Supporting Strategic Innovativeness: Scenario Planning for Driving Organizational Knowledge Sharing

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Abstract

Knowledge and knowledge sharing are an important facet of innovative activities. This paper aims to investigate knowledge creation in innovation context and presents the construct of using the supported scenario process as a venue of facilitating knowledge creation in innovation related activities. The process is outlined and tested empirically to investigate whether scenarios offer help in facilitating innovation through knowledge sharing and creation. The testing suggests that the supported scenario process has properties which support knowledge sharing.

1. Introduction

Today knowledge is more than ever the most critical resource of organizations and the impelling force of individuals, and its creation and use are closely tied to action – individual or organizational. As organizations have become larger and more diversified, and as individual roles and tasks have become more specialized, there is a growing need to convert personal knowledge to common usage. Consequently, the convergence of personal and organizational knowledge has become a significant and justified area of research. Articulation [28], [15], interpretation [36], codification and personalization [16], etc. are examples of processes by which personal knowledge is transferred from one individual to another.

Innovativeness, an organization's ability to initiate and implement innovations, is a critical resource for long-term organizational survival. Innovation as a type of knowledge has been raised to the podium in recent discussions as a source of competitive advantage [44]. Every innovation requires exploration of new knowledge, as well as exploitation of existing knowledge, personal as well as organizational and there is an ongoing search for competitive advantage through innovation at the national, regional and organizational levels. This has led to a quest for a way to enhance creativity and knowledge convergence from personal to organizational use in the innovation process.

Scenario planning is a means to stimulate the innovation process, knowledge creation and sharing. In essence, scenario planning is a way of balancing goal-oriented planning and intuition at individual and organizational levels. In scenario planning, the main focus is the process involved in the planning and the challenges it presents to managing knowledge during the process. In a successful scenario process the principal concerns, in knowledge management terms, are extracting knowledge from individuals and diffusing it between the people in the organization. In this paper the aim is to answers the question: How can scenario planning be supported effectively to drive knowledge convergence during the innovation process? A special arrangement is proposed; an artificial context that supports and stimulates the knowledge conversion process. Methodologically, this study follows the principles of case studies, and aims at analytic generalization after Yin [45] for the results.

Information and communication technology (ICT) offers many instruments for knowledge management and thus for the stimulation of the innovation process [33], [5]. Although the means to share information, communicate and express ideas have broadened drastically during the last decades, a lot of relevant knowledge in an organizational context remains unmined, unshared, and underutilized. The focus and contribution of this paper is first to provide a theoretical basis for a support system and, second, to develop a concrete system that supports and stimulates the conversion of personal knowledge to new innovations and organizational decisions. The developed system forms a set of artificial conditions to quasi-exercise organizational skills and capabilities. A system is proposed consisting of Group Support Systems, different mapping techniques, and cluster analysis to increase the

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communication between individuals and trust to the outcomes of the scenario process.

The initial validity of the developed system is evaluated empirically by experiments with two real cases. Based on the conceptual discussion, an actual environment is demonstrated where the creation of new knowledge can be stimulated and managed, and personal knowledge can be converted into organizational decisions. It is shown how even hidden, tacit aspects of individual knowledge can be externalized into an explicit form and generalized for organizational use. The large amount of new and innovative knowledge created is a potential proof of the value of the proposed approach.

2. Conceptual background

The paper will next define knowledge and the challenges regarding knowledge sharing and creativity in the innovation context. With these premises, the main argument is that the scenario process can be seen as a venue for knowledge creation and creativity in the process of innovation. In support of this argument, the paper presents a tested scenario-based approach for integrating diverse knowledge resources in the context of the process of innovation. The empirical investigation is based on two cases, which illustrate the process and form the base for the evaluation of the argument.

2.1 Knowledge and knowing

Knowledge is traditionally interpreted as a singular, independent object. Another, procedural interpretation of knowledge is to see it as a path consisting of related steps [4]. A further wider interpretation is seeing knowledge as a network or a system where each element is related directly or indirectly to each other. This latter definition leads to the conclusion that no totally new knowledge can be created; only the attributes of the knowledge system can be changed, or new relations between the elements created.

When defining knowledge, Tsoukas and Vladimirouv [39] relate knowledge to a person's ability to draw distinctions: "Knowledge is the individual ability to draw distinctions, within a collective domain of action, based on an appreciation of context or theory, or both. (p. 979)" According to this definition, a person is more knowledgeable if she/he can draw finer distinctions. Making distinctions and judgements, classifying, structuring, placing order on to chaos, are capabilities of an expert who has knowledge.

If decision-making is not a synonym for management, as Simon [34] has argued, decision-making undoubtedly at the core of all managerial functions. When a decision is made, the epistemic work has been done and the physical work to implement the decision can start. Kivijärvi [19] has elaborated the above characterization of knowledge further and defines knowledge as the individual or organizational ability to make decisions. All actions are consequences of decisions. The value of knowledge and information is ultimately evaluated by the quality of the decisions made. Making decisions involves also making distinctions, categorizations and judgments – we need to search for and structure alternatives. According to Emery [11], information has value only if it changes our view of the world, if our decisions are sensitive to such a change, and if our utility is sensitive to the difference in decisions.

When Polanyi talks of knowledge in his later works, especially when discussing tacit knowledge, he actually refers to a process rather than objects [29]. He summarizes knowledge as follows: "Knowledge is an activity which would be better described as a process of knowing. (p. 466)" [27]. Consequently, we should pay more attention, to the tacit *knowing* rather than tacit knowledge. Zeleny [46] characterizes the relationship of explicit and tacit knowledge much in the same way as Polanyi. He sees that although people may be quite knowledgeable, e.g., in industrial management, and even write books about the subject, [tacit] knowledge is embedded in the process of 'knowing', in the routines and actions that come naturally for a person who *knows* his way around things, so to speak, or in other words has knowledge of something.

Cook and Brown [6] emphasize that knowing is an important aspect of all actions and has its own epistemic content. It is that part of action that "does epistemic work". One of the propositions of Cook and Brown [6] is that "each form of knowledge can be used as an aid in acquiring the other (p. 385)" and they see "knowledge as a tool at the service of knowing (p. 388)". Thus, tacit knowledge most easily becomes evident when it is used, that is, it will manifest itself during the knowing process. Instead of using the concept of 'knowledge creation' Cook and Brown offer another concept, "generative dance", to describe the interactive process between knowledge and knowing.

To return to the conceptualization of knowing, the respective epistemic activity for knowing is decision making. Here, the concept of decision making is understood widely as including all the phases of information and knowledge gathering (intelligence and design [35]) – not just the choice phase.

2.2 Organizational knowledge and knowing

"Organizational knowledge is the set of collective understanding embedded in a firm (p. 981)" [39]. It is "the capability the members of an organization have developed to draw distinctions in the process of carrying out their work, in particular concrete contexts, by enacting sets of generalizations (propositional statements) whose application depends on historically evolved collective understandings and experiences (p. 983)" [39]. Similarly, as the definition of personal knowledge was extended, the above definition of organizational knowledge has been

extended as the capability the members of an organization have developed to make decisions in the process of carrying out their work in organizational contexts [19].

Organizational decision making (knowing) is an action between organizational knowledge and the members in an organization. A part of organizational knowledge remains tacit, unknown to the members of the organization. Everyone in the organization does not have or need all the knowledge available in the organization. A person only knows the domain of others' knowledge, not exactly what the others know or how one does something.

If organizational knowledge is understood as a system, its structure follows the organizational structure and is typically arranged hierarchically. For example, the knowledge needed to make a strategic investment decision in a manufacturing corporation is diversified all over the organization and collected during the strategy process: the board of directors knows best the strategic lines of the corporation, the financial department the financial possibilities, and finally the technical experts in production know the limits and possibilities of the technological alternatives. As such, an organization is more than an information system, it is a knowledge system.

2.3 Knowledge sharing and conversion

In the organizational context, personal (individual) knowledge and organizational knowledge are created, manipulated, transformed and used in decision making. Personal knowledge is used for personal decision making, whereas organizational knowledge is utilized in organization-wide decision making. Personal knowledge is always tied to personal action and personal valuation, while organizational knowledge is tied to organizational valuation. However one knowledge type cannot be directly converted to another type, it has to pass through the knowing process. The relevant literature offers a number of terms, means and concepts for conceptualizing the process, which are briefly discussed below.

Nonaka and Takeuchi [26] proposed and Nonaka and Toyama [25] revised the four modes of knowledge conversion (Socialization, Externalization, Combination, Internalization, SECI), and their knowledge spiral assumes that both types of knowledge are fully convertible to each other. They assume that tacit knowledge can be converted into explicit knowledge by "sequential use of metaphor, analogy, and model". In managerial studies this construct is widely accepted and has been elaborated further [8], [23].

Articulation is a process where a language is used in linguistic representation and operation of symbols. Language is understood widely to include "writing, mathematics, graphs and maps, diagrams and pictures" [28]. According to Håkanson [15], an articulation circle consists of three elements; skills, codes, and theory which interact in complex ways in the process converting tacit knowledge to an explicit code or language. According to him, "most forms of economically significant knowledge can be articulated and codified". Articulation is always an incomplete process, and some properties of the original knowledge are lost. The process also depends on the outcomes; if you know things better you are also more capable of articulating them.

Because "organizing implies generalizing" [40], *generalizing* is a conceptual device to transform individual knowledge to organizational knowledge. Generalizing in the organizational context necessitates norms, rules, goals and objectives.

A part of organizational knowledge can be effectively codified. *Codification* is an IT-centric strategy to manage knowledge and to transfer it over an organization. It is an opposite strategy to the *personalization* strategy [16]. By the codification strategy, "knowledge is extracted from the person who developed it, made independent of that person and reused for various purposes" [16]. This strategy is based on reuse-economics, investments in IT, and the transformation of knowledge from people to documents and computers. On some occasions, the difference between codified and computerized knowledge and information might be marginal.

Classification of knowledge is one of the core processes in knowledge conversion. It is a structuring process where order is placed onto chaos, splitting the complicated world into meaningful clusters. The capacity to draw and refine distinctions necessitates the capacity to make judgments [39] and decisions. Crude and unsophisticated classification methods lead to rough distinctions, reduced classifications and, further, to poor decisions.

Interpreting is a process where meaning is added to information or data. "Information is meaningless, but becomes meaningful knowledge when it is interpreted" [36]. However, the relationship between facts (information) and knowledge is twofold: knowledge is created by facts but the facts cannot be seen "without these facts being part of its current meaning structure" [41]. From the decision making and problem solving point of view, the difference is obvious: "Having knowledge implies that it can be exercised to solve a problem, whereas having information does not carry the same connotation." [42].

Knowledge grows from *sharing*. Knowledge transfer [36] between individuals is a process where knowledge is not divided but multiplied. Although knowledge sharing is a prerequisite for knowledge growth, sharing knowledge is like other businesses – valuable knowledge is not shared without compensation. Knowledge is power.

Disterer [9] discusses the barriers to sharing knowledge and divides them into individual and social barriers. The individual barriers include different types of fears: loss of power, revelation of the value of knowledge, uncertainty about the knowledge value, and lack of motivation toward

additional work. Social barriers encompass people-issues like: language problems, pressure to avoid conflicts, bureaucracy and organizational hierarchy questions, and incoherent organizational paradigms (strategies, visions, mission, values, etc.). Ford and Staples [12] found that people prefer to share knowledge they themselves perceive as valuable, relevant and unique, but mainly between people they trust.

Creating collective knowledge by mobilizing the knowledge of individuals is the key challenge to all organizational knowledge management, but especially to innovation management. The challenge is to build, combine and integrate the knowledge assets of many thousands of individuals.

A number of strategies have been proposed to convert personal knowledge to organizational usage. Each strategy has its own advantages and disadvantages. Knowledge conversion is the process where one form of knowledge is generated in the context of acting with the aid of another type of knowledge [6]. Thus, tacit knowledge cannot be directly converted to explicit or personal knowledge in general to organizational knowledge in isolation [6], [39]. However, when knowledge is used during action in a specific context, the content of knowledge is manifested and can be shared by another person or a group. In the following discussion 'knowledge conversion' or 'knowledge sharing' refer to this kind of epistemic action. In order to stimulate this kind of 'conversion' process appropriate context is propose, namely, the supported scenario process, where the items of individual knowledge can be integrated and used innovatively. The proposed system supports knowledge conversion and sharing by offering a context to do epistemic work and take a kind of quasi or simulated action.

2.4 Innovation and innovativeness

Innovation research has been largely concerned with the process of innovation, which was originally presented by Cooper [7], and developed by others. The research has focused on making the process more manageable and effective, and much of the research has been concerned with continuous incremental innovation, which admittedly is the most common case in practice. However, there is also a good body of research on capability driven or technology push innovation, which is also named as the aim of 4th or 5th generation innovation practices [24], [31].

For clarification, the difference between incremental innovation and discontinuous innovation is similar to the differences in strategic theory. Where the positioning school aims for correct positioning of the firm and the product [7], [30], the so-called 4th generation practices aim for more disruptive innovation, which is in fact aimed at disturbing the entrenched structures of a particular industry by leveraging the company's capabilities to create innovation that challenge the existing dominant design in the industry [24]. The heart of the 4th generation is to lean on the capabilities of the organization to create really new design instead of placing safe bets based on customer input.

The concept of capabilities is more or less loosely connected to innovativeness and technological prowess through the organizational structures and mental models, i.e. knowledge and knowing, required for innovation. Dynamic capabilities, a concept coined by Teece et al. [37], are defined as the capability to use and develop new competencies for sustained competitive advantage over rivaling firms, or in other terms "a learned pattern of collective activity [routines] through which the organization generates and modifies its operational routines [here also formal processes] in pursuit of improved effectiveness" [37], [10], [47]. Many writers have operationalized the concept of capabilities as organizational structures, conventions or routines [47], [21], and as these capabilities and the resulting competence are seen as the fundamental source of competitive advantage, they form the basis of innovative activity. The formal processes are built on top of these structures. Routines and processes are separated in this classification; routine is seen as a more informal and intuitive structure, the *gist* or 'the way we do things in this organization', and formal processes are formal statements that are a description of these structures, or aim to reform them. These two levels form the backend structure normally invisible to outsiders, whereas the services and products which are built on the capabilities and resources form the tip of the proverbial iceberg and large parts of the company's façade.

3. Supporting scenario process for creating innovative organizational knowledge

In its deepest sense knowledge is the capability to make decisions. Scenarios, as such, aim to increase that capability and are thus, a piece of organizational knowledge. On the other hand, knowledge is tied to action. Scenarios are a kind of 'quasi action' where knowledge items can be tested in relation to other items. Now, the question is how innovativeness, replication and combining of knowledge, and knowing in groups can be included in a process or processes in an organization in a way which promotes the achievement of organizational goals. Studies suggest that managers tend to be more vulnerable to cognitive biases in the face of an unstructured decision, especially if the decision carries high financial risk, and while processes and structural methods alleviate the problem, they require strict adherence and supervision [48]. This calls for support to enhance knowing, i.e. the quality of the decisions and decision making.

3.1 Scenarios

Starting from the very beginning, Kahn and Wiener [18] define scenarios as "Hypothetical sequences of events constructed for the purpose of focusing attention to causal processes and decision points" (p. 33), with the addition that the development of each situation is mapped step by step and the decision options of each actor are considered along the way. The aim is to answer the questions "What kind of chain of events leads to a certain event or state?" and "How can each actor influence the chain of events at each time?"

Schwartz [32] describes scenarios as plots that tie together the driving forces and key actors of the environment. In Schwartz' view the story gives a meaning to the events, and helps the strategists to see the trend behind seemingly unconnected events or developments. Some writers [32][2], use the concept of "drivers of change" to describe forces such as influential interest groups, nations, large organizations and trends, which shape the operational environment of organizations. The interpretation used in this study is that these drivers create movement in the operational field, which can be reduced to a chain of related events. These chains of events are in turn labeled as scenarios, leading from the present *status quo* to the defined end state during the time span of the respective scenarios.

3.2 The scenario process

One of the key questions in the scenario process is how to organize and transform available knowledge into logical and coherent scenarios, which are relevant to decision-makers of the organization.

The literature on scenario planning describes a multitude of techniques, methods and processes [3], from the intuitive approach [32], which largely relies on logical thinking in constructing scenarios to the statistical approach by Godet [13], which is built on modeling the environment and estimating the development on mathematical grounds. Heuristic methods form the intermediate by being more structured than intuitive approaches, but less so than statistical ones.

The process and method adopted in this study represent the intuitive-heuristic side of the scenario practice after Kahn and Schoemaker. However, despite obvious differences in the approaches, there are common elements across the field of scenario planning. These characteristic elements, which are used as the basis for the remainder of this study, are: 1) defining the problem, 2) analyzing the key elements, i.e. the drivers of change and uncertainties, 3) developing (preliminary) scenarios, 4) evaluating the results and making revisions, 5) creating the final scenarios, and 6) implementing the scenarios in decision making.

3.3 A support system

The most complex decisions in organizations, especially strategic decisions, are made by groups. Increasingly competitive environment also increases the complexity of decisions and the need for meetings and group work. Groups combine knowledge, create new knowledge and the members become committed to the implementation of the decisions [43]. To transfer tacit knowledge from individuals into organizational use, it is possible to apply some sort of group-based electronic discussion. *Group Support Systems* (GSS) are a potential set of methods that can be used to support scenario processes for knowledge creation. By definition, GSSs are a collection of applications, similar to groupware, aimed to facilitate group work and communication. Kwok and Khalifa [22], for example, claim that GSS enhances group learning through active participation and cooperative working practices. In scenario literature, it is sometimes claimed that one of the major benefits of the scenario process is the process itself, in the sense that it opens the decision makers up to consider the effects of change, also in ways that are not written down in the actual scenarios [1]. In this respect, it seems feasible that the GSS could add value to both the process and the final scenarios.

The scenario processes can be supported by a number of other methodologies. If the scenario process is considered as a learning experience, there might be room and demand for techniques enhancing knowledge representation. For some time now, there have been many suggestions, but rather limited research, about *maps* of different flavor. The most widely featured types of maps are the Mind Map, which has even been registered as a trademark, the concept map, the cognitive map and the causal map. The main differences between these variations are that a mind map pictures a central concept and the up-springing branches of related concepts, where the other maps can be used to describe multiple concepts with intertwining relationships and causalities.

The value of maps in general would be that with mapping techniques, relatively large volumes of complex data can be presented in an illustrative manner. For the scenario process, it can be proposed that, for example, the drivers and their relations can be formed into a map fairly easily, and perhaps the information value and usability of such a map would be higher than a written document of the same subject.

The multiphase scenario process includes phases where the participants are encouraged to articulate their beliefs, suppositions and information on the drivers of change, and the input is discussed and even partly personified. The GSS is responsible for codifying and diffusing the input and provides additional tools for the evaluation and classification of the knowledge. In the final scenarios the knowledge input is interpreted and generalized to the final scenarios. This means that in the light of the background,

the supported scenario process would seem to be a feasible way to integrate multidisciplinary groups to create new knowledge in the form of the scenarios, which could be used to promote *knowing* future opportunities and decision options. The properties of scenarios promote and even require open minded consideration of the plausible, instead of the known and probable as usual. This leads the participants to do epistemic work.

4. Experiences with the supported scenario process

The discussion above presented the premises for the argument that using the supported scenario process would facilitate sharing and creation of knowledge. This section comprises two cases to find support for the argument empirically. The cases both use the same supported process and facilities of a GSS decision room/laboratory.

The first case focuses on strategic planning and positioning of a university and the second case is from a research project where the objective was to develop measures to identify and assess business opportunities in an intersection of industries.

4.1 Process description

Case 1: University management. The case is based on two scenario sessions conducted in a medium-sized university, for details and an overview of the resulting scenarios, see Kivijärvi et al [20]. The participants of the sessions were research, teaching, and administrative staff from different departments and the administration of the university. The process followed the general steps described in section 3.2.

In the problem setting, a clear statement of the goal and scope helps to steer the process and keeps the discussions relevant. In the example, the objective was to map out the future position and operational environment of the university during the next ten years.

The actual work started by brainstorming the key external uncertainties and drivers of change. The phase comprised a defined period of time for idea generation with brainstorming or a similar tool, followed by a period for writing comments on the ideas and clarification of the proposed drivers. Unclear items were rephrased or explained by verbal comments and overlapping items were removed or merged. After the discussion, the drivers were prioritized by voting.

The drivers form the backbone of the scenarios for the university. The method proposed by Blanning and Reinig [2] was used to form the scenarios. The phase comprises brainstorming of events which will or could be triggered by the drivers. The resulting event sets were once again discussed and commented on, and overlapping events were merged or removed.

The point of the next phase is to develop a large set of events, which are derived from the drivers, say 50-100. The catch in this approach is that the group votes for (or otherwise assigns) a subjective probability and impact factor for each event. The original proposition is that the scenarios are formed by selecting three groups of 10-20 events, so that the most probable events form a realistic scenario, medium to high probability events with a positive impact form a positive scenario, and the events with medium to high probability and a negative impact form a negative scenario. In the present case, the scenarios were formed on the basis of the voting by grouping them graphically from the scatter plot, so that in the final stage of the workshop the results were subjected to discussion with the concern that the set was logical and coherent and that the events were grouped in approximate chronological order. Later, however, the expectation-maximization clustering method was used instead of the originally proposed graphical clustering, to adjust the final grouping of the event to scenarios.

The GSS workshop phase of the process ended in the evaluation of the events and the graphical grouping, from which the data was moved to the rest of the process in a GSS-log file. The log contained the input items and voting results, i.e. the drivers, events and their ranks, impacts and probabilities. The first task after the workshop was to examine the log, clean the data and start mapping the drivers and the events.

The approach taken in the mapping was to use the principles of systems thinking to ponder about the cause and effect relationships between the drivers and events inside the scenarios. Using this analogy, the drivers of the scenarios form a system with feedback relations.

After the scenario sets had been formed by clustering the events, and the drivers had been examined, the logic behind the scenarios was manifested in concept maps based on the event items and comments from the participants. The mapping as a process was executed by feeding the items to a cognitive mapping program, IHMC cMapTools, and links between the events were drawn. The names for the scenarios were picked after examining the general theme in the scenarios. In this case, after the initial maps were drawn, they were presented to some of the closer colleagues familiar with the sessions as a sort of focus group interview, to test the reactions and validate the logical structure of the maps.

The final scenario stories are written around the logics in the concept maps. During the writing the maps were subject to some minor adjustment. Otherwise, the writing is a fairly straightforward process of tying the events together as a logical story, from the present to a defined state in the future. Previous work, such as publications by government bureaus, research organizations and similar instances, offers the opportunity to test and challenge the writer's own perspectives. Careful examination of the drivers aids considerably in forming the scenario logics and reverberates in the stories, as well as in the scenario

maps. One might characterize the process as iterative, as a resonance between the drivers and the scenario maps conducted by the writer.

Case 2: Opportunity recognition in an intersection of industries. The subject outline for the second case was seeking new opportunities in the intersection of a manufacturing industry and a complementing sector. For this setting the participants were selected so that the group included participants from each industry, as well as academics and general experts in the field. The process followed the same outline as the previous case.

The workshop started with a presentation of the aims of the research project and scenarios in general, followed by the outline and objectives of the workshop. The identification of the drivers was also done as in the first case.

When the drivers had been sorted, the work proceeded to identifying the events, or in this case, business opportunities. The identification was done in two phases to interface the idea generation better with the drivers. The basic questions to aid the event recognition were "What kind of business opportunities can the identified trends open in ten years' time?" "What events will these opportunities create?". The events were also discussed and clarified in the group.

The evaluation phase is of paramount importance to the final scenarios, as the evaluations form the basis for grouping the events to scenarios. Unlike the previous setup, the events were evaluated in three dimensions using the GroupSystems Alternative Analysis -tool. The first dimension was still the probability of occurrence for the events, but the impact was split in half. Thus the second dimension was the impact each event should have on the business and earning logic of the industry implementing the product, and the third was the impact of an event to the earning logic of the supplying industry and technology. This dual dimension was selected, because of the setting explained above, first of all to separate the consideration of impact and usability clearly to one perspective at a time and also to serve the interest groups equally in terms of the results. As noted, the criteria in the process differ from the ones used before, to serve the project within which the workshop was organized.

The major practical differences to the previously reported workshops were that an auxiliary presentation was run on a smart board beside the common video screen, where each phase was briefly outlined. The second difference was that brainstorming of events was first done with pen and paper with a print of the prioritized drivers before switched to brainstorming the events or future business opportunities with the GSS. The purpose was to focus the participant's attention and keep them informed about the process, as the previous sessions had been judged a little bit confusing. Similarly, the reason for the two-part event identification was participant input from the previous sessions, which stated that the events were not necessarily well connected with the drivers.

The workshop was concluded after the evaluation and presentation of the intermediate results. The events were presented in a scatter plot, the grouping was discussed preliminarily, and the voting results were examined. The final grouping of the scenario sets was left to be done with cluster analysis, but the possible themes were discussed freely and the scenario writers took notes of the comments.

4.2 Results

The evaluation of the support system is based on the two cases presented above. The cases were rated with a questionnaire and also explorative interviews were conducted in the first case to further improve the system. These practices form the basis for data-source triangulation and also enable basic cross-case comparison to address the validity of the proposed system construct.

Interviews were conducted with the participants of the first case to investigate possible weaknesses in the process and to probe whether the arguments regarding knowledge creation would be supported. The interviews were done as semi-structured, themed, interviews by one researcher, who later transcribed the discussions from tapes, and the results were analyzed in a group. The themes of the interviews were whether the scenarios captured the essence of the session, were the results perceived as reliable, did the support system enhance communication and was there knowledge sharing or creation. The interviews were conducted some time after the session, so the novelty of the situation did not affect the results.

Although the process was seen by the interviewees as generally positive and working concept, clear areas of criticism arose. On the negative side, the goals of the process or the process itself were somewhat unclear to the participants or were forgotten during the process. The identification of drivers of change was not integrated to the process well enough, or the identified drivers did not connect to the future events properly. Even though the participants were presented with a list of the prioritized drivers, they felt that the events did not connect to the drivers, which is somewhat puzzling, as the group was specifically asked to think of events those drivers would cause. One topic of critique was also poor catering to relationships in the elements of the scenarios.

Based on the interviews, there were two reasons for the poor logicality or credibility of the scenarios. Firstly, some subjects were downright suspicious of the validity of the scenario sets. The other reason appeared to be that subjects did not want to rate the results too highly, when they had seen but a handful of probable events instead of ready scenario stories.

In the matter of knowledge creation, the information from the interviews was rather inconclusive. The

statements were mostly vague, although pointing to the direction that some knowledge creation took place. The subjects saw the GSS as a positive thing because they felt that information sharing was effective, and promotes open minded consideration. When others' contributions can be seen, it can create different connotations and mind sets. One factor influencing the outcome was that the definition of 'knowledge' or knowledge creation is none too familiar to the subjects and the definitions are somewhat equivocal. If any knowledge creation happened, it would have been mostly a combination of explicit knowledge or systemization of conceptual knowledge assets.

The subjects generally saw the scenario method as a viable tool for large and important decisions, even with its flaws. One finding was that in addition to the concrete scenarios some interviewees also saw the process as kind of learning experience, promoting open-minded consideration of different options and ideas, and as a possibility to create consensus on large issues and goals in a large heterogeneous organization. When asked, the participants identified the whole of the process, GSS and the situation as the basis of trust, rather than one separate factor.

The second case was rated with a questionnaire. Table 1 presents the questionnaire items. All the items were evaluated with a Likert-type 10-step scale and each category held at least one negatively phrased item to alleviate a positive response bias in the group. Excluding the researchers, the number of respondents was n=7, which is very low and denies many of the standard statistical tests, or affects their reliability significantly.

On average, the basic premises seemed to be in order, as the session goals seemed to be clear to the participants, the goals were apparently reached and the most important factors were also included in the scenarios.

Again on average, the results were seen as trustworthy, but the participants only slightly agreed that it was because of the process, but then again agreed strongly that the work methods brought trustworthiness to the results. Judging by the answers, the GSS seems to have had a positive impact on the results, as the GSS seems to have fitted effortlessly to the process as a support tool and have helped in systemizing the process and creating trustworthy results.

It may be a long stretch to suggest that in fact the answers indicate that the scenario process has at least some of the intended properties. Nevertheless, if the objective was to create plausible paths from the different knowledge assets of the participants and these objectives were met in a manner satisfying practicing industrial managers, there has been at least some knowledge convergence. Much in the same way, when the participants answered that the ideas were understood and the system helped in idea generation, it may indicate that the support system facilitates codification and diffusion of knowledge. Altogether, these results, together with the interviews from the first case, suggest, not bindingly, but to some extent, that the supported scenario process is at least partially able to facilitate knowledge creation in the innovation context.

Table 1. Questionnaire items and basic statistics

Questionnaire items	Avg.	Md	Mo	St. Dev	Conf
Have you used or tried GSS tools previously?					
I have worked with a GSS previously (1 never - 10 regularly)	5,71	8,00	8,00	3,09	2,29
How do you think the environment affected the results (1 extremely negatively, 10 extremely positively)	7,86	8,00	8,00	0,90	0,67
The brainstorming process (1 completely disagree - completely agree 10)					
The goals of the session were clear	8,57	9,00	10,00	1,40	1,04
The goals were reached	8,14	8,00	7,00	1,21	0,90
Do you feel that the process included the most important factors	8,00	8,00	8,00	1,00	0,74
Do you consider the results as realistic and relevant to your company	7,86	8,00	7,00	1,35	1,00
Are the results trust-inspiring to you	8,00	8,00	8,00	0,82	0,60
The results are trustworthy because of the used work methods	7,29	8,00	8,00	1,38	1,02
Work methods (1 completely disagree - completely agree 10)					
The process helped in getting and outlining ideas	7,71	8,00	8,00	1,25	0,93
The ideas were clear and understood	7,43	8,00	8,00	1,13	0,84
GSS-environment in the process (1 completely disagree - completely agree 10)					
GSS systematized the process	8,86	9,00	10,00	1,21	0,90
GSS helped in observing different perspectives	7,57	8,00	8,00	2,64	1,95
GSS helped in getting committed to the process	7,29	8,00	6,00	1,60	1,19

The overall results seem to be positive regarding the feasibility of using the proposed support system in the scenario process. It can be noted that the results support the formed theoretical framework. The results duplicate many of the reported results on the benefits of a GSS, so it can be cautiously suggested that the theory supports the usability of a GSS in a scenario process and *vice versa*. The first case indicates that the argument is at least partially supported, in the sense that information or knowledge was diffused in the group, and the participants felt that they had learned in the process, which in turn would indicate that the process promotes knowing future decision options.

The contribution of the second case is that the results are similar to the first case and thus suggest that the process is indeed feasible and replicable in different contexts, and secondly it informs that industrial managers feel that the process provides trustworthy results in the context of promoting recognition of business opportunities.

One problem in terms of the reliability of the testing is that the cases do not provide unconditional support for the whole support system. It is partially a matter of interpretation, but strictly speaking the test subjects have seen and evaluated the artifact of a GSS supported scenario session. In the light of these points, the validity of the argument is partially open. The subjects deemed the scenarios reliable and have declared that using the scenario

process in major decisions would be a viable option, which supports the argument in the sense that the backbone of the scenarios and the main substance is gathered in the GSS meeting, and the rest of the proposed support system is to make the results more usable and intelligible to the focus group. Thus, the empirical evaluation can be extended to support analytically [45] the whole argument at least in the conceptual level.

Summing up the findings, it seems that the concept of utilizing the supported scenario process to create actionable knowledge seems feasible. On the other hand, it seems that the execution of the process needs further development to achieve optimal performance and results from the setting.

5. Conclusions

Starting from the definition of knowledge and knowledge creation, this paper has presented an argument that scenarios and the supported scenario process in particular are able to promote innovative knowledge creation in a multi-actor environment. The premises include the definition of knowledge and knowing, the properties of scenarios and the support system. The empirical experiences from the process were shown to be positive and suggested that the process is able to promote knowledge creation and sharing. It can be said in conclusion that the empirical results support the concept of knowledge creation by the scenario process.

The challenges come from the properties of knowledge, knowing, and knowledge sharing. The special properties of the innovation process and scenario planning have determined the properties of the actual implementation of the support system. Compared to, for example, Gray's [14] suggestions, this support system is not aimed to lessen employee power and unique knowledge as might be suggested in the case of many knowledge repository systems, as the scenario process facilitates diffusion of information and allows the participants to reflect on the results themselves, which should not lessen the unique knowledge or the participants. The scenario process can be positioned in the front end phases of innovation activities, particularly opportunity recognition. A proposed uses for the scenarios would be opportunity and path recognition.

Although, the empirical testing was rather narrow at least in sample size and therefore the statistical generalizability of the results is somewhat problematic. On the other hand, in terms of analytical generalization [45], the findings correspond reasonably well with the theoretical premises, and are reasonably reliable in the sense that the results are similar between the two cases. The validity, on the other hand, is open to interpretation. The chain between the premises, the main argument and the empirical findings is hardly seamless, so the results may be handled as a sort of proof-of-concept rather than definitive validation.

If the concept of scenarios is a venue to promote *knowing,* then the basic lines of future research are replication and further validation of the results. In other terms, scenario planning as such is a subject which has been thoroughly researched and documented in journals such as Futures and Long Range Planning. Even so, research on facilitating the scenario process and interfacing scenarios to management, could be deemed lacking and this paper amongst others has aimed at pushing to that direction.

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