also be seen as indicating a lack of maturity of PSS research: apparently, PSS research still has to prove its added value to planning practice. On the other hand, when it comes to research *with* PSS (e.g., application oriented), one has to conclude that besides a growing number of real-world application studies, of which several also served to fuel research on PSS, a substantial number of experimental case studies are being carried out. Although there is nothing wrong with executing experimental case studies in which the prime focus is trying out the PSS instrument for a planning issue, one should be aware that such studies easily abstract from lots of real-world peculiarities (instabilities, unexpected dynamics, non-equilibriums, unpredicted behaviours, unforeseen disasters, etc.). Taken together, although there are some positive signs, it is just not fully convincing, certainly not when one takes the number of years of PSS research into account.

Therefore, one can conclude that PSS research shows that PSS were not, are partly still not and thus probably will not become a really valuable tool for planning practice.

4. PSS education

As regards PSS education, it is interesting to take a look at the learning outcomes of planning schools and their umbrella organizations. In the learning outcomes published by AESOP (Association of European Schools of Planning), there is nothing specifically associated with the teaching of PSS instruments, in either a conceptual or a technical sense (see Fig. 1). The only reference one can interpret as possibly referring to PSS is statement j: 'Techniques for data collection, for data analysis and synthesizing, including modern information technology.' However, this could also refer to the development of practical competence in the application of statistical methods, like SPSS or SAS. In fact, the same applies to the US counterpart of AESOP, the ACSP (Association of Collegiate Schools of Planning). It refers to, inter alia, quantitative and qualitative methods, but it can also refer to quantitative and qualitative data gathering, the use of SPSS for statistical analysis and the application of PowerPoint to show your results. And in a recent EU study on the demand for and supply of teaching in geographical information technology (Rip et al., 2014), teaching in PSS – or more in general, teaching about instruments to support planning – is not even mentioned.

Although courses in statistics, GIS and computing literacy have been added to curricula over the past few decades, and these can be considered the prerequisites for professionals to be able to understand and use PSS effectively, establishing some sort of basis is not the same as establishing a PSS mind-set. In my opinion, one needs to understand in what classes of cases, for what classes of planning questions, in which ways (e.g. methodologies), etc. one can make use of which classes of PSS. Without knowledge of the diversity of PSS types, the functionalities of diverse PSS, the applications already performed with various PSS, the added values and drawbacks of these applications, the PSS methodology attuned to a specific planning context, etc. and some basic hands-on training in PSS, one will not be able to judge the appropriateness of PSS for a certain planning issue, nor be able to apply PSS instruments in a proper way. And given that these classes of courses are not given in educational planning departments, I have to conclude that PSS still have a long way to go in planning curricula.

They *acquire due knowledge of:*
a. the nature, purpose, theory and method of planning;
b. the history of planning as an institution and a profession;
c. the cultural differences in planning on a European and international level;
d. developments in the natural and man-made (economic and social) environment and knowledge of the impact of men's exploitation, i.e. possibilities for sustainable development;
e. the political, legal and institutional context of planning practice both at the national and at the (evolving) international i.e. European level;
f. the instruments and performance of instruments for implementing planning policies; specialized fields of planning;
g. relationships across and between these fields.

They *develop practical competence in:*
h. methods for problem definition and collaborative problem-solving in inter-disciplinary and multi-disciplinary settings;
i. thinking in terms of concepts, instruments and measures and management of knowledge for practical application
j. techniques for data collection, for data analysis and synthesizing, including modern information technology;
k. valuing and managing the built and natural environment
l. anticipating future needs of society, including the appreciation of new trends and emerging issues in planning;
m. methods for generating strategic planning proposals and the advancement of application;
n. integrating aesthetic and design dimensions in planning proposals;
o. devising plans, programs and measures and guiding the implementation policies
p. written, oral and graphic communication.

They *develop an attitude i.e. a feeling for:*
q. planning to be basically oriented towards solving the needs of society within a framework of sustainable development;
r. the cultural imbedding of the manmade environment;
s. the value dimension of planning;
t. the ethical implications of planning.

Fig. 1. End terms of the Association of European Schools of Planning (AESOP).

To sum up, at the moment there is no specific teaching of planning support instruments like PSS in a conceptual and/or technical and/or socio-technical sense in planning education. As far as I can tell, specific courses in PSS in spatial planning teaching programmes are at the best very rare. PSS education therefore shows that PSS were not, are not and thus probably will not become a valuable tool for planning practice.

5. PSS in practice

As mentioned, it was recognized a long time ago that PSS are underutilized in planning practice. This stimulated the execution of a range of studies to shed more light on the reasons for this underutilization. For instance, Guido Vonk et al. (2005) identified 74 bottlenecks that play a role in hampering the application of PSS in planning practice (see Fig. 2). These bottlenecks can be grouped into three categories.

First, the instrumental quality of PSS instruments apparently influences the application of PSS in planning practice. In general, the suppliers of PSS are tending to deliver more advanced instruments, whereas planning practice is mainly requesting simpler instruments. Although it is understood that the dichotomy between the complexity and the simplicity of systems is foremost a matter of communication and visualization, such issues as unfulfilled previous experiences and unfulfilled expectations hamper the easy acceptance of more complicated systems in planning practice. It is also understood that PSS are necessarily complicated not only because the public has demanded the consideration of an increasing number of dimensions (traffic, economic development, environmental sustainability, distributional impacts, etc.), but also because the interactions among these dimensions are complex and poorly understood.

Second, the acceptance of PSS in planning organizations is mostly hampered by insufficient cooperation between planners and PSS experts, and by insufficient communication within the organization, especially between organizational management and innovative precursors.

Third, the acceptance by the user of the PSS instrument and its outcomes is hampered by a range of issues, such as a lack of user-friendliness and a lack of experience to make use of the PSS, as well as a lack of intention to start making use of a PSS. This last bottleneck is a consequence of the expected steep learning curve that is associated with many PSS: potential users have to invest a lot of time and energy before they are able to work with the instrument in a fruitful way.

Furthermore, Pelzer (2015) detected lots of 'intended' PSS studies, whereby planners intended to make use of a PSS to help them execute their planning tasks, but then decided not to use one because, for example, of a lack of funding, changing political interest or the departure of key persons. Therefore, although PSS application studies actually apply PSS, a lot of (perhaps most) intended PSS applications are not realized. One can therefore conclude that current planning practice shows that PSS are not and probably will not become a really valuable tool for planning practice.

6. The PSS future: conclusions revisited

The above has painted quite a negative picture of the role of PSS in the past, the present and the future. However, this needs some further remarks. In general, the straightforward extrapolation of past and current PSS developments into the

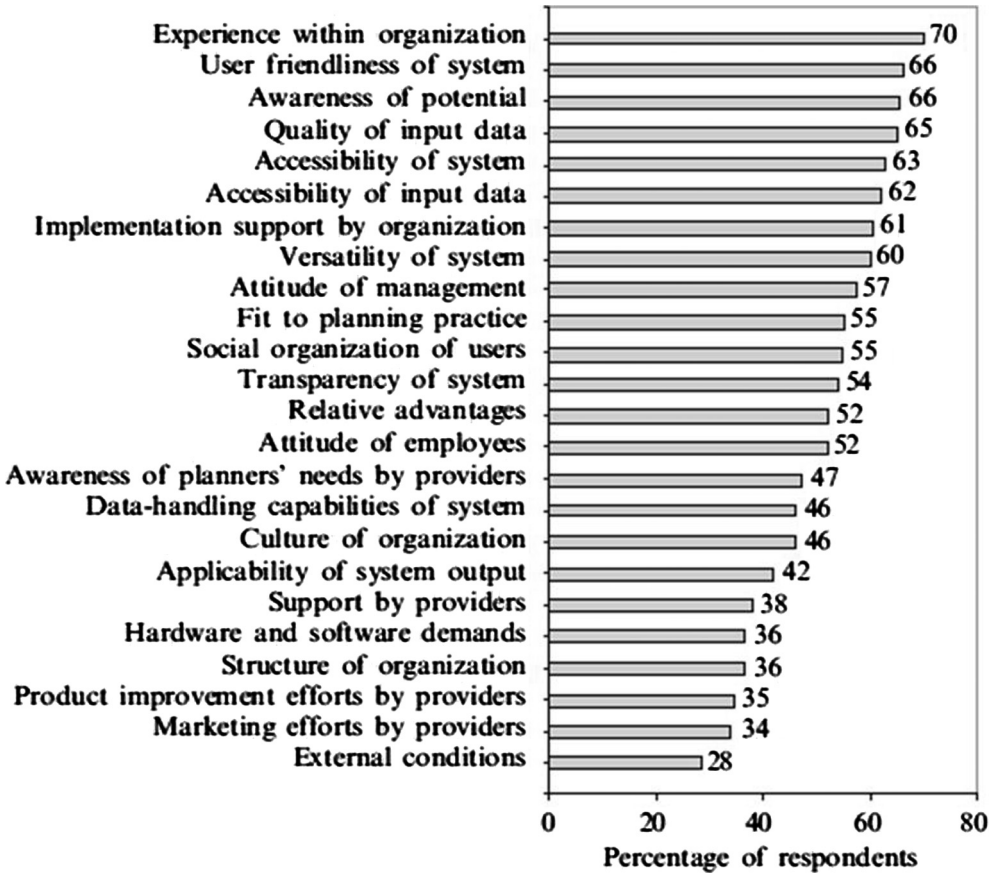

Fig. 2. Bottleneck indicators with their importance.

future should be done with some care, because the future is not just the straightforward continuation of the past. Looking at, for instance, the history of PSS, one could conclude that the adoption of PSS in planning practice has taken a very long time and is still quite fragmented and diversified. On the other hand, one could argue that although establishing the foundations of PSS applications is difficult and slow, future PSS developments can be implemented and applied much more quickly exactly because of those firm foundations. The same can be said about the other foci on PSS developments identified above. For instance, I concluded that a lot of PSS research is still research *on* PSS (i.e. 'bottlenecks' or 'potentials') instead of research *with* PSS (i.e. research in which a PSS is applied to deal with real-world planning problems), although both types can overlap; for instance, real-world case studies can inform about bottlenecks and potentials.

However, looking at more recent contributions to, for instance, the CUPUM (Computers in Urban Planning and Urban Management) and AGILE conferences, one can conclude that empirical research is moving away from experimental case studies towards real-world planning problems. PSS education is also on the move. I concluded, mainly on the basis of AESOP (EU) and ACSP (US) learning outcomes, that the teaching of PSS in a conceptual and/or technical sense is absent from planning education. Although in general this still seems a defendable statement, looking at some new curricula in more detail (e.g. CASA–University College London) one can identify courses that are dedicated to instruments (DSS, SDSS, PSS, GeoDesign, etc.) in which the support of policymaking and decision-making (including planning) is at the core of the course.

Concerning PSS in practice, I concluded that the picture is quite differentiated and diversified. Some parts of planning practice use PSS tools much more intensively than other parts, notably transport planning versus land-use planning, and for some classes of planning tasks the application of a PSS is much more common practice than it is for other tasks, notably communication versus analyses. However, it seems that with the growing attention to the 'smart city' concept, planning practice is opening up much more widely to technological innovation and support, including PSS.

To summarize, although on the surface PSS history, PSS research, PSS education and PSS in practice present quite negative pictures, recent PSS developments are clearly much more positive. To strengthen these positive developments, I now make some recommendations concerning the future of PSS.

7. The future of PSS: some recommendations

The first recommendation concerns the quest to bridge the implementation gap; that is, the discrepancy between the growing supply of PSS instruments on the market and the lack of demand for and actual application of PSS in planning practice. For the last 15 years, quite a lot of PSS research has focused on identifying, measuring, classifying, explaining, etc. the PSS implementation gap. Although further research on this gap will no doubt yield some new insights, its added value can be questioned. The reason for this is that we already know quite a lot as a result of so much research on the PSS implementation gap. Further, it is expected that continued discussion of the implementation gap will only be negative, and will hardly change things.

Instead, it is recommended to focus on the positive rather than the negative: we should look at the success stories (successful or best practices) and try to learn from them; after all, the proof of the pudding is in the eating. Especially in this era of smart city developments, this seems to be a good strategy.

And, in line with the above recommendation, we should look at the lessons learned from the more successful application of transport engineering analytical tools and see whether they are applicable to the less successful spatial planning PSS. This could, of course, yield fruitful insights. If so, we should spread the good news; after all, everyone wants to be on the winning team. I believe that this kind of research and its valorization will bring PSS to actual planning practice much more quickly. We must also recognize that, in order to become effective in practice, PSS tools have to be embedded in the planning process. This will require access to appropriate (open) data and a good instrumental infrastructure (e.g. in the cloud), as well as their appropriate organization. In that, the development of smart cities opens up new initiatives and possibilities.

My second recommendation concerns the identification and acceptance of the diversity in the PSS field and in planning practice itself. The PSS field is far more differentiated and diversified than it seems at first sight. Besides well-known, generally available PSS such as What-If and CommunityViz, there is also a range of much more dedicated, not generally available and mainly small PSS instruments that are applied in specific planning practices. And then, of course, there are the general communication platforms (or 'enabling technologies') like Facebook and the Chinese Weibo, which enable citizens to join forces and start participating actively in policymaking. It does not seem right to lump all these technologies together and base conclusions about their successes or failures on that. In addition, one has to differentiate PSS applications according to the scope and focus of the efforts, in the sense that small site planning issues are quite different from urban growth management efforts across entire metropolitan areas. Likewise, elaborate planning models to facilitate the cross-agency collaboration of professionals are quite different from public engagement efforts to encourage public reviews of master plans and options. And related to that, in such a much more differentiated world, PSS in actual planning practice should be applied in a much more selective manner. This also accords with the observation about the 'intended' PSS applications in planning practice (see Pelzer, 2015). PSS are by no means a panacea for all our problems or challenges in planning practice. In my opinion, selectivity in or of its application in actual planning practice evidences a growing maturity of the PSS field.

In general, one can state that because of its growing complexity (sustainable growth, climate change, citizen participation, etc.), spatial planning needs PSS instruments to support the proper handling of its planning tasks, and this will no doubt contribute to overcoming the implementation gap.

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