

The usefulness of Decision Support Systems in participatory forest planning: a comparison between Finland and Italy

I. De Meo^{1*}, F. Ferretti², T. Hujala³ and A. Kangas⁴

¹ *Consiglio per la Ricerca e la Sperimentazione in Agricoltura-Agrobiology and Pedology Centre (CRA-ABP). Pza. D'Azeglio, 30. 50121 Firenze, Italy*

² *Consiglio per la Ricerca e la Sperimentazione in Agricoltura-Apennines Forestry Research Unit (CRA-SFA). Via Bellini, 8. 86170 Isernia, Italy*

³ *Finnish Forest Research Institut Vantaa Unit. P.O. Box 18. 01301 Vantaa, Finland*

⁴ *Department of Forest Sciences. University of Helsinki. Latokartanonkaari, 7. P.O. Box 27. 00014 Helsinki, Finland*

Abstract

Aim of study: Participation of stakeholders is considered an essential element in producing, at different spatial and temporal scales, forest plans accepted by local community and fulfilling the requirements of Sustainable Forest Management. Increasingly, computer-based decision support systems (DSS) and tools are being introduced to assist stakeholders and decision-makers in coping with the complexities inherent in participatory forest planning. The study aimed to investigate how useful the users and researchers see DSS tools and which opportunities they perceive DSS might carry for enhancing participatory forest planning in their field of activity.

Area of study: 15 Italian and Finnish researchers and practitioners were interviewed.

Material and methods: Face-to-face structured interviews were used to collect opinions and experiences. Quantitative and qualitative information were analyzed to investigate differences between Italian and Finnish respondents as well as between researchers and practitioners

Main results: Results showed that in Italy there has been more focus on forest-level and medium-term problems and the intelligence phase, while in Finland there has been more attention to region-level and long-term problems and equally intelligence, design, and choice phases of decision-making. Deviations probably reflect different planning contexts and culture, variability in experiences and expertise in DSS and in availability of suitable DSS.

Research highlights: The study suggests to pay attention to evaluating the success criteria of participatory planning when preparing for the use of DSS and related tools in practical forest planning processes. Experience sharing is a key to reaching more successful use of DSS.

Key words: computer-based decision support; participatory processes; spatial scale; success criteria; temporal scale; users' perception.

Introduction

Various regions throughout the world face the challenge of planning the use and management of forests in a socially acceptable way. During the past two decades the shift from top-down expert decisions to participatory planning processes has given more attention to the views and experiences of local people and interest groups such as land owners, industry, hunters, recreational organizations, and environmental NGOs. As a result, the decision-making tasks within the planning

processes have become more complicated and information needs more demanding (Kangas *et al.*, 2008; Laamanen and Kangas, 2011; Nordström *et al.*, 2011).

Participatory planning of forest resources has evolved as a mix of preference elicitation, forest resource analysis and group negotiation activities (Buchy and Hoverman, 2000; Kangas *et al.*, 2006; Mendoza and Prabhu, 2006). In different countries and planning contexts, varying process models have been applied. In general, however, the planning process includes three separate phases: intelligence, design and choice (Simon, 1960). Intelligence means gathering the pertinent information, design means defining the possible options or courses of action and choice means selecting the best

* Corresponding author: isabella.demeo@entecra.it

Received: 30-03-12. Accepted: 17-10-12.

option. In each of the phases it is possible to utilize computer-based decision support systems (DSS) or tools. Several computer-based tools have been used to provide background information as well as to generate new information in the course of the planning cases (Díaz-Balteiro and Romero, 2008; Ananda and Herath, 2009). DSS can also be used to provide illustrations for evaluating the proposed actions (*e.g.* Fürst *et al.*, 2010).

In different countries, the available DSS are different, and the culture of using DSS varies. For instance in Finland, MELA system (Redsven *et al.*, 2011) with a growth and yield simulator and linear optimisation possibilities has been in active use since 1970's. More recently, MCDM (multiple criteria decision making) tools such as MESTA or Web-Hipre have been used to facilitate interactive participatory planning, in small-group setting in particular (Pykäläinen *et al.*, 2001; Hiltunen *et al.*, 2009; Mustajoki *et al.*, 2011). In Italy, where the culture of developing and using DSS in the ambit of planning forest resources is relatively new, DSS are not widely used. However, in recent years there has been an attempt to introduce computerized procedures in forest decision making processes and some DSS are under construction. ProgettoBosco, a data-driven DSS for forest planning (Ferretti *et al.*, 2011), is currently the most widely used. There are examples of using computerized tools in participatory forest planning also in other European countries (*e.g.* Nordström *et al.*, 2010, 2011; Lindner *et al.*, 2012).

The way people see the usefulness of forest DSS may also depend on their profession. Researchers in the field are assumed to be well familiar with the DSS tools, their opportunities and limitations, while the forestry professionals may be less so. The DSS is typically developed in research organizations and then gradually introduced to forestry practise.

DSS and related forest planning software have played varying roles in participatory processes in different contexts. The characteristics of forest-problem-specific DSS that could enhance successful participatory planning processes have been analysed theoretically by Menzel *et al.* (2012). However, there have been no studies about process facilitators' perceptions on the value on DSS in participatory forest planning, and the available feedback from real planning cases only deals with stakeholder participants' post-negotiation feedback (*e.g.* Pykäläinen *et al.*, 2007, Hiltunen *et al.*, 2009).

Comparative knowledge about the main functions of software, use experiences and development challenges would show a way to improving the usefulness of

DSS in participatory forest planning. This study takes a look at the experiences and perceptions of researchers as well as practitioners in Finland and Italy, representing the northern European and Mediterranean approaches, respectively. The aim is to learn about the similarities and differences of use cases and respondents' perceptions on the opportunities that DSS might carry for participatory planning.

Material and methods

Mixed-method interviews with participation experts

The research is based on quantitative-qualitative interview data collected in October and November 2010. A total of 15 interviewees were selected subjectively by the authors (with the support of other experts of the sector) among Finnish and Italian participatory planning experts (8 in Finland and 7 in Italy). The interviewees included i) professors and researchers at universities or research institutes, ii) representants of national or regional forestry centres, iii) professionals of private associations, iv) representants of state enterprises. They were divided into two main categories: professionals and researchers (9 and 6 respectively).

Structure of the interview

A questionnaire suitable for a face-to-face interview was developed to collect data and to work as an interview guide (Appendix I). The final version of the questionnaire was produced after a test phase during which improvements were suggested by participatory planning experts from various countries, institutions and with different background.

The questionnaire comprised 13 close-ended questions, which were chosen to keep the structure simple. Moreover, responses to the closed-end questions are more easily analysed allowing both quantitative and qualitative contemplation. In some cases the respondents had to choose from a list of preset responses. Other questions were formulated to offer an n-options ranking scale.

The themes presented in the questionnaire were: i) since how many years interviewees have been involved in participatory planning; characteristics of participatory planning in which the respondent is mostly involved, from the spatial and temporal point of view; phases of decision process in which participation is used (Q1-

Q2-Q3-Q4); ii) opinions about the potential use-fulness of DSS in improving participatory planning (Q5); iii) experiences with the use of DSS in participatory planning (Q6-Q7-Q8-Q13); and iv) experience-based opinions about the role of DSS in improving various phases of participatory planning and supporting criteria for successful participation process (Q9-Q10-Q11-Q12).

It was assumed that parts i and ii can be submitted also to participation professionals and researchers with no DSS experience, while the parts iii and iv were addressed to people who have used DSS, to collect suggestions from their experiences. The difference between ii and iv is supposed to reflect the deviation between expectations and experiences.

Data acquisition

The interviews were conducted in English, at the place of work of the respondents. One of the authors conducted the interviews, which lasted from 45 to 120 minutes and summarized them after registration. English was the mother tongue neither for the respondents nor the interviewer. The opportunity was used to ask about the meaning of difficult questions in Finnish or Italian.

The face-to-face structured interviews were conducted in the course of filling the questionnaire. In such a way, the order in which questions were asked remained the same, and the questions were always answered within the similar context. The questions and the possible alternative answers were read together by the interviewer and the interviewees. For each question, besides ticking the given answer, there was discussion and exchange of information, in order to collect explanations for responses and to discuss the various related aspects with the interviewees. The discussion was assumed to help to interpret the quantitative results and, furthermore, the discussion was helpful because the interviewees, particularly the practitioners, were often in difficulty to understand the significance of some words and concepts.

Analysis

Recordings of interview discussions as well as interviewer's notes were used as the qualitative part of data while the questionnaire responses formed the quantitative part. The analysis followed a mixed-method principle (Tashakkori and Teddlie, 1998). Response distributions or mean values were determined for each question

by nationality (Finnish/Italian) and by expertise background (researcher/professional). For each question in turn, meaningful statements were extracted from the recordings and notes, and they were looked through to find support and logical interpretations to the quantitative results. The most relevant quotes were finally chosen to the result description as illustrations.

Results

Characteristics of participatory planning

In Finland the respondents had a longer experience in participatory planning than the respondents in Italy (Fig. 1). However, in Italy the participatory approach in forest planning has quickly earned attention in the last decade. In both countries, professionals have less experience than researchers, as expected. Partly this result may, however, be due to the subjective selection of the respondents and the small sample.

Considering the temporal scale of forest management problems (Fig. 2), the Italian interviewees have been more often involved in medium term participatory planning (2 to 10 years) while the Finnish respondents

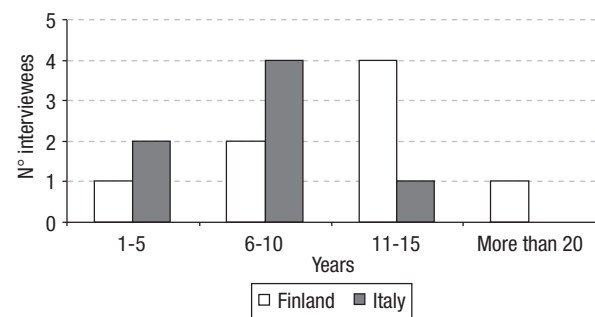


Figure 1. The experience of the respondents in participatory planning (Q1).

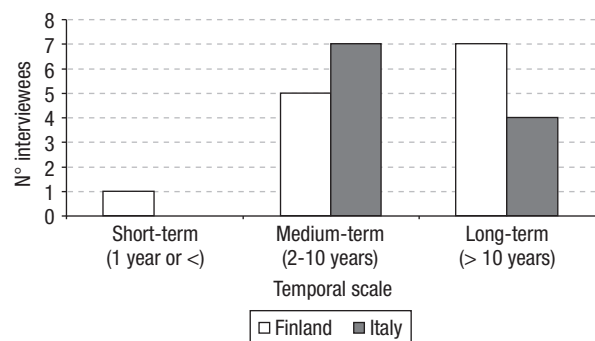


Figure 2. Temporal scale of forest management problems (Q2).

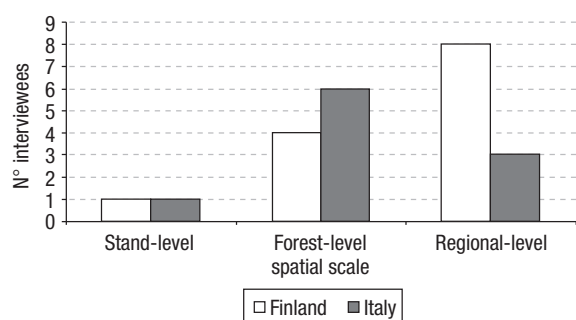


Figure 3. Spatial scale of forest management problems (Q3).

have more experience in long term planning (more than 10 years); only one Finnish interviewee has been mainly involved in short term planning. Professionals have been more often involved in medium term planning while researchers have been involved in long term planning: this implies a slight mismatch in interests and experiences.

From a spatial point of view (Fig. 3), Italian interviewees have been more often involved in forest-level planning (forest landscape with several stands that belong together for a common purpose) than Finnish respondents who have focused most in regional-level planning (a set of landscapes that may be managed each to address different objectives). Professionals and researchers have been involved at the same level. It appears that the long-time scale and large spatial scale are largely related, as well as the medium-time and medium spatial scale.

Considering in which phases of the decision process participation is used (multiple answers were allowed) (Table 1), the Finnish respondents have used it more or less in all the phases. The Italian respondents have used participation most often at the intelligence phase and least often in choice phase. In interview discussions it became clear that even if participation is used in the choice phase, the stakeholders actually do not make the decisions.

“Normally stakeholders are not involved in decision making and they don’t take part to the final decision

Table 1. In which phases of the decision process participation is used (Q4)

Phase	Country		Background	
	Finland	Italy	Professional	Researcher
Intelligence	6/8	7/7	8/9	5/6
Design	7/8	4/7	6/9	5/6
Choice	6/8	3/7	5/9	4/6

... They are never directly included in decision making, but in selecting alternatives ... so they have indirect power on the final decision.” (interviewee 9, Finland).

General opinion about the potential usefulness of DSS

The scores about the potential usefulness of DSS in improving different tasks of participatory planning given by Finnish and Italian respondents were quite similar but researchers expressed higher scores than professionals for most of the functions. For one question the scores were equal both with respect to the country and to the background (Table 2). The mean of the answers was above 4 (usefulness from moderate to high) in all cases but those concerning formalization of preferences. The mean values below 3 for expressed and non-expressed preferences mean that DSS is not expected to reveal hidden preferences, and among professionals DSS is seen only moderately useful in capturing even the shown preferences.

This element merged more than once in the discussion, particularly from Italian respondents.

“It’s so difficult to collect opinions and expectations from stakeholders ... often they are simple people such as farmers, forest entrepreneurs, timber sellers...they are in difficulties also during an interview.” (interviewee 5, Italian)

“I’m really puzzled how a DSS can support in formalizing the preferences that stakeholders are not able to express ... it’s a problem to collect their preferences.....sometimes it’s a problem also to discuss with them ... we have to begin a long process of involvement of the stakeholders...” (interviewee 2, Italian)

The highest DSS usefulness scores were given in both countries for improving the transparency and traceability of the participatory planning process. Transparency was also stressed in the open discussions.

“With the use of computerized tools, it is also possible to give every participant a voice, and every opinion will be documented...” (interviewee 13)

“The most important function of DSS is to give transparency to the decision making process, and documenting the arguments for and against the management options is important in ensuring transparency ... final guidelines remain publicly archived in the DSS database...” (interviewee 6)

DSS was also seen useful in a sense that it can create a common language in a multidisciplinary group

Table 2. To what extent it is possible to improve the different tasks of participatory planning with a DSS (Q5). Greatest differences highlighted

Functions	Country	Score	Background	Score
Facilitating/supporting the identification, structuring and formalization of the decision problem	Finland	4.3	Professional	4.1
	Italy	4.0	Researcher	4.2
Facilitating/supporting the formalization of the preferences expressed by the stakeholders	Finland	4.3	Professional	2.9
	Italy	3.6	Researcher	4.2
Facilitating/supporting the formalization of the preferences that stakeholders are not able to express	Finland	3.4	Professional	2.8
	Italy	3.3	Researcher	4.2
Facilitating/supporting the gathering and the organization of the preferences expressed by the stakeholders	Finland	4.3	Professional	4.0
	Italy	4.4	Researcher	4.8
Supporting communicating to stakeholders the information concerning the various alternatives	Finland	4.3	Professional	4.2
	Italy	4.4	Researcher	4.5
Supporting communicating to stakeholders the information concerning the decision making process	Finland	4.0	Professional	4.1
	Italy	4.4	Researcher	4.3
Giving to the stakeholders the possibility to verify their effectiveness (potency) on the definition of the alternatives	Finland	4.0	Professional	4.0
	Italy	4.0	Researcher	4.0
Giving transparency and traceability to the decision-making process	Finland	4.8	Professional	4.6
	Italy	4.6	Researcher	4.8

Note: Number of respondents in each subgroup 6-9.

(interviewees 4 and 1), which may also enhance transparency.

Experience with the use of DSS in participatory planning

Most of the respondents assessed that DSS can aid in the participatory planning tasks. Only one Italian researcher said he doesn't use DSS, because it is not needed for participatory planning he is involved in.

However, the DSS used (Table 3) could be generic software, like GIS or Excel rather than forestry DSS or DSS designed for participatory planning (interviewees 3 and 6). Italian respondents frequently affirm that they use only simple DSS.

"In my region, but I suppose all over Italy, participation is common in the development of Regional Forest Plan ... we use very simple DSS like Excel, or Arcview ... we don't have DSS finalized to support participation." (interviewee 7, Italian)

"We use simple DSS to support the elicitation and aggregation of the preferences and gathering of the various information..." (interviewee 2, Italian)

With regard to the way in which DSS has been used during the participation process (Table 4), Finns

reported using a facilitator; for Italians and professionals in particular the support of an expert internal to the organization was frequent. Internet applications and computerized hand-on experiments were rather uncommon, especially in Italy.

"The support of the expert is necessary to use DSS ... the crucial point is the way the expert uses the method and the way he's able to communicate information and techniques." (interviewee 3)

Table 3. Which DSS interviewees use (Q8)

"DSS" name	N° interviewees
Gis (Arc-Gis, Arc-View, Sutigis, MapInfo, Idrisi)	11
Mela	5
Excel	4
Hipre (MCDA)	3
Mesta	3
ProgettoBosco	2
Ahp, A'wot, SMART	1
Monsu	1
Smaa	1
Tosia	1
Voting methods	1
Word processor	1
Worksheet	1

Table 4. How the DSS has been used during the participation process (Q13)

	Country		Background	
	Finland	Italy	Professional	Researcher
Internet based	4/8	0/6	3/9	1/5
With the support of a facilitator	8/8	2/6	6/9	4/5
With the support of an expert (internal to the organisation)	2/8	6/6	6/9	2/5
With hands-on experiments	3/8	0/6	3/9	0/5
Other	1/8	0/6	1/9	0/5

Experience-based opinions about the use and role of DSS

When asked about experience-based opinions of the role of DSS, the scores expressed by Finnish respondents are higher than those of Italian respondents and researchers express higher scores than professionals (Table 5).

The highest values are attributed to “Supporting communicating to stakeholders the information concerning the various alternatives” and “Giving transparency and traceability to the decision-making process” and the lowest to “Facilitating/supporting the formalization of the preferences that stakeholders are not able to express”. The scores given based on the experiences are lower than those given to the question of general

potential of DSS (see Table 2 and Table 5). The greatest drop from the potential to the experiences by Italian respondents were observed in the task “Supporting communicating to stakeholders the information concerning the various alternatives” and “Supporting communicating to stakeholders the information concerning the decision making process”, while among Finnish respondents the largest score drop was observed in the task “Facilitating/supporting the gathering and the organisation of the preferences expressed by the stakeholders”. For professionals the drop was deep, but for researchers the average score from experiences was actually higher than the expressed potential.

During the open discussions also the role of DSS in monitoring the achievement of the planning goal was considered.

Table 5. To what extent the used DSS contribute to improve these tasks of participatory planning (Q9). Greatest differences highlighted

	Country		Background	
	Country	Score	Background	Score
Facilitating/supporting the identification, structuring and formalization of the decision problem	Finland	4.0	Professional	3.4
	Italy	3.3	Researcher	4.2
Facilitating/supporting the formalization of the preferences expressed by the stakeholders	Finland	3.9	Professional	3.0
	Italy	3.0	Researcher	4.4
Facilitating/supporting the formalization of the preferences that stakeholders are not able to express	Finland	2.9	Professional	2.2
	Italy	2.7	Researcher	3.8
Facilitating/supporting the gathering and the organization of the preferences expressed by the stakeholders	Finland	3.6	Professional	3.1
	Italy	3.5	Researcher	4.4
Supporting communicating to stakeholders the information concerning the various alternatives	Finland	4.4	Professional	3.6
	Italy	3.0	Researcher	4.5
Supporting communicating to stakeholders the information concerning the decision making process	Finland	4.1	Professional	3.6
	Italy	3.2	Researcher	4.3
Giving to the stakeholders the possibility to verify their effectiveness (potency) on the definition of the alternatives	Finland	3.6	Professional	3.3
	Italy	3.6	Researcher	4.3
Giving transparency and traceability to the decision-making process	Finland	4.4	Professional	3.8
	Italy	3.8	Researcher	5.0

Note: Number of respondents in each subgroup 4-9.

“...stakeholders are invited during the period of validity of the plan and there is an information exchange between decision makers and stakeholders... databases are used for this monitoring.” (interviewee 8)

Most respondents were able to answer the question concerning the usefulness of DSS tools to achieve the success criteria for participatory planning (Table 6). The scores expressed by Finnish respondents are generally higher than Italian ones, except for “Quality and selection of information”, “Cost effectiveness” and “Acceptance of outcome”. The scores expressed by researchers and professionals are quite similar except for “Fairness” and “Neutrality of process”. Professionals seem more optimistic about the possibilities of DSS in that respect than researchers. An opposite trend can be observed for the “Cost effectiveness”. Highest scores on average were given to the “Transparency” criterion, and lowest to the “Accountability” and “Cost effectiveness”.

For Italian respondents the role of DSS in fostering creative thinking is lower than for Finns. This aspect was evidenced also in the discussions.

“The use of DSS represents a limitation for creative thinking ... DSS use limits the openness of thinking and the efforts of the stakeholders by offering them pre-packed alternatives.” (interviewee 4, Italian).

“If the DSS comes to the decision process it can foster thinking, in the sense that decision makers, experts and stakeholders discuss together objectives and alternatives and implement DSS in a creative way.” (interviewee 12, Finnish)

“The way DSS is used will have a great effect on the benefits it produces. For instance, while a DSS is very formal tool, it can still be used creatively... if the DSS is not flexible it can have an opposite effect, to restrict thinking...” (interviewee 12, Finnish)

In the discussions it was stressed by several interviewees that the way in which the DSS is used may be more important than the actual DSS which is used. Some good use case examples were told. It was also noted that DSS could be used in a manipulative way, but the use of DSS could also reduce manipulation.

Table 6. Criteria that DSS tools, communication means and working techniques could be useful to support a successful participation process (Q10). Greatest differences highlighted

	Country	Score	Background	Score
Fairness (equality, impartiality)	Finland	4.3	Professional	3.9
	Italy	3.1	Researcher	3.5
Quality and selection of information	Finland	4.1	Professional	4.1
	Italy	4.3	Researcher	4.3
Cost effectiveness	Finland	3.0	Professional	3.0
	Italy	3.3	Researcher	3.4
Opportunity to influence outcome	Finland	4.0	Professional	3.7
	Italy	3.3	Researcher	3.7
Challenging status quo and fostering creative thinking	Finland	3.8	Professional	3.3
	Italy	2.9	Researcher	3.3
Transparency (transparent, open decision process)	Finland	4.5	Professional	4.3
	Italy	4.1	Researcher	4.3
Structured decision-making process	Finland	4.0	Professional	4.3
	Italy	3.4	Researcher	4.3
Acceptance of outcome	Finland	3.4	Professional	3.3
	Italy	3.5	Researcher	3.6
Accountability (responsibility, answerability of the decision process, assumption of responsibility by decision makers)	Finland	3.8	Professional	3.2
	Italy	2.6	Researcher	3.5
Legitimacy (stakeholders' acceptance of decision process. Stakeholders' belief that the actions of decision makers are appropriate.)	Finland	3.8	Professional	3.4
	Italy	3.0	Researcher	3.3
Independence and neutrality of process (no external pressure)	Finland	4.0	Professional	3.7
	Italy	3.0	Researcher	3.3

Note: Number of respondents in each subgroup 4-9.

general experts meet stakeholders and explain them how to use the DSS ... they make practice together ... It's important to have time to explain people how to use software." (interviewee 10)

"If the person who uses the DSS is not neutral, he can use it to manipulate the process; for this reason using it in a neutral way is important." (interviewee 6)

"The responsible of the plans puts all the information in the DSS and they cannot manipulate the data, because the data are clear for all the users." (interviewee 2)

The Finnish respondents see DSS as more important than Italians in the organization phases, and Italians more important than Finns in the design and choice phases, but the differences are not large (Table 7). Re-

Table 7. In which phase of the participatory planning process the DSS has been used and to what degree different methods in the DSS have been found useful (Q11)

	Country	Score	% answer	Background	Score	% answer
<i>Organisation</i>						
a) Organising the process (time frame, budget definition...)	Finland	3.7	38	Professional	3.5	44
	Italy	3.0	29	Researcher	3.0	17
b) Problem structuring (focus on the problem situation, formulate a joint problem, rising awareness, assessment of current status)	Finland	4.1	100	Professional	3.9	100
	Italy	3.8	57	Researcher	4.3	50
<i>Intelligence</i>						
c) Identification of stakeholders	Finland	2.3	38	Professional	5.0	11
	Italy	5.0	14	Researcher	2.3	50
d) Definition of criteria, goals and constraints	Finland	4.0	100	Professional	3.8	89
	Italy	3.8	57	Researcher	4.3	67
e) Elicitation of stakeholders' preferences	Finland	3.8	100	Professional	4.1	78
	Italy	4.3	43	Researcher	3.5	67
f) Elicitation of decision makers' preferences	Finland	4.1	88	Professional	3.8	56
	Italy	4.0	29	Researcher	4.5	67
g) Gathering/identifying of information/expert knowledge regarding the decision problem	Finland	3.9	88	Professional	3.5	89
	Italy	3.8	86	Researcher	4.4	83
h) Creating new information and knowledge	Finland	3.5	75	Professional	3.1	78
	Italy	3.0	86	Researcher	3.4	83
i) Aggregation of stakeholders' preferences	Finland	4.3	100	Professional	4.2	100
	Italy	4.0	71	Researcher	4.0	67
<i>Design</i>						
j) Identification of alternatives	Finland	3.8	75	Professional	4.0	67
	Italy	4.6	71	Researcher	4.4	83
k) Exploration of alternatives (investigating, discussing, modifying...)	Finland	4.4	100	Professional	4.5	89
	Italy	4.8	57	Researcher	4.5	67
l) Illustrations of effects	Finland	4.1	88	Professional	4.1	89
	Italy	4.6	71	Researcher	4.8	67
<i>Choice</i>						
m) Selection of the best option	Finland	4.1	100	Professional	4.0	89
	Italy	4.2	71	Researcher	4.4	83
<i>Monitoring</i>						
n) Achievement of the goals set by the stakeholders	Finland	3.6	88	Professional	3.6	56
	Italy	3.0	14	Researcher	3.3	50

Note: Number of responses varies between 1 and 9 in subgroups, therefore to be interpreted with caution.

searchers see DSS more useful than professionals in most tasks, the only exceptions were the process organisation (a), identifying the stakeholders (c), elicitation and aggregation of stakeholder preference (e and i) and the monitoring of the achievement of the goals set by the stakeholders (n). The reliability of these results suffers from low response rates particularly among Italian respondents, probably reflecting scarce personal experience of the use of DSS.

Each of the respondents were obviously thinking about different DSS tools, and they had used the tools in different ways. In the open discussion, for instance, one interviewee (13) pointed out: “*MCDM tools are powerful in structuring the problem even if they are not specifically designed for that purpose...*” Another respondent (interviewee 4) argued “*...DSS can be useful in defining an understandable method or process for the stakeholders...*”

Many respondents stressed that a DSS might not be useful, if it is introduced late in the process. One respondent (interviewee 2) argued: “*The computerised tools are most important in the first phases of the process: to gather various actors around a table using a common tool to organise their ideas.*” Interviewee 14 pointed out that “*In some cases DSS was not useful because it was introduced at a point where the process was already organised.*”

The respondents could also specify the reasons related to negative answers (Question 12). Nobody considered the first two possibilities: DSS available is too costly or too difficult to use. In most of the cases respondents affirm that DSS are not used because they are not needed in the participatory planning they are involved in or because they cannot see the benefit DSS would provide (Fig. 4). Most of the answers are related to the intelligence phase.

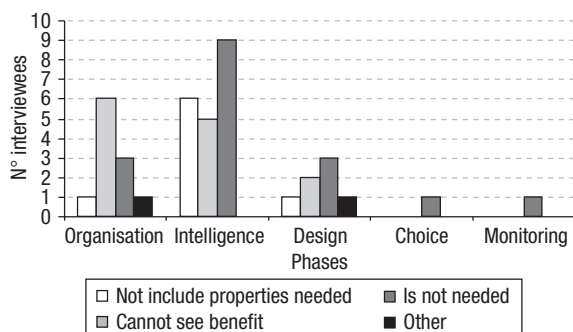


Figure 4. Phases of the participatory planning process where the DSS has not been used and reason for that (Q12).

Discussion

According to the above results there are deviations in the opinions between the Italian and Finnish respondents, as well as between researchers and professionals. The explanation may lie in personal experiences of using DSS or in the availability of suitable tools, but also on the planning context the interviewees have mostly been involved in. It is noteworthy that the number of informants in the study was only 15, providing scarce evidence base for strong interpretations from the quantitative part of the results. However, the integration of qualitative interview part with the questionnaire filling increases understanding about the perceptions regarding DSS and thus the validity of devised interpretations. Further, the 15 subjectively selected informants constitute a rather representative sample of the limited overall number of participatory forest planning experts in Finland and Italy. Therefore the quantitative results can be seen as direction-giving perceptions and the qualitative results as a reliable set of viewpoints existing in the current social reality.

Italians use participation mostly in the intelligence phase (Q4). This is most likely due to the planning culture. In specific, a reason can be the planning approach that primarily aims to ensure the due consideration to all stakeholder groups, to involve as many stakeholders as possible, to identify key-actors and therefore facilitate bottom-up decision processes (Paletto *et al.*, 2012).

Professionals are involved in different spatial and temporal planning levels than researchers, which may reflect the different experiences these two groups have in the field. It calls for more interaction in which the parties could learn from each other. An interesting thing is that on average the scores given based on the practical experiences are lower than those given to the question of general potential of DSS (Q9 vs Q5); it can suggest that expectations from DSS are higher than the thus far gained outcomes from DSS application. The expectations could be better fulfilled after learning to use DSS more properly in the participatory planning processes. These lines of thought further underline the importance of knowledge and experience exchange.

Considering the temporal scale of forest management problems (Q2), Finnish and Italian participatory planning experts are not involved in short term planning. Likewise, considering the spatial scale, they are not involved in stand-level planning. It is quite obvious that it isn't usually important to involve stakeholders at operational stand-level planning, but it is important

to observe corresponding experiences from respondents. However, it must be noted that in urban or recreational forests participatory DSS-assisted stand-level planning may become more relevant in upcoming years. It is evident that planning professionals need software, action models and exercise to handle also this kind of planning tasks together with the relevant stakeholders.

Italians use DSS less than Finns (Q9 and Q11). This is probably due to the different planning culture, lower expertise in DSS and poorer availability of suitable DSS. It is probable that when the culture of using DSS and pioneer users' personal experiences develop (Italians are younger users than Finns, Q1), the possibilities of using DSS more will increase in Italy. This consideration is strengthened by the fact that the expectations of Italian respondents regarding the potential usefulness of DSS proved to be similar to the Finnish ones.

Organisation and intelligence seem to be the phases where the respondents see little usefulness for DSS. It is probably necessary to provide planning professionals with examples and good experiences of how DSS could be and have been used to foster organisation and intelligence phases of participatory planning. In particular the DSS developer community might need to better show the capability of their DSS. Or, on the other hand, the currently low scores for DSS usefulness may be due to lack of proper DSS for these phases. In this case the prime recommended action would be to create such software. Further research is needed to clarify the situation and select optimal actions to link DSS and use situations.

In the work of Menzel *et al.* (2012), the potential for a DSS to enhance achieving the success criteria of participatory planning was analysed from a theoretical point of view. They defined that DSS could potentially be helpful (or harmful) regarding fairness, the opportunity to influence outcome, the quality and selection of information, cost effectiveness, challenging the *status quo* and fostering creative thinking, a structured decision-making process, transparency, and independence and neutrality of the process. These criteria got the highest scores in this study as well, except for cost efficiency and challenging status quo. Menzel *et al.* (2012) defined that DSS could potentially help with respect to the cost-efficiency, if the information provided by DSS is acceptable and thus reduces the time and money invested in gathering information. The professionals answering the questions in this study

probably were considering the number of meetings with stakeholders required and other practical issues. What comes to challenging status quo, Menzel *et al.* (2012) have the same notion that DSS in this respect be either an asset or a hindrance, depending on how it is used.

Conclusions

The study pointed out that opinions on the opportunities of DSS to foster participatory planning differ between Finland and Italy, and also between researchers and practical professionals in these countries. It is probable that such differences exist in other countries as well. Therefore it is important to tailor the efforts of DSS development and application according to the context at hand. However, international developmental processes are highly important to facilitate knowledge and experience exchange and to reach economy of scale in internationally common DSS development matters.

The respondents underlined that the available DSS don't match exactly with all features that users need (*e.g.* current DSS don't include properties needed to support the organisation and intelligence phases). Developing forest management DSS for future use should therefore incorporate practical users in the software design phase. Concurrently, the DSS developers and researchers of the field should investigate the properties of participatory planning processes and devise creative DSS functionalities for potential new use cases. Alongside these investigations it would also be important to understand why there are higher expectations than outcomes from DSS application, in order to develop better DSS in the future and to better communicate their pros and cons to the potential users.

The main limitation of the quantitative part of our analysis is that it is based on the information obtained from a quite little number of respondents. This limit is primarily due to the fact that —particularly in Italy, but also in Finland— the researchers and professionals actively involved in participatory planning are quite few. However, the qualitative part of our analysis enabled to acquire a deeper understanding about the respondents' experiences and insights, which makes the evidence base stronger and overall interpretations more reliable.

Participation in forest planning is rapidly developing in these years, consequently the context alters rapidly; for this reason we recommend to implement this kind

of studies with up-to-date results about DSS users' and developers' experiences and perspectives. From these further studies it would be possible to obtain internationally comparative knowledge about the main use situations of software and a sharing of experiences and development challenges that represents a key to reach higher successfulness in using and developing DSS which concretely support participation in forest planning.

Acknowledgements

COST Action FORSYS (FP0804) provided financial support. We thank the forest researchers and professionals who participated as interviewees and contributed to the improvement of knowledge about DSS and their application.

References

- Ananda J, Herath G, 2009. A critical review of multi-criteria decision making methods with special reference to forest management and planning. *Ecol Econ* 68: 2235-2248.
- Buchy M, Hoverman S, 2000. Understanding public participation in forest planning: a review, *Forest Policy Econ* 1: 15-25.
- Diaz-Balteiro L, Romero C, 2008. Making forestry decisions with multiple criteria: A review and an assessment. *Forest Ecol Manag* 255: 3222-3241.
- Ferretti F, Dibari C, De Meo I, Cantiani P, Bianchi, M, 2011. ProgettoBosco, a Data-Driven Decision Support System for forest planning. *Mathematical and Computational Forestry & Natural-Resource Sciences (MCFNS)* 3(1): 27-35.
- Fürst C, Volk M, Pietzsch, K, Makeschin F, 2010. Pimp your landscape: a tool for qualitative evaluation of the effects of regional planning measures on ecosystem services. *Environmental Management* 6:953-968.
- Hiltunen V, Kurttila M, Leskinen P, Pasanen K, Pykäläinen J, 2009. Mesta: an internet-based decision-support application for participatory strategic-level natural resources planning. *Forest Policy Econ* 11: 1-9.
- Kangas A, Kangas J, Kurttila M, 2008. Decision Support for Forest Management. Springer Science. p: 222.
- Kangas A, Laukkanen S, Kangas J, 2006. Social choice theory and its applications in sustainable forest management – a review. *Forest Policy Econ* 9: 77-92.
- Laamanen R, Kangas A, 2011. Large-scale forest owner's information needs in operational planning of timber harvesting – some practical views in Metsähallitus, Finnish state-owned enterprise. *Silva Fenn* 45: 711-727.
- Lindner M, Werhahn-Mees W, Suominen T, Vötter D, Zudin S *et al.* 2012. Conducting sustainability impact assessments of forestry-wood chains: examples of ToSIA applications. *Eur J Forest Res* 131: 21-34.
- Mendoza GA, Prabhu R, 2006. Participatory modeling and analysis for sustainable forest management: overview of soft system dynamics models and applications. *Forest Policy Econ* 9: 179-196.
- Menzel S, Nordström EM, Buchecker M, Marques A, Saarikoski H, Kangas A, 2012. Decision support systems in forest management: requirements from a participatory planning perspective. *Eur J. Forest Res* 131:1367-1379.
- Mustajoki J, Saarikoski H, Marttunen M, Ahtikoski A, Hallikainen V, Helle T, Hyppönen M, Jokinen M, Naskali A, Tuulentie S, Varmola M, Vatanen E, Ylisirniö AL, 2011. Use of decision analysis interviews to support the sustainable use of the forests in Finnish Upper Lapland. *Journal of Environmental Management* 92: 1550-1563.
- Nordström EM, Eriksson LO, Öhman K, 2010. Integrating multiple criteria decision analysis in participatory forest planning: experience from a case study in northern Sweden. *Forest Policy Econ* 12: 562-574.
- Nordström EM, Eriksson LO, Öhman K, 2011. Multiple criteria decision analysis with consideration to place-specific values in participatory forest planning. *Silva Fenn* 45: 253-265.
- Paletto A, Ferretti F, De Meo I, 2012. The role of social networks in forest landscape planning. *Forest Policy Econ* 15: 132-139.
- Pykäläinen J, Pukkala T, Kangas J, 2001. Alternative priority models for forest planning on the landscape level involving multiple ownership. *Forest Policy Econ* 2: 293-306.
- Pykäläinen J, Hiltunen V, Leskinen P, 2007. Complementary use of voting methods and interactive utility analysis in participatory strategic forest planning: experiences gained from western Finland. *Can J Forest Res* 37: 853-865.
- Redsven V, Hirvelä H, Härkönen K, Salminen O, Siitonen M, 2011. MELA2009 Reference Manual, 2nd ed. The Finnish Forest Research Institute. 664 pp.
- Simon HA, 1960. The new science of management decision. Harper & Row, New York.
- Tashakkori A, Teddlie C, 1998. Mixed methodology: combining qualitative and quantitative approaches, 1st ed. Sage Publications, Thousand Oaks.

Appendix I

1. Since how many years are you involved in participatory planning?

- 1-5 6-10 11-15 16-20 More than 20

2. With reference to the participatory planning you're involved in, to which scale of forest management problems do you refer, from a temporal point of view? You can give multiple answers.

- Short term (operational): planning horizon extending over one year or less*
 Medium term (tactical): planning horizon extending from 2 to 10 years
 Long term (strategic): planning horizon extending over more than 10 years

3. And from a spatial point of view, to which scale do you refer? You can give multiple answers.

- Stand level: homogeneous unit according to ecological, physiographic and development features*
 Forest level: forest landscape with several stands that belong together for a common purpose
 Regional/national level: a set of landscapes that may be managed each to address different objectives

4. With reference to your experience, in what phases of the decision process is participation used? You can give multiple answers.

- Intelligence* *Design* *Decision making*

5. With the use of computerized tools, to what extent do you think it is possible to improve the different tasks of participatory planning shown in the table below?

Functions	Low	Low to moderate	Moderate	Moderate to high	High	I don't know
Facilitating/supporting the identification, structuring and formalization of the decision problem						
Facilitating/supporting the formalization of the preferences expressed by the stakeholders						
Facilitating/supporting the formalization of the preferences that stakeholders are not able to express						
Facilitating/supporting the gathering and the organization of the preferences expressed by the stakeholders						
Supporting communicating to stakeholders the information concerning the various alternatives						
Supporting communicating to stakeholders the information concerning the decision making process						
Giving to the stakeholders the possibility to verify their effectiveness (potency) on the definition of the alternatives						
Giving transparency and traceability to the decision-making process						
Other, what?						

6. Do you currently use DSS to support participation process, or you have used DSS in some specific planning case?

- Yes* *Sometimes* *No*

Appendix I (cont.)

7. If NO or SOMETIMES, please specify why you do not use DSS in participatory planning. You can give multiple answers

DSS available is too costly to use	
DSS available is too difficult to use	
DSS available does not include properties needed	
I cannot see the benefit DSS would provide for the planning task	
DSS is not needed for participatory planning I'm involved in	
Other, what?	

8. If YES or SOMETIMES, please give the name(s) of the DSS you use, or you have used in your planning case

	Name
1	
2	
3	
4	

9. Referring to your experience/case, to what extent do you think the DSS used contribute to improve these tasks of participatory planning?

Functions	Low	Low to moderate	Moderate	Moderate to high	High	I don't know
Facilitating/supporting the identification, structuring and formalization of the decision problem						
Facilitating/supporting the formalization of the preferences expressed by the stakeholders						
Facilitating/supporting the formalization of the preferences that stakeholders are not able to express						
Facilitating/supporting the gathering and the organization of the preferences expressed by the stakeholders						
Supporting communicating to stakeholders the information concerning the various alternatives						
Supporting communicating to stakeholders the information concerning the decision making process						
Giving to the stakeholders the possibility to verify their effectiveness (potency) on the definition of the alternatives						
Giving transparency and traceability to the decision-making process						
Other, what?						

Appendix I (cont.)

10. The following criteria can be set for a successful participation process. Referring to your experience/case, which criteria do you think DSS tools, communication means and working techniques could be useful to support? You can give multiple answers.

Functions	Low	Low to moderate	Moderate	Moderate to high	High
Fairness (equality, impartiality)					
Quality and selection of information					
Cost effectiveness					
Opportunity to influence outcome					
Challenging status quo and fostering creative thinking					
Transparency (transparent, open decision process)					
Structured decision-making process					
Acceptance of outcome					
Accountability (responsibility, answerability of the decision process, assumption of responsibility by decision makers)					
Legitimacy (stakeholders' acceptance of decision process. Stakeholders' belief that the actions of decision makers are appropriate)					
Independence and neutrality of process (no external pressure)					

Appendix I (cont.)

11. Referring to your experience/case, in which phase of the participatory planning process has the DSS been used? For each phase that you answer "YES", please specify to what degree different methods in the DSS have been found useful.

	Yes					No	I don't know
	Highly useful	Very useful	Some-what useful	Not very useful	Not useful at all		
<i>Organization</i>							
a) Organizing the process (time frame, budget definition...)							
b) Problem structuring (focus on the problem situation, formulate a joint problem, rising awareness, assessment of current status)							
<i>Intelligence</i>							
c) Identification of stakeholders							
d) Definition of criteria, goals and constraints							
e) Elicitation of stakeholders' preferences							
f) Elicitation of decision makers' preferences							
g) Gathering/identifying of information/expert knowledge regarding the decision problem							
h) Creating new information and knowledge							
i) Aggregation of stakeholders' preferences							
<i>Design</i>							
j) Identification of alternatives							
k) Exploration of alternatives (investigating, discussing, modifying...)							
l) Illustrations of effects							
<i>Choice</i>							
m) Selection of the best option							
<i>Monitoring</i>							
n) Achievement of the goals set by the stakeholders							
o) Other (what? In which phase?)							

Appendix I (cont.)

12. For each phase (a-o) of question 11 that you responded "NO", please specify why a DSS has not been used.

	Phases
DSS available is too costly to use	
DSS available is too difficult to use	
DSS available does not include properties needed	
I cannot see the benefit DSS would provide for the planning task	
DSS is not needed for participatory planning I'm involved in	
Other, what?	

13. Referring to your experience/case how has the DSS been used during the participation process? You can give multiple answers.

Internet based	
With the support of a facilitator	
With the support of an expert (internal to the organization)	
With hands-on experiments	
Other, what?	

Date:

Name:

Family name:

Country:

Institution:

Position:

Role in participatory planning (stakeholder, facilitator, expert):

Age: 20-30 31-40 41-50 51-60 61-70 More than 71