ELEMENTS IN THE CONSTRUCTION OF FUTURE-ORIENTATION: A SYSTEMS VIEW TO FORESIGHT

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Abstract

Foresight is currently perceived as a critical activity in the development of innovation policies and corporate strategies. While there are many descriptions of the benefits of foresight, there is little research on how these benefits are created. In addition, although the view about innovations has shifted towards a systems understanding, the same has not happened in foresight, which is largely seen as a process. The process view and focus on the outcomes has created a situation where the dynamics between agents involved in foresight is still not well understood. One emerging approach to improve the understanding of the dynamics of foresight, and to embed foresight more closely with innovation management and policy, is the systems view. In this paper, we build on the systems view of foresight, and study what are the elements in foresight as a system and how they contribute to the creation of futures knowledge. Based on literature we propose six elements that are useful for understanding a foresight system: agents, cognitive schemes, strategic objects, scaffolding structures, memory objects and embodied metaphors. We illustrate the elements and their interaction with a case example focused on creating future-orientation in a research and technology organisation. Based on the elements and the case study we argue that the strategic objects and scaffolding structures are important leverage points when steering the foresight as a system.

Keywords: Foresight system, complex adaptive systems, innovation systems, future-orientation

Introduction

Although foresight is often described as a systematic practice (e.g. Miles et al., 2008), it is rarely approached *as a system*. Instead, it is commonly defined either as a process (Martin, 1995; Horton, 1999; Becker, 2002), an ability (Slaughter, 1997) or a dynamic capability (Rohrbeck, 2011). In this regard foresight has not yet fully followed the development in innovation research, where the systems perspective has been influential (however, see Andersen and Andersen, 2014). It is perhaps because of this lack of a systems perspective that there is little understanding of *how* the contributions of foresight are created, although there are many lists of *what* the contributions are (see e.g. Irvine and Martin, 1984; Salo et al., 2004; Georghiou and Keenan, 2006; Rohrbeck and Schwarz, 2013). As a consequence, foresight is often treated as a one-off process, and it is seldom integrated into the innovation system, organisational practices,

or perceived as a continuous strategic practice. For example, a survey of Austrian firms found that less than 3% of the firms had integrated strategic foresight systems (König et al., 2014).

Recently, there have been efforts to bring insights from innovation systems thinking to foresight (Andersen and Andersen, 2014; Saritas, 2013). However, these efforts have not yet offered a crisp description of what the foresight system consists of and what are its key dynamics. In order to understand foresight as a system, there is a need to identify the system elements. This identification enables the analysis of the dynamics in the foresight system, which again opens a fresh perspective to unravel how the contributions of foresight are created. In this paper we build a systems perspective to foresight by studying what the elements of the foresight system are, and how these elements help at explaining the dynamics of futures knowledge creation (see Dufva and Ahlqvist, 2014).

We base our theoretical framework on literature on complex adaptive systems (e.g. Kaufmann, 1995; Stacey, 1996; Anderson, 1999) and innovation systems (e.g. Lundvall, 1992; Hekkert et al., 2007; Alkemade et al., 2007), but draw also on other fields such as knowledge management (e.g. Nonaka, 1994; Cacciatori, 2008; Håkanson, 2007), strategy (e.g. Mintzberg, 1987; Whittington, 1996; Heracleous and Jacobs, 2008) and foresight (e.g. Miles et al., 2008; Martin, 1995; Saritas, 2013; Fuller and Loogma, 2009). The complex adaptive systems literature builds an overall foundation of what a system is and how it functions. The innovation systems approach opens specific insights on how regulation, industrial interactions, and societal structures affect foresight practice. Thus, innovation systems approach functions as a context in which the complex adaptive system of foresight operates.

We illustrate the theoretical framework with a case study of a Foresight Network formed in a Finnish RTO (research and technology organisation), VTT Technical Research Centre of Finland. The case study aimed at widening the future-orientation in a RTO that already has quite established foresight competences though its specific foresight team. The case study analysis is based on three types of empirical materials: (1) researcher notes, (2) material created during the project that initiated the Foresight Network, and (3) feedback gathered during the case study project. While the case study is focused on the intra-organisational interactions, in our view the framework should be applicable also in inter-organisational network contexts. The case study RTO consists of several rather independent teams and departments, and the aim of the Foresight Network was to cross the intra-organisational boundaries. In this way the situation is, at least to certain degree, analogous to an inter-organisational context in the innovation system.

Methodological approach: Elements in building future-orientation

In our approach, we view foresight as a system embedded in the wider innovation system. We define *foresight system* as a transient ensemble of agents, set up to catalyse future-oriented insights, decisions and actions at a certain context. We propose six elements that help in understanding the system and its dynamics. However, it is worth pointing out that we are not advocating a reductionist viewpoint. We view the elements as analytical constructs, not ontological entities. They raise different aspects of the system and help us focus on different phenomena in the system. Also, our view is based on the principle of synergy: the whole system and its interactions are something more than just a straight sum of its separate elements. The elements are presented in table 1.

Table 1. Description of the elements in building future-orientation

Element	Description	References
Agents	Individuals or groups in the foresight system	Anderson, 1999
Cognitive scheme	A set of mental constructs about operational environment, the agents who populate it and its dynamics	Lane and Maxfield, 2005; Ericson, 2001
Strategic object	A deliberately constructed boundary object that acts as a focus point for the interaction of the agents	Ahlqvist et al., 2012
Scaffolding structure	A structure mediating the interaction between the agents	Lane and Maxfield, 2005
Memory object	An encapsulated crystallisation of the outcomes of foresight	Cacciatori, 2008
Embodied metaphor	A heuristic for thinking about complex issues through the use of a analogies, similes or images	Heracleous and Jacobs, 2008

The system consists of agents, who act according to their cognitive schemes. By *agent* we mean an individual, a group, an organisation or other entity that acts, in other words, that has agency in the context of the system (see Anderson, 1999; Lane and Maxfield, 2005). The *cognitive scheme* is a set of mental constructs, which include perceptions of who the other relevant agents in the system are, the attitudes towards the other agents and the foresight process, and an understanding of how the system can change and how foresight is contributing to that transformation (Lane and Maxfield, 2005; Ericson, 2001). In other words, the cognitive schemes represent the mental models the agents have of the environments in which they operate. These cognitive schemes are not static; they change and evolve in the interaction between agents (Ericson, 2001). Cognitive schemes cannot be directly changed, but they can be influenced by constructing focus points for the interaction. We call these focus points strategic objects.

A *strategic object* is "a boundary object that is deliberately constructed to form the basis of an epistemic community" (Ahlqvist, 2012, p. 4). The strategic object builds on Star and Griesemer's (1989) classic notion of "boundary object", but sets it more directly to the context of organisations and strategic management. Strategic object is an attractor around which different agents convene. It gathers agents together around a specific topic and, thus, brings this topic to the attention of the agents. It also acts as a signal of what is acceptable or preferable in the system. In this way it influences the cognitive schemes of the agents. While the strategic object is deliberately constructed, it may be interpreted in different ways by the agents, according to their cognitive schemes (cf. sensemaking, Weick, 1995). The interaction between the cognitive schemes and the strategic object thus goes both ways.

The interaction between agents is mediated by different *scaffolding structures* (Lane and Maxfield, 2005). Scaffolding structures have two functions. Firstly, they provide a place for sharing and challenging cognitive schemes. As agents interact, they constantly shape their cognitive schemes. Secondly, the scaffolding structures influence the interaction via their structure. The scaffolding structures might be oriented towards enabling search of new solutions, disseminating information, interpreting existing information or creating new knowledge. In other words they are characterised by both space and agency. They enable the creation of temporal weak ties (cf. Granovetter, 1973), relations between the agents that are specific to the foresight context. The increase in relations brings the system further from stability towards the "edge of chaos" where new knowledge can be created (Kaufmann, 1995; Stacey, 1996).

Knowledge is created in the interaction between the agents (on knowledge construction in foresight, see Dufva and Ahlqvist, 2014). It is an emergent property of the system. This

knowledge could be, for example, new perceptions or ideas about the future or alternative narratives about future developments. The tangible outcomes of foresight include forecasts, descriptions of future possibilities, different perceptions of the future, and an understanding of the consequences of actions (Eerola and Miles, 2011). Additionally, it has been argued that foresight builds up towards an ability to adopt alternative perspectives (Rohrbeck and Schwarz, 2013) and broadens the context to give a wider picture of the issue under scrutiny (Halonen et al., 2010). Therefore we do not consider the knowledge only as tangible outcomes, but also as ideas that foster the building of new capabilities.

A common division of knowledge is between tacit knowledge (the professional competence of an individual) and explicit knowledge (knowledge articulated in some form by an individual or a group) (Polanyi, 1997; Nonaka and Takeuchi, 1995; Karlsen and Karlsen, 2007). Following this division we consider two ways by which knowledge is captured in the system: memory objects (Cacciatori, 2008) and embodied metaphors (Heracleous and Jacobs, 2008). The memory objects relate to the tangible outcomes of the process, while the embodied metaphors refer to the learning and sensemaking process as such.

Memory objects are encapsulated crystallisations of the outcomes of the foresight process. They are tangible presentations of knowledge or practice. They can be explicit knowledge about the alternative futures for example in the form of scenarios or roadmaps, or, alternatively, they can be depictions or templates for a successful foresight practice. A key issue is that a memory object is easily transferable across projects. Memory objects thus enable the outcomes of one project to be used as the inputs in another project. Also, memory objects enable the circulation of good practices or novel methods across different foresight projects. What is required in both the transfer of explicit knowledge and good practices is that they are codified and encapsulated. This means that they need to use commonly used codes, and be packaged as coherent and identifiable entities (cf. Håkanson, 2007).

Embodied metaphors, on the other hand, offer a heuristic for thinking about complex issues through the use of metaphors. Like memory objects, embodied metaphors can represent knowledge about the futures or foresight practices. For example, a scenario can be presented as “the blossoming garden” or “a desolate wasteland” and a foresight practice can be described as “navigating the wild seas”. Understanding the embodied metaphor requires knowledge of the context in which it was created and on the contexts to which it relates to. Embodied metaphors are crystallisations from the discussions and other interactions between agents. While memory objects can be transferred without the direct involvement of knowledge provider, embodied metaphors cannot be transferred indirectly.

The elements we describe here help to analyse the foresight system, but what is more important is the interaction between the elements (figure 1). Knowledge encapsulated in memory objects or embodied as metaphors influence the cognitive schemes of the agents by challenging existing mental models or providing new ones. The cognitive schemes in turn have an effect on how the agents interact, since they describe how the agents in the system perceive their environment. The quality of the interaction is also an important factor: as new knowledge is created through the interaction between agents it makes a difference who interacts with whom and how this interaction affects the knowledge creation process. This continuous systemic interaction can be presented as a cycle between the capabilities of an agent (represented by the cognitive schemes), the relations between agents (represented by the scaffolding structures and strategic objects) and the knowledge created (represented by the embodied metaphors and memory objects.

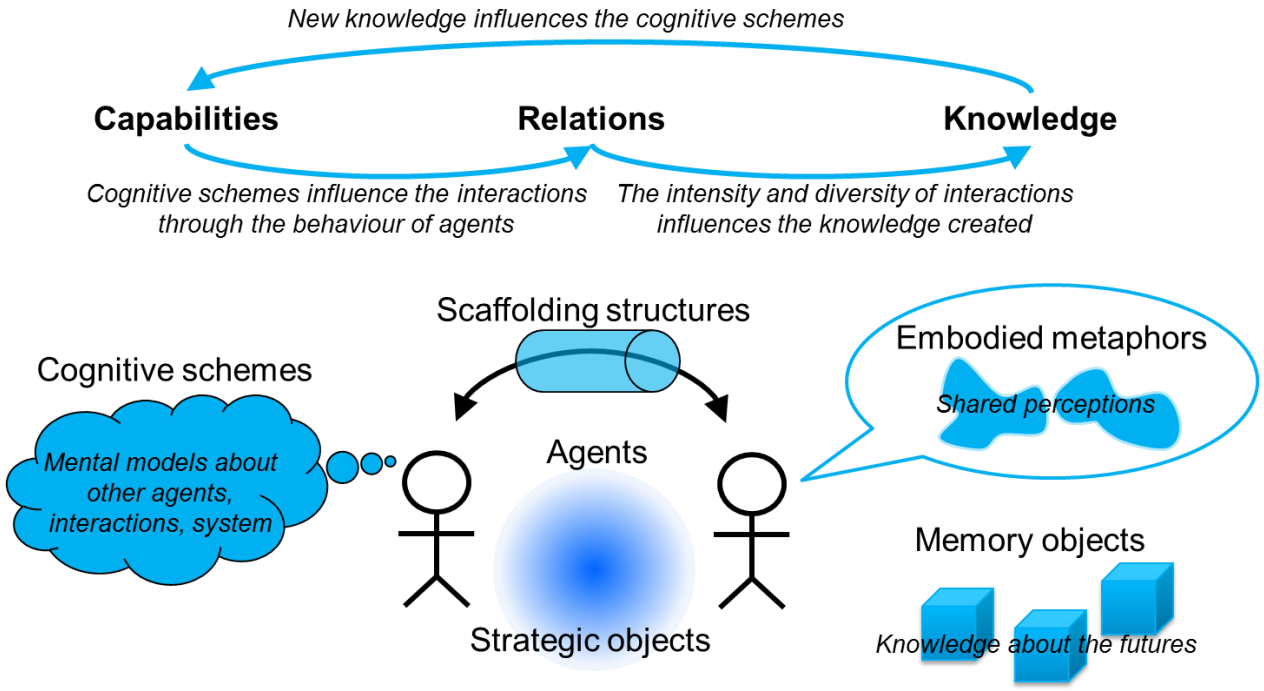

Figure 1. Schematic of the foresight system and its elements

The interaction between agents creates emergent phenomena in the system. Examples include the emergence of new knowledge, shared perceptions and the shaping of the dominant logic. New knowledge could be captured in the memory objects, shared perceptions could be crystallised in embodied metaphors, and dominant logic reflected in the cognitive schemes. In our view they differ from the elements in that they are the outcomes of the interactions in the system. Of course, in a system it is hard to delineate what is the cause and what is the effect, as things are interconnected. Therefore, our distinction between the system elements and emergent phenomena should not be taken as a statement about the ontology of the system, but as a pragmatic guideline to help the analysis. In the next section we will illustrate how the elements of the foresight system can be used in the context of a case study.

Case study: System elements in the foresight network project at VTT Technical Research Centre of Finland

Our case study is a project aiming to create a foresight network in a Finnish RTO VTT Technical Research Centre of Finland. The project started in January 2012 and ended in December 2013. It included a foresight training program held in spring 2013 for members of the organisation interested in foresight, four workshops aimed at solving a foresight related problem of a project (called “foresight case clinics”), an annual foresight seminar, other networking activities and the creation of online platform and knowledge repository.

The project mobilised agents across the organisation (figure 2.). The actual foresight team in the organisation formed the core of the project, and was responsible for coordinating the activities. During the project a foresight network was formed out of experts (for example, younger and more senior scientists and experts in business support division) of the organisation practising foresight and interested in learning more about foresight methods and practices. The network gathered 200 persons, which is about 7% of all the employees of the organisation. The project

also created relations to the foresight practitioners in other research institutes and aimed to increase the use and understanding of foresight also beyond the organisational foresight network.

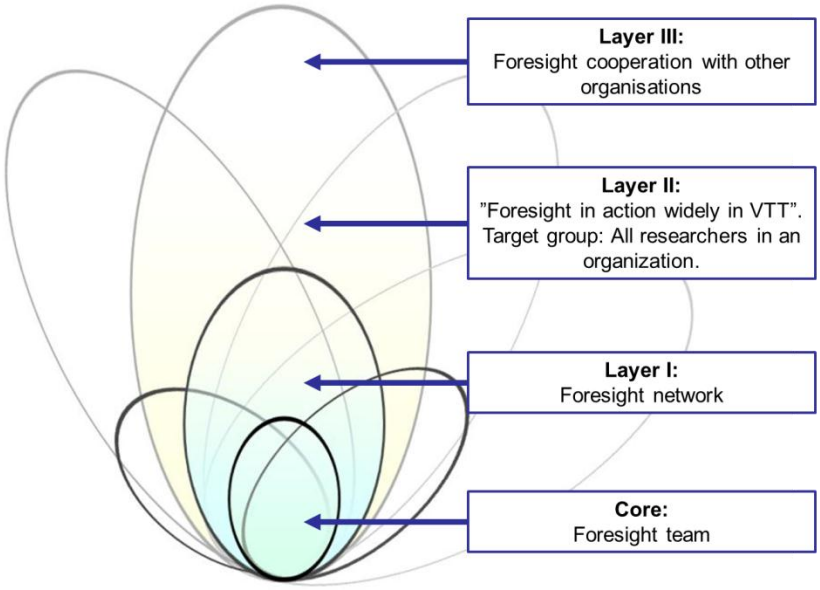

Figure 2. The onion model of agents in the foresight network project.

We have no systematic data on the cognitive schemes of the agents at the start or end of the project, and thus we cannot analyse how the cognitive schemes might have changed during the project. However, during the training and case clinics, as well as in other interaction between the foresight team and other experts in the organisation, two differing views became apparent. First, the participants of the training and case clinics were curious and sceptical as to how the foresight team can "know the future". This shows, to put it bluntly, that commonly held misconception about foresight and futures studies as "hazy crystal ball gazing" exists in one form or the other also in the expert organisation with highly advanced R&D capabilities, and it also reflects a situation in which the systemic functions of foresight in the organisation are not clearly explicated and communicated. The experts in the foresight team, on the other hand, did not see that they had ever espoused such a conception of foresight, but instead had communicated a view of foresight more as a critical component of organisational strategic practice that seeks to catalyse futures imagination through exploring alternative futures in different contexts together with technology experts. Thus, the foresight team had not claimed to have the "right answers", but instead the experts in the foresight team saw themselves as accelerators of thinking about future alternatives and pathways. Therefore, as can be seen, the first step in setting up the foresight network was to stitch up this surprisingly widely shared gap in the organisational culture that defined technology expertise in engineering fashion as something that has "clear boundaries" and "exact foundation", and foresight as more vague form of "knowing the future" instead of perceiving foresight as a critical part of organisation's strategic thinking and practice.

In contrast, the expectation from the foresight team was that the other experts in the organisation would adopt the same understanding and aims about foresight as the foresight experts had, while the other experts were keener on seeing how to apply foresight in their own work, and were not that interested in the dimensions of foresight as such. There were thus

different positions and attitudes in the organisation towards foresight that were consequently taken into account by considering the motivations from the individual, project and organisational viewpoints (see Dufva et al., 2013). However, despite the differing positions the feedback gathered from the training and other activities in the foresight networks was very positive, including also a positive attitude towards foresight in general.

From the system perspective of this paper, the foresight network can be perceived as a strategic object. It was the key locus for creating a more embedded understanding of foresight in the organisation, and it provided both a network space, and in the works a physical space, for enhancing the future-orientation of the organisation. The foresight network was deliberately constructed and proposed as an internal project because of the need to create a joint organisational understanding of foresight as strategic futures knowledge, and also to gather the foresight experience of the organisation under the same conceptual "umbrella". While the project was not directly connected to the strategy making of the organisation, during the realisation of the foresight network project, a new VTT-level strategy was published which raised foresight and innovation policy among the key strategic perspectives in the organisation; a position that remarked a quite drastic change to the preceding organisational strategy.

There were four scaffolding structures that mediated the interactions between the agents in the foresight network: foresight training, case clinics, annual seminars and the online platform. The foresight training was focused on increasing the foresight capabilities of the organisation and creating a common understanding of what foresight means among the network participants. It provided a structure for exchange of ideas and questions about foresight. It also enabled experts to discuss how foresight practices could be connected to the day-to-day work in the organisation. In other words, the foresight training was a forum for channelling and shaping the foresight culture of the organisation.

While the training dealt with the day to day work of the organisation via concrete examples and case exercises, the foresight case clinic was designed to embed foresight into the knowledge producing practices of the organisation. All the realised case clinics were connected to on-going projects in the organisation, but they also aimed at creating new concepts that would be applicable in other projects and thus enhance the participants' capabilities to use foresight in other project settings. Although the results of the foresight case clinics were made available to the whole network, the clinics reached a smaller number of experts in the organisation than the training.

The training and case clinics were scaffolding structures for mediating interactions inside the organisation. The annual free and open foresight seminar, organised by VTT's foresight team in co-operation with organisations communication division, is an example of a scaffolding structure to engage agents outside of the organisation. While this tradition started a year before the foresight network project, it was aligned with the project and the network was used in the planning and dissemination of the seminar. This tradition has also continued: the annual seminar has been organised after the actual foresight network project in 2014.

The online platform is another scaffolding structure providing continuity after the actual project. It is mainly used as a repository of the material produced and gathered during the project. The online platform also includes a mailing list for the foresight network, providing a targeted channel for discussion on foresight issues. While the online platform and mailing list were mostly used as one-way communication, they also have a role as "tangible" outcomes of the foresight network and artefacts showing its continuing existence. In contrast, although the training and the case clinics received excellent feedback, they are, as such, not continued as internal foresight activities due to scarcity of resources in the organisation. They are a good example of scaffolding structures that are temporary and project specific. However, many of the principles of

case clinics will continue, for example, in the workshops in other projects, and realised also with external expert partners and customers.

While the training and case clinic were not continued as internal activities, they produced material and concepts that were encapsulated as memory objects and will also be used in subsequent projects, as noted above. The foresight training produced an easily accessible learning material on foresight and templates and tools for group work on scenarios, roadmapping and trend analysis. These have been used in various projects and are part of the "foresight artefacts" of the organisation. The case concept was further developed to be a quick, low-risk and easily implementable service for SMEs interested in exploring the future. Thus the outcomes of the foresight network project have been directly utilised in other processes.

The foresight network process also produced embodied metaphors. A central metaphor is the onion model (figure 2) which helps to position also the current foresight activities in the organisation. The foresight network acts as a bridge between the futures professionals in the VTT's foresight team and the rest of the experts in the organisation (cf. Hines, 2003). Another source of embodied metaphors was the foresight case clinic, although this was not the original intention. The target of the foresight case clinic was to produce concepts applicable generally in the organisation for solving a problem faced by one project. In other words, the case clinics aimed at producing memory objects about the solutions. Instead, the main empirical outcome of the foresight case clinics was embodied metaphors such as "positive envy points", "GMO theme parks" etc., which can invoke different views to the future, but are rather cryptic to someone who has not participated in their initial production process.

To summarize, the elements of the foresight system we characterised in this paper helped us to analyse the case study and pointed out to different contributions of the foresight network project. A summary of the elements in the case study and main implications from them is given in table 2. The agents and the strategic object gave insights into how foresight network was organised, while the scaffolding structures showed the channels of interaction created by the project. The cognitive schemes and embodied metaphors gave insights towards the attitudes and cultures of foresight practice. The memory objects represented the "tangible" outcomes of the project and demonstrated how the project was connected to subsequent projects.

Table 2. Elements in the foresight network project

Element	**Examples in the case study**	**Implication**
Agents	Foresight team, foresight network, other experts in the organisation, external foresight practitioners	A layered approach for organising foresight; crosses intra-organisational boundaries (e.g. divisions, research areas, teams)
Cognitive schemes	Attitudes towards foresight, the basic understanding of foresight	Different attitudes were discussed and iterated
Strategic object	The foresight network	Offered a space to develop organisational foresight practices
Scaffolding structures	Foresight training, case clinics, seminars and online platform	Some structures were active only during the project, while some continue to exist
Memory objects	Training material, case clinic concept	Memory objects were used in subsequent projects
Embodied metaphors	The onion model, case clinic results	Some concepts or results are difficult to scale up from the project level towards the organisational level without knowing their production process

Conclusions

We analysed the foresight network project from the viewpoint of foresight as a system. The theoretical contribution formed a systems perspective to a foresight process, and identified a set of elements, like strategic objects, cognitive schemes, and scaffolding structures, that are relevant in this perspective. The systems perspective to foresight enables one to identify key aspects in the foresight, and to emphasise the importance of boundary crossing expert interaction in the construction of organisational future-orientation. The elements and the case example enhance the understanding of what the foresight system is, and what are its key components and dynamics. Our paper thus contributes to the systems understanding that is currently emerging in foresight (Andersen and Andersen, 2014; Saritas, 2013; Amanatidou and Guy, 2008).

The dynamic between agents and strategic objects crystallises the foresight capabilities of the organisation: the agents bring in the individual capabilities while the strategic object represents the locus of the community of foresight practitioners in the organisation. The cognitive schemes complement this dynamic by directing the attention to the mental models, attitudes and perceptions of foresight shared by organisational experts. When combined, these elements open up a strategic window to interpret the quality of foresight culture in the organisation (see Ahlqvist et al., 2012).

In addition to capability enhancement, the key contributions of foresight practice and exercises include networking and the creation of new knowledge. In our model, the scaffolding structures help in identifying and distinguishing between different channels of interaction, and thus analysing the social relations that are behind the futures knowledge creation (see also Dufva and Ahlqvist, 2014). The memory objects and embodied metaphors are examples of two types of knowledge: the explicit and tacit, respectively.

Although our case study was on the organisational level, we argue that the elements presented in this paper could also be useful on the level of innovation systems. The elements in our model are based on theoretical concepts derived from the literature which is not restricted only to the organisational level. Furthermore, the notion of foresight system is well aligned with the systems understanding of innovation. The foresight system and the elements can thus contribute on both levels of analysis: the organisation and innovation system.

For innovation management, the elements of foresight systems offer a framework by which to identify key leverage points in foresight exercises. While a complex adaptive system, such as the foresight system, cannot be directly managed as such, it can be influenced, channelled and steered through the scaffolding structures and strategic objects. Strategic objects can be used to assemble agents together by a future-oriented theme. It can also be used to channel and stimulate the futures imagination of the agents. The scaffolding structures can be used to influence the nature of the interaction. Together they offer the context in which agent interaction and, thus, the knowledge creation takes place. Therefore, the elements can perceived as leverage points through which policies or strategic actions can stir a virtuous cycle of agent interaction, knowledge creation and capability enhancement (cf. figure 1.)

To conclude, the elements of a foresight system identified in this paper offer a starting point for further developing a systems understanding of foresight. We also see that our contribution could prove useful for understanding the complex knowledge creation processes in foresight and thus could help in planning foresight processes that have right scope, magnitude, and duration for different organisational contexts.

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