Title: Methodologies for participatory foresight and priority setting in innovation networks

Authors: Ville Brummer
Systems Analysis Laboratory
Helsinki University of Technology
P.O. Box 1100, 02015 TKK, FINLAND
ville.brummer@tkk.fi

Date: XX, 2009

Abstract: Tähän abstrakti

Keywords: Tähän kiiwördsit
Academic dissertation
Systems Analysis Laboratory
Department of Mathematics and Systems Analysis
Helsinki University of Technology

Methodologies for participatory foresight and priority setting in innovation networks

Author: Ville Brummer
Supervising professor: Ahti Salo
Preliminary examiners: XXX YYY
Official opponent: ZZZ

Publications
The dissertation consists of the present summary article and the following publications:


Contributions of the author
1. Introduction

Participatory foresight (Irvine and Martin, 1984; Salo and Cuhls, 2003) is a widely employed methodology for assisting the design and the implementation of innovation policies, both in public (Martin and Johnson, 1999; Georghiou and Keenan, 2006) and private sectors (Reger, 2001). Originally, foresight was mainly developed for improving decision making on innovation policies and strategies, by engaging experts for consideration on alternative futures and using their expertise for making better decisions (Irvine and Martin, 1984; Cuhls 2003). Especially, participatory foresight was seen useful in support of the development of thematic S&T priorities (Martin and Irvine, 1989), where expert participation is needed for compensating or complementing possible lack of amount and quality of statistical or other hard data.

From the 90’s, there have been growing trend of characterizing the rationale of foresight processes not only in view how well they may support certain decision making situation (Martin and Irvine, 1989), but also in view of how they may “wire-up” international, national and regional innovation systems and contribute to innovation capacity of industry clusters and research communities (Martin and Johnson, 1999; Barré, 2002; Cuhls, 2003), by engaging stakeholders for building a common vision and increasing their awareness and commitment to S&T actions (Cuhls 2003), creating new networks and strengthening existing ones (Lundvall, 1992; Martin and Johnson, 1999), and fostering diversity (Könnölä, 2006), among others. As a result of this development, foresight is nowadays seen a tool for contributing these all objectives (Barré, 2002; Georghiou and Keenan, 2006) and, for example, High Level Expert Group for the European Commission (2002) defines participatory foresight as follows; “systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint actions”.

A need for deal with multiple objectives can also be seen in the management of foresight activities (Salo et al 2004). Especially, several studies have raised the question of how to balance requirements of developing coherent and readily implantable recommendations to the decision makers, and increasing awareness on S&T opportunities, fostering more creative debate on S&T opportunities and thus contributing to the innovation system in a more aggregate level (Rip, 2003; Havas, 2003; Rask, 2008).

Despite the acknowledgement of need to deal with several objectives and parallel processes, there seems to be lack of rigorous methodologies to do that (Havas 2003), especially within the coordination of priority setting activities in innovation networks (Salmenkaita and Salo 2004). Too decision-oriented processes and domination of decision makers may cause lack of creativity and new ideas (Eriksson and Weber, 2008). On the other hand, methodologies, that particularly aims to produce information
on alternative states of future (such as Delphi-method; e.g. Linstone and Turoff, 1975 and Scenarios; e.g. Bishop et al 2007) or foster interaction and creativity (such as expert workshops; e.g. Salo and Gustafsson 2004) may be difficult to translate results into actionable recommendations for the decisions that the foresight process may have been expected to support (van der Meulen et al., 2003). Furthermore, too much emphasis on the consensual vision building may make foresight results difficult to use – they may become too abstract and obvious to benefit decision making (Keenan, 2003).

Within the many large-scale national foresight activities, the demand of serving several objectives is partly met by applying multiple methodologies and engaging wide range of stakeholders from different parts of the society (e.g. Durand, 2003; Havas, 2003; Keenan, 2003; Georghiou and Keenan, 2006). However, this may also make foresight processes rather laborious, and they may require a lot of resources and make them rather time consuming. In the management of innovation networks, “heavy” use of several methodologies and extensive participation may not be possible (e.g. Azzionea and Manzini 2006). Despite the multiple objectives, often foresight activities must carried out within rather tight time-frames and budgets, and they should enable fast and adaptive responses to the rapidly changing technologies and society (Salo 2001; Salmenkaita and Salo 2004).

The 6 essays of this theses aim to response to these challenges by developing new methodologies for assisting managers of the foresight activities to better deal with multiple objectives and expectations. Especially, this thesis develops method for assisting thematic R&D priority setting in innovation networks, where alongside this function; priority setting process can be adapted to respond also other objectives, such as consideration of S&T opportunities from different perspectives and enhancing networking and diversity. Especially, the methodological development is focused to serve management of innovation networks, where tight time frames, restricted resources and parallel processes call for rather light-weight and easily implementable methodologies. Each essay describes also a real-life case. The relevance of these methodological approaches is thus reflected not only from related literature, but also how they were suited for support the priority setting process in the particular contexts.

The rest of this summary article is organized as follows…

2. Background and contributions

2.1. Technological change and Innovation process

One of the main rationales of applying foresight methodologies is a need for anticipating, fostering and responding to technological change ( ). In a narrow sense,
technological change can be seen as a development of a technology. In a wider sense, technological change can be seen as complex chains of technological developments and product and process innovations, of which interrelations and dependencies act a major role.

In this thesis, technological change is understood in this wider sense, that also many other academics and practitioners see more sufficient approach. Moreover, the focus is not just in technological development but innovation process that includes also system, where technology is embedded and dynamics, how technologies interact with the surrounding innovation environment (Hekkert et al., 2007). Thus, this approach includes, not just changing technologies and their interrelations, but also their interactions with the changing society, public governance and consumers attitudes, among others.

2.2. Innovation networks

The related literature characterizes innovation process in context of different kinds of entities. For example Innovation system is a very common concept used for characterizing the environment of the innovation process. Instead of just actors and actions that are straightforwardly linked to S&T development, this approach puts technological development to a very wide context – many times, for example, innovation system refers to national level or regional level and much emphasis is laid on technologies’ interactions with the surrounding society at large. S&T collaboration also can be considered in context of, for example, value chain that characterizes the interactions purely as linear supplier-customer relationships – in this approach, no emphasis is laid on the horizontal interactions of technologies and the system they are embedded.

These concepts do not capture the nature of the innovation process and collaboration in all the relevant levels. Often, innovations are developed, for example, in industrial clusters and/or research communities of which focus is only part of the innovation system; they approach the innovation process from the perspective of certain kind of expertise and/or markets. On the other hand, neither vertical model of value chain is sufficient to conceptualize this kind of collaboration - it does not capture the elements of horizontal coordination of S&T activities and their interactions with the changing innovation system.

In this thesis, the focus is in innovation networks that include, among others, research communities and industrial clusters. This concept covers technological development and interactions in context of not only production chain, but also governmental bodies and users, but restricts it to organizations and actors that proactively contribute to the technological development. Thus, in this thesis, when referring innovation process, we
particularly refer to technological development that is embedded to innovation network and dynamics, how technologies interact with the surrounding innovation network.

2.3 Functions of participatory foresight in innovation networks

In general, participatory foresight can be seen as a tool for contributing to innovation process and it can be applied in many levels of innovation system (Edquist, 1997; Martin and Johnson, 1999). The focus can be in the international (e.g. Georghiou, 2001; Jewell, 2003; Carlsson, 2006) or national (e.g. Lundvall, 1992; Durand, 2003; Havas, 2003; Keenan, 2003;) innovation system, in an innovation network (e.g. Salo and Salmenkaita), in a value chain (e.g. Könnölä et al 2009) or in a single organization (e.g. Reger 2001). Depending on the context where foresight is applied, it can serve the needs for producing relevant information on decision making, building a common vision and engaging society for the debate on S&T opportunities, and enhancing learning and knowledge transfer, among others (Martin and Johnson, 1999; Barré, 2002). In single organizations the focus is often in straightforward support of forward-looking decision making and development of new knowledge (Reger, 2001). In the level of national or international innovation system, on the contrary, more emphasis is often placed on the comprehensive engagement of stakeholders from different sectors of the society and identification of alternative developments and futures (Georghiou and Keenan 2006).

In innovation networks, foresight can be seen as a tool for managing innovation process - coordinating S&T activities and responding to the rapidly changing technologies and societies. In more detailed foresight can have at least two kinds of functions; i) supporting the decision making related the innovation process, especially thematic R&D priority setting ii) contributing to the capacities of the network in a structural level.

2.3.1 Supporting forward-looking priority setting

Priority setting is one of the most common approaches for managing innovation process in innovation networks. Within priority setting, role of foresight is often to identify trends and developments, elicit prospective ideas on process and product innovations, and foster debate on their interrelations among participating stakeholders.

Foresight can assist priority setting driven by both, internal and external pressures:

- **Function 1.1 Integration of S&T opportunities with changing society and economy:** Priority setting activities can explicitly aim to respond to external pressures such as societal, environmental and economical changes in the broader innovation system. In this context, foresight can assist decision making by producing information on societal, economical trends, developments, threat
and challenges, and offering a framework for analyzing S&T actions in view of alternative futures.

- **Function 1.2 External coordination of S&T actions:** Priority setting activities can also be driven by internal pressures of identifying mutual synergies, avoiding overlapping, coordinating S&T actions to form coherent entities that are needed for developing and commercializing innovations. In this context, foresight can be used for systematic mapping and analysis of present and future S&T activities, identifying mutual synergies and searching for potential for leveraging the present expertise in new markets.

In both of these cases, early engagement of key stakeholders and development of understanding on shared goals, may also make it easier to implement the decided actions and coordinate the S&T activities along the established priorities.

### 2.3.2 Contributing to capacities of an innovation network in a structural level

Besides supporting decision making, one rationale of foresight is to contribute to innovation networks also in a structural level. By offering framework for experts and other stakeholders to debate on new S&T opportunities, new ideas and their relation to the changing society, foresight can be used for support i) creating and transferring new knowledge and opening new perspectives to the S&T opportunities and challenges and ii) building a consensual vision and deepening the collaboration among experts and related stakeholders. More detailed, in a structural level, foresight can be used for:

- **Function 2.1 Building a consensual vision:** One benefit in engagement of experts and other stakeholders for foresight and priority setting activities is that it may increase their commitment on the decisions following the foresight process. However, discussions on alternative futures and collaborative analysis of S&T opportunities and challenges are also useful in increasing understanding and building consensual vision – not only in view of taken decision – but in more general level. This, again, may be beneficial in synchronizing strategies and joint actions in network also beyond the foresight scope.

- **Function 2.2 Creating new networks and strengthening the existing ones:** One of the basic characteristics of innovation networks is that composition of actors and stakeholders involved to the innovation process evolves over time. Along the technological development, dependencies of existing actors and stakeholders changes and from time to time, there might be also need for engaging new actors to the innovation process. Sometimes, there might be also need for more systemic changes; for example in context of EU policies, integrating national innovation networks together have been seen useful approach for increasing the competiveness of EU countries in the globalizing world. In these kinds of contexts, by offering a structured framework for experts to debate on S&T
challenges and opportunities, foresight can be seen a reactive tool for assisting innovation networks shape their composition along the technological development and changing society. On the other hand, foresight can also be seen as proactive tool for engaging new stakeholders to innovation process and facilitating the integration of different innovation networks together.

- **Function 2.3** Fostering the consideration of innovation process from several perspectives: Within priority setting, foresight can explicitly support the consideration of alternative S&T activities from several perspectives, and thus support the decision makers to develop priorities that better response to multi-faceted future challenges and opportunities (Martin and Irvine, 1989). However, consideration of alternative trends and drivers, and prospective ideas on innovations from different perspectives can be seen as a learning process for evolved stakeholders (Cohen and Levinthal, 1989) that again, may be critical factor for the network’s, and it’s organizations capacity to develop new ideas and innovations (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998).

- **Function 2.4** Feeding the innovation network with new ideas of innovations: Successful innovation process does not require always totally new information and skills – on the contrary, often innovations are the result of combining existing knowledge in a new way. Thus, by bringing researchers, industrialist, government officials and customers together and enabling structured framework for consideration of how new kinds of combinations of existing and new knowledge and changing innovation system, foresight can be beneficial also in developing new ideas and innovations.

2.4 Contributions of the thesis

This thesis develops new methods for participatory foresight for innovation networks. The methodological development described in the context of six case studies constitutes a coherent methodology that can be used in different foresight and priority setting activities. Especially, the methodology enables managers of the foresight activities to balance different objectives derived from the rationales described above (see also Rip 2003, Rask 2008). Based on objectives placed on foresight process, it can be adapted to mainly support priority setting, such as in papers [II] and [III] but if needed, it also enables managers of the process to put more emphasis on, for example, identification of new networks, such as in paper [IV] and consideration of innovation process from several perspectives, such as in papers [I] and [VI].

The methodology developed in this paper gives some responses to the identified difficulties to make trade-offs between different foresight objectives, especially between objectives related to decision making (functions 1.1 and 1.2) and contributing to capacity of innovation network in a structural level (functions 2.1, 2.2, 2.3 and 2.4) (e.g.
For example in paper [V], methodology enables both – consensual vision building among involved S&T experts (Function 2.1) and supporting decision making on S&T priorities (Function 1.1); in paper [I] and [VI], methodological choices enables – at the same time - efficient coordination of S&T actions (Function 1.2), engagement of new experts to the innovation process (Function 2.2) fostering the consideration of innovation process from several perspectives (Function 2.3) and feeding innovation process with new ideas (Function 2.4)

The methodology is developed for supporting the management of foresight activities under tight time-frames and parallel processes (see also Salo 2001, Azzonea and Manzini 2007). If needed, the methodology enables the implementation of foresight within few weeks, such as in paper [II], but if more time can be reserved for activities, it can be also longer processes, that engage wide range of stakeholders from different scientific and/or geographical area, such as in papers [III], [IV] and [V]. Methodology allows managers of the foresight processes to embed the activities to the surrounding innovation environment (Salo and Salmenkaita, 2002, Salmenkaita and Salo, 2004); it enables the use of results from other processes as input, such as in papers [II], [VI], and it produces results, that can be easily adapted also for other activities, such in papers [II], [III], [IV] and [V].

Each paper presents a case study, where foresight has several functions. In all the papers the methodology is used for supporting priority setting – but alongside - it is used for contributing to capacity of innovation network also in a structural level. The below table summarizes the research setting, and their relation to foresight rationales described above.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Case study</th>
<th>Research topic</th>
<th>Function of foresight</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
<td>Collaborative development of innovation in Finnish Foresight Forum</td>
<td>• Develop a methodology for engaging wider group of stakeholders to panel work and feeding panel discussion with new ideas and week signals.</td>
<td>Primary 2.3 and 2.4 Secondary 1.2 and 2.2</td>
</tr>
</tbody>
</table>
| [2]   | Collaborative development of Finnish Strategic Research Agenda (SRA) | • Design a process for participatory development of national S&T priorities within very tight time frame.  
• Analyze what kinds of methodological choices are | Primary 1.2 Secondary 2.1, 2.2 and 2.3 |
<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Phases</th>
</tr>
</thead>
</table>
| [3] Collaborative Development of Joint Research agenda for international research program | 1. Design a process for participatory development of international research program.  
                                                                                                                                      | Primary 1.2     |
|                                                                      | 2. Analyze what kinds of methodological choices are needed for development of S&T priorities in international level.                                                                                          | Secondary 2.1, 2.2 and 2.3 |
| [4] Identification of expert networks in international research program | 1. Develop a methodology for identification of new research networks in context of S&T priority setting.                                                                                                   | Primary 1.2 and 2.2 |
                                                                                                                                      | Primary 1.1     |
|                                                                      | 2. Analyze trade-offs between different foresight objectives.                                                                                                                                                 | Secondary 2.1 and 2.3 |
                                                                                                                                      | Primary 1.2     |
|                                                                      | 2. Analyze the use of interactive decision support tool in support of decision making.                                                                                                                | Secondary 2.2 and 2.3 |

3. **Rigorous Methodological Choices vs. Adaptive process design**

The methodology developed in this thesis relies on combination of Internet surveys and face-to-face discussions and it consists of 4 generic phases:
1. Web-based solicitation of issues
2. Web-based evaluation and commenting
3. Multi-criteria analysis
4. Face-to-face workshops

The basic assumption behind the methodology is that web-based activities as such, are not adequate way of carrying out foresight and priority setting activities, but development of a coherent research agenda and constructive debate on future opportunities and challenges call also for face-to-face meetings (see also XXX and XXX). However, as a supporting element, Web-based activities were seen to possess several advantages (see also XXX and XXX).

Web-based activities enable engagement of larger number of stakeholders to the foresight process as it is cost-efficient for both, organizers of the foresight process and involved stakeholders. This was one of the important reasons for using Web-based-activities for example in process described in papers [III] and [IV], where large number of stakeholders and geographical distances made it too expensive to organize face-to-face workshops for all the relevant stakeholders. In case [VI], there was need for engaging stakeholders that may not have time to participate to series of workshops. Internet questionnaires may also be beneficial where foresight activities must be carried out in very tight time-frame, such as in the process described in paper [II]. Besides cost-efficiency, web-based participation may also have other benefits for the process; in process described in paper [I], Internet participation was used especially for avoiding ‘group thinking’ (see e.g. XXX) and broadening the scope of the panel work with new ideas of innovations and weak signals. In process described in paper [V], Internet surveys were used for engaging participants and orient them to panel work already before actual meetings.

Besides combination of Web-based and face-to-face activities, the methodology relies also on other, rather strict, methodological choices: i) Definition of “unit of analysis", ii) well-defined roles and responsibilities iii) use of multi-criteria analysis and iv) modular process design. On one hand, these choices made it possible to guide the foresight process desired direction. On the other hand, these choices made it possible to give space for rather free and multifaceted discussions in some parts of the process.

3.1 Strict definition of “unit of analysis”

The methodological choice made in all the described processes is the definition of unit of analysis that would act as a basic element of analysis and discussion throughout the process. In paper [I], foresight activities were built around identification of “innovation ideas” and in papers [II], [III], [IV] and [VI], where aim of the foresight activities was to assist decision making on S&T priorities, foresight participants identified and analyzed
“research themes” and “research issues”. In paper [V], that had a bit larger scope of analyzing some parts of Finnish innovation system, foresight activities focused on identifying “driving forces” and “focus areas of competences”.

Strict focus on pre-defined units made it possible to focus the process on desired direction. For example, in paper [III], participants where encouraged to suggest and analyze issues that may especially possess potential for EU-wide collaboration and in paper [I], participants were asked to suggest issues that are somehow new and innovative in the described context. The definition of “action-oriented” unit – such as research issues or innovation idea - helped also managers of the foresight process to guide the process towards concrete results that helped them to overcome the challenge of foresight results being too abstract for decision making (see Keenan 2003).

As these basic elements of analysis were defined beforehand, it allowed some space for freedom and creativity elsewhere. For example, there was no need for producing background research or defining strict focus what comes to the substance of the process. Participants of the process were allowed to suggest, analyze and discuss on any issues they saw important - and at the same time – the process stayed understandable and transparent for both for involved stakeholders and actors that use the foresight results.

3.2 Well-defined roles and responsibilities

Another methodological choice that is common for all the approaches described in the paper is rather strict definitions of roles and responsibilities for involved stakeholders. For example in paper [II], researchers, industrialists and decision makers had different roles; researchers suggesting research issues and evaluating them in view of novelty and tentative interest - industrialists evaluating relevance and suitability – some researchers and industrialist developing first results for supporting decision making – and decision makers making tentative allocation of funds.

Through these kind of choices, it was possible engage wide range of stakeholders to the process cost-efficiently (both in view of funds used for foresight process and effort that stakeholder have to dedicate to activities) as involved stakeholders only contributed to small part of the process – this also made the processes more transparent and understandable for foresight participants and stakeholders that use the foresight results. This also made it possible focus the foresight process to the desired direction - for example in paper [V] panels where particularly designed interdisciplinary - and design the foresight process to meet requirements such as geographical (papers [III] and [V]) and/or gender (paper [V]) balance.

3.3 Use of Multi-criteria analysis
One of the distinctive features of the methodology is the use of multi-criteria decision analysis (MCDA) in analyzing and communicating the results from surveys (see also XXX, XXX and XXX). MCDA was used for compiling shortlists of issues (i.e. ‘innovation ideas’ in paper [I], ‘research themes’ in papers [II] and [VI] and ‘research issues’ in paper [III] and [IV]) that, in view of Web-based evaluations, seem to be most interesting with regards to evaluation criteria. Thus, based on the analysis, discussion in face-to-face workshops could be focus on those issues that possess potential for further analysis and interesting debate.

The methodology uses Robust Portfolio Modelling (RPM; Liesiö et al 2007/2008) for analyzing the results. The use of this methodology has at least two advantages; i) instead of analyzing the what issues have highest scores in view of a certain criteria (for example most novel ones), the analysis highlights issues that get highest scores with regard to all the evaluation criteria (for example novelty, relevance and feasibility). Moreover, ii) instead of giving strict weights for criteria (e.g. novelty=30%, relevance=20% and feasibility=40%; see e.g. XXX and XXX), the analysis enables the use of incomplete information (XXX); preference information on weights can be elicited as incomplete rank-orderings (e.g. ‘Novelty is more important than Feasibility’, “Relevance is less important than Feasibility”; Salo and Punkka 2005). Thus, based on the objectives placed on the foresight process, the discussion can be focused on issues that best correspond the objectives of the process; for example in case study described in paper [III] analysis puts more emphasis to issues that receive high rankings in criteria “Suitability for International collaboration” and in paper [IV], most emphasis is placed on criteria “Networking”.

Besides focusing discussion on issues that receive highest rankings in view of evaluations, the RPM-analysis can be used for different purposes. In paper [I], two kinds analysis were presented in the workshops: i) consensual analysis that identifies issues receiving highest rankings) and ii) dissensual analysis, that identifies issues receiving, not only highest, but also most controversial rankings. The latter one was used for identifying issues that may include elements of weak signals. Thus, besides focusing the workshop discussion on issues that had been seen most important in view of evaluations, RPM-analysis was used for focusing the discussion on issues that may be surprising, somehow controversial and thus, worth of further consideration.

In paper [VI], workshop discussion was supported by Interactive decision support tool RPM-explorer© (Jalonen 2006) that enables workshop facilitator to change relative information on weights and illustrate how importance of issues changes along the changing emphasis on different criteria. Besides focusing the discussion on issues that are interesting from certain perspective (i.e. with certain weights), the RPM-analysis was used for screening and identifying issues that are important from different perspectives.
In paper [IV], RPM-framework is extended to identify potential research networks. The developed analysis identifies both, issues that receive high rankings with regard to evaluation different criteria, and researcher networks that could be built around these issues. Thus, besides focusing the discussion on issues receiving highest rankings, the discussion can be focused on issues that also possess potential for collaborative efforts and researcher networks that might be interested to carry out the research related to the identified issues.

Overall, RPM-analysis enables managers of the foresight process to focus the foresight process to meet the desired, multitude goals; besides priority setting, it can be used for supporting the identification of new ideas and weak signals, development of research networks and consideration of innovation process from several perspectives. In all the described processes, the analysis was used only as starting point for discussions and within the meetings, there was also room for discussion on issues that were not highlighted in the analysis and also totally new ideas.

3.4 Modular process design

The methodology relies on four basic modules described above and in all the case studies, foresight activities were carried out in different sectors in parallel through these similar modules (i.e. activities were divided to for example research areas or panels).

Modularity gives some response to challenge of balancing needs of ‘centralized’ and ‘autonomous’ management of different parts of the foresight process (Havas 2003). On one hand, using similar modules in all sectors made it easier to synthesize inputs from different sectors together. However, these modules gave also different sectors some freedom to use the given methodology adaptively. This was the case especially in papers [II] and [V], where each sector (i.e. ‘theme area’ in paper [II] and ‘panel’ in paper [V]) had dedicated chair responsible for the foresight work in particular sector; some chairs based the workshop discussion mainly on web-surveys and analysis, but some chairs used them only as one starting point for discussion.

Another advantage of modularity is that it enables the use of the methodology in different contexts. For example in paper [I], where foresight activities aimed to produce new ideas, phase 2 was repeated twice; in the first evaluation round, participants gave verbal comments on innovation ideas which after they elaborated their own suggestions based on the comments, and only in the second evaluation round, participants gave numerical evaluations on innovation ideas. On the other hand, in paper [II], where most emphasis was put on supporting decision making within rather thigh schedules, there were no elaboration rounds. In paper [5], that aimed to analyze S&T opportunities especially against the changing innovation system, the whole procedure was repeated
twice; first round focused on analyzing changing innovation context and identifying “driving forces”, and second round focused on identifying S&T actions – i.e. “focus areas of competences” - that would best respond to changing context.

The modularity enables also iterative process design that makes it also possible to adapt the process to, not only different, but changing context and objectives. For example in paper [III], workshops were carried out in theme areas that were organized differently than web-surveys and evaluations – this was because managers of the process wanted to organize workshops of which participant base would be coherent enough to carry out goal-oriented discussions. In this similar process, due to limited time, analysis on possible research network (extension to module 4 introduced in paper [4]) was carried out only after the process. In paper [1], in order to get more “fresh” perspectives, the phases 1-3 were carried out to students in Helsinki University of Technology.

4. Discussion

Methodological choices’ relation to higher level objectives

- Tools for tune the scope of foresight
- Enabling efficient trade-off’s between foresight objectives

Comparison with other approaches

5. Conclusions and future research

Multi-layer approach

Multi-stakeholder approach