

# A Framework for Utilizing Group Support Systems in Scenario Process

Kalle Piirainen<sup>1</sup>; Samuli Kortelainen<sup>2</sup>; Kalle Elfvingren<sup>3</sup>; Markku Tuominen<sup>4</sup>

<sup>1</sup> Research Assistant, Lappeenranta University of Technology, kalle.piiirainen@lut.fi

<sup>2</sup> Assistant, Lappeenranta University of Technology, samuli.kortelainen@lut.fi

<sup>3</sup> Senior Assistant, Lappeenranta University of Technology, kalle.elfvengren@lut.fi

<sup>4</sup> Professor, Lappeenranta University of Technology, markku.tuominen@lut.fi

**Abstract** — In modern day business, managing environmental change has become a vital part of building success. Changes in technology or business conditions can have a drastic effect on the business in the long run. One of the more potent tools proposed to avert this problem is scenario planning. It has been noticed in multiple occasions that traditional forecasting is vulnerable to sudden changes; scenario planning aims to work around the problems of forecasting by mapping the possibilities of the future with a wider perspective. The purpose of this study is to test whether the scenario process can be facilitated with a group support system (GSS) and whether it presents positive gains to the scenario process. According to the two case studies processed in this paper, it seems that GSS indeed holds potential for facilitating the scenario process. On average, people participating in GSS supported sessions have found that GSS enhances group work in the scenario process and that the concept of creating satisfactory scenario with GSS support is feasible.

**Keywords** — Scenario planning, Scenario process, Group Support System, GSS

## I. INTRODUCTION

### A. Background

In modern day business, managing environmental change has become a vital part of building success. The increasing speed of changes in the field of business and the shortening product life cycles are discussed right up to a point where these concepts threaten to become clichés [1][2][3]. The problem of uncertain operating conditions boils down to the question of; how a business can develop reasonable strategies for steering the company in the long run [4].

Strategic planning is seen as an important part of modern corporate management. Traditional techniques and tools have been criticized for being too rigid in the perspective of managing change in the environment [1][5][6]. In many instances the analysis that fuels development of corporate strategies is a snapshot of the surrounding world and does not perceive possible anomalies in the development of future situations.

In the traditional sense management is all about knowing the relevant decision parameters and forecasting the result of each decision. In contrast, in recent literature e.g. [1][2] scenario planning has gained attention as a structured method for interfacing strategic planning with evolving operating conditions. The main advantages of scenario planning, when compared to other methods for preparing

for the future, are the following: scenarios are not a single point prediction of a defined time-space in some point of future, and multiple scenarios are conventionally used to map the borders of plausible futures [6][7]. The central idea in this approach is to avoid problems that arise if, against all probability, a carefully conducted forecast of future business proves to be faulty [5].

### B. The scope and issues of this study

The aim of this study is to develop a conceptual framework for utilizing a group support system (GSS) in the scenario process. In scenario planning, the main focus is the process involved in the planning and the challenges it presents to managing knowledge in the process. In a successful scenario process the principal concerns, in knowledge management terms, are extracting private information and tacit knowledge from the participants, diffusing it between the people in the group, and recombining and filtering it to form explicit knowledge in the final scenarios. Or in other words, the aim is in mapping the development of the environment [8][9][10]. The purpose of this study is to test whether a GSS can be used to facilitate the process and whether it will add value to conducting the process.

The principal issues in this study can be further reduced to following questions:

- What are the preferred qualities in scenarios and the characteristic elements of a successful scenario process?
- What challenges does the scenario process present to group work and knowledge creation?
- Can the scenario process be facilitated using a GSS and can use of the GSS add value to the scenario process?

The first task is to establish the makings of a good scenario and to determine a generic scenario process. The second major task is to seek proper methods for utilization of GSS in scenario planning, using the formulated generic process as a junction. The third main event in the scope of this study is a series of empirical experiments, where an experimental scenario process is executed in laboratory conditions.

### C. Methodology

The study follows the constructive research methodology described by Kasanen et al. [11]. The constructive approach

follows the path from the definition of the research problem, through constructing a solution to the presented problem, to the testing of the construction and the assessment of generalizability and validity of the results [11].

In terms of research methods, a descriptive literary study is used to determine the conditions for successful scenario planning and the challenges that the scenario process presents to the use of a GSS, i.e. to form the construction for the research problem.

In the empirical phase the construction is put to test in a GDSS laboratory, or a decision room type, face-to-face, GSS-setting at Lappeenranta University of Technology. The method is a multiple case study. Even though Yin proposes single case study in testing theory propositions [12], multiple cases are used for two major reasons; to alleviate the effect of the researchers' action and to raise the external validity of the results. The presented framework is used in scenario sessions and the sessions are evaluated with a questionnaire presented to the participants. The observations and interview results are processed with qualitative and quantitative methods.

The questionnaire results are processed quantitatively, to get an overview of the results of the experiments and to evaluate the weak and strong points of the tested process. On the basis of these results, a series of interviews is conducted to further disseminate the causalities behind the results. By these means the authors investigate how the empirical findings correlate with the presented framework and to wish to achieve increased understanding of the usability of the GSS.

## II. SCENARIO PROCESS

### A. *Origins and background*

The dawn of scenario planning dates back to the 1960's. The credit of being the *primus motor* has been given to Herman Kahn, who at the time worked with the RAND Corporation [7][13]. At first scenario planning was mostly used for military purposes. The breakthrough in business was at the 1970's when Pierre Wack, being familiar with Kahn's work, started to experiment with scenario planning in Royal Dutch/Shell.

The field of scenario planning is rather scattered, e.g. Bradfield et al. describe the situation as being a methodological chaos [13]. The reason for this is that every practitioner has different emphasis and views. The two main schools are Kahn's American school and Wack's French or *La Prospective* –school. Inside these camps the methodologies can be further divided to Intuitive-logical, *La Prospective* and Probability –models. However, in this study the aim is in the scenario process rather than nuances of conduct, as it can be seen as the key in utilizing a GSS in scenario work.

### B. *Definitions*

As stated above, scenario planning differs from traditional forecasting methods in some important aspects. It has been claimed that compared to other methods of managing change, scenario planning has some advantages as discussed above. Traditional trend analysis is essentially an extrapolation of past development and as such ignores the abrupt changes in development. On one hand, contingency planning does not include information about the path of development, and on the other expert opinions are inherently guesses, although mostly educated ones. [2][6]

Starting from the very beginning, Kahn and Wiener [14] define scenarios as "Hypothetical sequences of events constructed for the purpose of focusing attention to causal processes and decision points" with the addition that the development of each situation is mapped step by step and each actor's decision options are considered along the way. Schwartz [7] describes scenarios as plots that tie together the driving forces and key actors of the environment. Ogilvy expresses this more poetically; his view is that, like in a proper tragedy, a scenario should have a beginning, middle, and an end [15]. Schoemaker writes that scenarios simplify the infinitely complex reality to a finite number of logical states. In Schoemaker's view scenarios as realistic stories might focus the attention to perspectives that might otherwise end up as overlooked [6]. Furthermore, Coyle and Chermack argue that scenarios and the process involved sensitize people to consider changes in the environment better [2][3].

From the above definitions, it can be derived that scenarios are a set of separate, logical paths of development, which lead from the present to a defined state in the future. Furthermore, it can be deduced that scenarios are not descriptions of a certain situation some time in the future, nor are they a simple extrapolation of past and present trends.

### C. *Preferred qualities in scenarios*

Now that a definition of scenarios is established, the next step is to discuss what qualities should be achieved in the scenario process. Keeping the process in mind, it can be useful to stop for a moment, to think what the preferred outputs are.

According to definition, scenarios are sequences of events. Many writers also stress that this chain must be detailed enough, in order to give ground to interpreting which scenario(s) is about to materialize [6][14][15].

The Bermuda triangle of scenario planning is formed of three overlapping challenges: sufficient detail, relevance to the user, and length. Although a good scenario is detailed, the volume of information should be kept on a manageable level. Business managers are after all notorious for

TABLE 1  
DIFFERENT SCENARIO PROCESSES, ADAPTED FROM BERGMAN [9]

Key elements	Intuitive approach	Heuristic approaches		Statistic approach
	Schwartz [7]	van der Heijden et al. [16]	Schoemaker [6][17]	Godet [18]
Defining the problem and scope	1. Exploration of a strategic issue	1. Structuring of the scenario process	1. Framing the scope 2. Identification of actors & stakeholders	1. Delimitation of the context 2. Identification of the key variables
Analyzing the key elements of scenarios	2. Identification of key external forces 3. Exploring the past trends 4. Evaluation of the environmental forces	2. Exploring the context of the issue	3. Exploring the predetermined elements 4. Identification of uncertainties	3. Analysis of past trends and actors 4. Analysis of the interaction of actors & the environment
Constructing the scenarios	5. Creation of the logic of initial scenarios 6. Creation of final scenarios	3. Developing the scenarios 4. Stakeholder analysis 5. System check, evaluation	5. Construction of initial scenarios 6. Assessment of initial scenarios 7. Creation of the final learning scenarios 8. Evaluation of stakeholders	5. Creation of the environmental scenarios 6. Building the final scenarios
Implications	7. Implications for the decision-making 8. Follow-up research	6. Action planning	9. Action planning 10. Reassessment of the scenarios and decision-making	7. Identification of strategic options 8. Action planning

ignoring too long written documents. A relating point is keeping the scenarios relevant to the decision making. There is little use for totally unrelated information and it may frustrate the reader.

The next important challenge is the coherence of the scenarios. Schoemaker [6] defines three basic tests for consistence: 1) Are the trends compatible with the chosen time frame 2) Do the scenarios combine the effect of compatible drivers, and 3) Are the major stakeholders positioned in places that are realistic?

One qualitative factor is the number of scenarios. Walsh [1] suggests that 2-4 would be optimal, although Schwartz [7] is certain that above three would be waste. A reasonable approach has been introduced by Schoemaker [6], who suggests developing 7-9 preliminary scenarios, and then choosing or combining the necessary number of final scenarios out of them.

Another major concern is preserving the nuances of expert opinions and innovativeness in the final scenarios. An innovative atmosphere in the process helps thinking outside the box, and the nuances give depth to the story, which may help in reflecting which of the scenarios is about to unravel in the near future.

Lastly, Selin [8] reminds that trust is what makes or breaks the final results. The process and communicating the results must gain the subjective trust of the decision makers; otherwise scenario planning will not be implemented in the actual management culture.

#### D. Scenario Process

Despite the aforementioned colorful collection of practices, there are identifiable universal elements in the different proposed processes. Table 1 describes some of the more cited models, as presented by Bergman [9]. Starting from the first column from the left, Schwartz exemplifies the intuitive approach, which largely relies on logical thinking in constructing scenarios. In the middle there are two examples of heuristics methods which are more structured than the intuitive, but less so than the statistic ones. On the right is the statistic approach by Godet, which is built on modeling the environment and estimating the development on mathematical grounds. Extremes in

methods are often considered risky; on one hand, in the intuitive approach the results or the process may seem too creative in order to win trust, and on the other hand, the statistic approach tends to be mechanical and does not encourage innovativeness. However in this context, the mission is not to disseminate the methods, but rather the process.

Despite the obvious differences in the approaches, there are common elements across the field of scenario planning. These characteristic elements are: 1) Definition of the problem, 2) Recognizing key drivers of change and uncertainties, 3) Developing (preliminary) scenarios, 4) Evaluating results and revision, 5) Creating final scenarios, and 6) Implementing the scenarios in the decision making.

### III. KNOWLEDGE CREATION IN SCENARIO PROCESS

As stated in the introduction, one angle to the scenario process is that its purpose is to create actionable knowledge from the private knowledge assets of participants in the explicit form of scenario stories. The challenges this presents can be derived from the desired qualities of the scenarios and the process itself, as described above.

Viewing the scenario process in terms of Nonaka et al., it can be seen as a process where individuals' knowledge assets are Socialized, Externalized, Combined and Internalized again (the SECI process) [10]. In these terms the final scenarios can be viewed as a knowledge vision, and to achieve this goal knowledge assets and the space to utilize these premises have to be present in order to create fruitful SECI. Furthermore, the knowledge assets can be seen as held by the participants and *Ba* is analogous to the mental and physical state of being. This proposition is reinforced by Chermack's notion that the mechanism which results in the benefits of scenarios is lowering information barriers and reforming mental models in organizations. [3]

#### A. Knowledge management challenges in scenario process

Keeping the definition and qualitative aspects in mind, the challenges of managing the scenario process can be mapped. Firstly, Stähle and Grönroos state that information sharing is conceptually unnatural for people and that trust is

necessary for people to share knowledge [19]. This translates so that the participants not only have to have a media through which they can communicate, but also a will to do so.

One definition of knowledge is that information can be transcended to knowledge by giving it context so that everyone within the language or social barrier can understand the contextual meaning [19]. In the context of the scenario process, relevant information about the future is largely in public domain, but also buried in experts' tacit knowledge. The question of making it actionable is how to organize the available information as logical and coherent scenarios, which are relevant to the decision-makers of the firm.

In scenario literature, some guidelines have been established on the selection of the people who to include in the scenario work. The general view on this subject has been that the managers of the firm concerned may have too one sided views on the environment [2]. This can be also explained with the notion that an individual is able to learn new and filter the most valuable knowledge from fields he/she has prior knowledge of, thus creating some amount of path dependency [20]. Also, in the supposedly emerging, more networked knowledge economy the influence of extra-organizational interest groups is said to be greater than before, thus perhaps raising the demand to include these groups in strategic considerations [21]. Translating this to scenario process means that path dependence creates a challenge of how to inspire people to see beyond their usual horizons and also how to single out the most important factors despite of possibly lacking absorptive capacity.

The question of trust is also present in another form, in order to create trustworthy scenarios; the process needs to fill the participants' methodological criteria to gain trust.

Concluding about the challenges of managing knowledge in the scenario process, it can be suggested that the main problems would be encouraging the participants to articulate their knowledge assets and communicate them within the group, create an atmosphere or a place where everyone can and will participate, and connect the fruits of the process to satisfactory scenarios that effectively mirror the collective understanding of the group.

#### *B. Managing the process with a group support system*

In some instances, e.g. according to Ståhle and Grönroos [19], the field of knowledge management has been divided into two parts; the so called Scandinavian school stresses that knowledge creation happens primarily as a social process, whereas the other school, dubbed as North-American, focuses on technical means of managing knowledge. In some sense this would indicate that electronically mediated work methods may not be ideal for

knowledge creation. On the other hand, there are also contradicting views claiming that, due to effective information sharing and consensus creation, the use of a GSS would in fact be beneficial to learning or knowledge creation in a group [22][23]. Little has been written directly on the subject of mediating the scenario process with electronic means, perhaps the best known example is Blanning and Reing's method, which has been described in multiple instances, e.g. [24].

By definition, group support systems are a collection of applications aimed to facilitate group work and communication [25][26][27]. In the general hierarchy of decision support systems (DSS), GSS is placed in the branch of communication driven DSS [28]. Without going into too much detail, GSS implementations generally feature tools for idea generation, prioritization, commenting and discussion, packaged into a software suite [26].

Generally GSS tools are perceived as an effective way to mediate meetings, share information and achieve consensus on decisions concerning un- or semi structured problems [25]-[28]. In recent studies it has been suggested that the GSS would particularly enhance "exchange of unshared information" [23] which could be interpreted so that the GSS facilitates communicating also tacit knowledge.

One of the more celebrated features of the GSS is the ability to work around constrictions of location and time; with computer mediation, meetings can be conducted so that the attendants are conventionally 1) in the same place at the same time, 2) in different places at the same time, 3) in the same place at different times, or 4) in different places at different times [26][31]. The advantages of asynchronous and/or decentralized sessions are not indisputable, but there are propositions that with asynchronous setting the substance of interaction gains depth, as people are more able to reflect the theme and the input of others, resulting in better decisions [32]. Similarly the question of decentralized participation arises with the above discussed demand for including external interest groups and experts in the scenario process; it would seem feasible to have an efficient virtual or decentralized session with GSS mediation, the main concern being the motivation and team cohesions of the participants [33]. In addition, on the basis of the above, a hypothesis could be set that the GSS would lower the transaction costs in acquiring knowledge, i.e. in the form of lessened time consuming and travel expenses. However, as intriguing as these considerations of 'advanced' GSS settings might be, at this stage the main concern is the traditional face-to-face synchronous setting.

The GSS methods have also received critique from researchers. One great drawback, also concerning the scenario process, is that some nuances of human communication are lost in electronic communication,

TABLE 2  
BENEFITS AND CHALLENGES OF USING GSS, ADAPTED FROM [26]-[29]

GSS features	Description and advantages	Outcome, Benefit	Challenges
Process structuring	Keeps the group on track and helps them avoid diversions: <i>- clear structure of the meeting; improved topic focus; systematical handling of meeting items</i>	Shorter meetings	
Goal oriented process	Aids a group to reach its goals effectively: <i>- process support facilitates completing the tasks; discussion seen to be concluded; electronic display makes the commitments public</i>	Improved quality of results Greater commitment Immediate actions	Learning through commitment and collaboration
Parallelism	Enables many people to communicate at the same time: <i>- more input in less time; reduces dominance by the few; opportunity for equal and more active participation; participation and contribution at one's own level of ability and interest; electronic display distributes data immediately</i>	Shorter meetings Improved quality of results	Sufficient amount of detail
Group size	Allows larger group sizes: <i>- makes it possible to use tools for the effective facilitation of a larger group; enhances the sharing of knowledge</i>	Greater commitment	Relevant and coherent scenarios
Group memory	Automatically records ideas, comments and votes: <i>- instantly available meeting records; records of past meetings available; complete and immediate meeting minutes</i>	Better documentation Immediate actions	Implementation to decision making
Anonymity	Members' ideas, comments and votes not identified by others: <i>- a more open communication; free anonymous input and votes when appropriate; less individual inhibitions; focus on the content rather than the contributor; enhanced group ownership of ideas</i>	More/better ideas Greater commitment	Better trustworthiness of scenarios and process
Access to external information	Can easily incorporate external electronic data and files: <i>- integration with other data systems; effective sharing of needed information</i>	Easier to justify the acquisition of the system	
Data analysis	The automated analysis of electronic voting: <i>- voting results focus the discussion; software calculates e.g. the average and standard deviation of the voting results</i>	Shorter meetings Better documentation	Efficient communication for knowledge creation
Different time and place meetings	Enables members to collaborate from different places and at different times: <i>offers means for remote teamwork</i>	Reduced travel costs Time savings	

although this can be at least partly averted by including verbal communication when appropriate. Another major consideration is the effectiveness of the input compared to traditional means of communication. The magnitude of this issue depends largely from the people participating in the session, the factors being habituation in electronic expression and development of suitable mental models [33].

The benefits of using a GSS are listed along with the challenges of the scenario process in table 2. Considering the challenges in the scenario process compared to gains in using a GSS, seems that the research findings support the possibility of facilitating the scenario process effectively by means of a GSS. Weighting the benefits and challenges, GSS mediation has clearly plausible benefits. In many instances a GSS has been deemed effective in facilitating communication and, to some extent, improving group cohesion and idea generation, e.g. [33][34]. Also idea generation is more efficient and, as an important feature, the process outcomes can be recalled and printed from the system for further use. Although one could criticize written communication compared to oral, with GSS the original input is retrievable unaltered, as opposed to traditional methods. Other benefits might be commitment and consensus creation through anonymity and information sharing; when the participants' roles outside the session are not present with the input seen by the group, the focus would turn to the substance more than in traditional face-to-face situations.

Furthermore, there are even suggestions that a GSS could

indeed add value to the scenarios. Among others Kwok and Khalifa [22] claim that a GSS enhances group learning through active participation and cooperative working. In scenario literature, it is sometimes claimed that in fact the major benefit of the scenario process is the process itself, in the sense that it helps the decision makers to consider the effects of change, also in ways that are not written down in the actual scenarios[3][6][9]. In this perspective, it would be feasible that a GSS could add value to both the process and the final scenarios.

#### IV. EMPIRICAL TESTING

As an important part of this study, some empirical experiments were conducted in order to test and validate the constructed theoretical framework. The testing was conducted in a decision room with a GSS, at Lappeenranta University of Technology (LUT).

The decision room is used for teaching and research in the field of group decision support processes and systems. The decision room has been designed to support up to ten-person electronic meetings, and there is a possibility for remote use from within the University. The main group support software of the decision room is the GroupSystems developed by the University of Arizona and Ventana Corporation. The GroupSystems contains all the general characteristics of GSS software. The facilities are specifically constructed for supporting the use of the GSS, including a big horseshoe-shaped table that faces a large screen and a PC with an adequate display for each participant in the decision room.

### A. Test settings

The first three experiments, henceforth called case I, were carried out as a series on 16.-17. February 2006 and the second series on 22. May and 19. June 2006. The participants in the first series were 3<sup>rd</sup> – 5<sup>th</sup> year, or post graduate, students who took part in a course concentrating in the use of decision support systems. Case II, respectively, consisted of a fourth setting, in which participants were random staff members of the Department of Industrial Engineering at LUT, and a fifth one where the participants were researchers and administrative personnel from a variety of different departments of LUT.

In both cases the place was the same; the decision room, or GDSS-laboratory, of LUT. The tested groups had the same objective of creating scenarios concerning changes that LUT will face over the next ten years. The subject was chosen so that the participants would have comparable interest and background information on the subject. In both cases the same facilitator acted as the chairman, presented the task and set up the GSS-application.

The main differences in Case I and II are the selection of the test subjects and differences in scenario methodology. The actual methods are described in further detail below. Method in case I represents a more intuitive-logical method, whereas the method in case II is a more mechanical approach. The process outlines are presented in table 3, with the appropriate GroupSystems tool in brackets. In addition to test setting the research objectives of the cases differ in the sense that where case I is more mechanical concept testing, case II is intended to validate and explain prior results and focuses more on qualitative methods.

TABLE 3  
GSS MEDIATED SCENARIO PROCESSES

Case I	Case II
Session time 1h 45min	Session time 3h 45min
Problem setting, (15min)	Problem setting (15min)
Key Drivers of Change (30min) (Categorizer)	Key Drivers of Change (30min) (Categorizer)
	Identifying Future Events (45min) (Categorizer)
Preliminary Scenarios (30min) (Voter)	Priorization of Events (45min) (Categorizer)
	Creating Scenarios (45min) (Alternative Analysis)
Evaluation and final scenarios (30min) (Categorizer)	Evaluation (45min) (Categorizer)

### B. Case I

The session followed a modification of the generic process described in table 3 above. The first step, definition of the problem, was made by the facilitator, who presented the group with a summary of the exercise and a paper version of PESTEL analysis considering LUT. The PESTEL, in fact originally just PEST, acronym stands for the Political, Economical, Social, Environmental and

Legislative or Regulatory factors in the sense how they affect the organizations concerned. It presents a framework for analyzing the organization's macro environment, or acts as a checklist when different actors are evaluated. [4]

The reason for introducing PESTEL in this process is that it opens up a wider perspective on the drivers of change, compared to a situation where the group is just asked to brainstorm drivers without any framework or general theme.

Then the work progressed to the next phase where the group brainstormed the key drivers of change and the uncertainties. Brainstorming was followed by discussion where unclear items were clarified within the group and overlapping items were removed or merged. After the discussion the drivers were prioritized by voting. A ten-point scale was used in all the voting through GroupSystems, as it allows accurate weighing and does not have a neutral point, so the participants are forced to take either a negative or a positive posture.

Of the prioritized drivers, ten of the most important were chosen. The drivers were positioned in a matrix so that two of the most important and independent drivers were first given the four possible combinations of realization/not realization. These four combinations also formed the four scenarios created in the session. Then the rest of the chosen drivers were placed in the matrix below the first drivers and the state of realization was logically derived from the previous by the group. Lastly the formed scenarios were evaluated.

This approach relies much on the logic of the participants in the forming of scenarios and it might be described as an intuitive-logical or borderline heuristic process. The weak point is the formulation of scenarios, where, also depending on the drivers, distinctions of the scenarios can be very small, thus bringing the scenarios closer to forecasting. Also, when the drivers were voted with the question setting "When A happens and B does not, would C materialize, or not?" the frequencies of Yes and No –answers were in many occasions almost equal, which of course undermines the validity of the vote results.

### C. Case II

In case II the approach was somewhat different from case I. The session started with definition of the problem and proceeded to defining the major drivers of change, as in case I. The drivers were discussed in a similar fashion as in case II.

The difference is in the part where the participants were presented with the prioritized list of drivers and were asked to identify concrete events that are consequent on the identified drivers. These events were once again discussed and commented on, and overlapping events were merged or removed.

The events were then subjected to voting in two dimensions with the alternative analysis tool; first the impact of the event and then probability. The ten-point scale was interpreted here so that in probability vote 10 was read as 100% and 1 as 10%. Votes for impact factor were interpreted in a similar manner: vote 10 was read as "extremely positive/favorable" incident and 1 "highly

negative” The scenarios were formed on the basis of voting, so that events that had the highest probability were grouped in a “realistic” scenario and events with average to high probability and the most negative or positive impact were grouped in negative and positive scenarios respectively.

In the final stage the events forming each scenario were subjected to discussion in order to ensure that the scenario sets were logical and coherent, and the events were also grouped in approximate chronological order.

This process was intended to be more structured than case I, although it can be criticized for being too mechanical to capture the innovativeness and nuances of the session. In fact case II uses large parts of Blanning and Reinig’s framework for scenario creation [24], with some modifications. As described in their paper, Blanning and Reinig tend to go straight to brainstorming events in the future, with headlines such as ‘optimistic’ ‘negative’ and ‘realistic’ events. In contrast many scenario practitioners explicitly warn about such an approach [2]. The point of the criticism is that the three categories steer the process too much, resulting in uninventive thinking. It can also be suggested that the present or likely the future can not be simply forged into pessimistic or optimistic scenarios with a good conscience. Case II might be called a hybrid process, which synthesizes elements from the intuitive and the mechanical approach, to alleviate the problems of the “triangular” view, at the same time preserving the clean structure it provides for the process.

#### D. Description of research material

In both cases all the participating subjects reviewed the session with an anonymous questionnaire. The questions were derived from the theoretical framework, particularly from the challenges of the scenario process and characteristics of GSS. A 5-point Likert scale was chosen instead of a 10 point one, because in all cases the participants were more familiar with performance grading in a 5-point scale.

To further explore the scenario experience, the participants in case II were interviewed personally. The interviews were conducted in the usual working environment of the subject, during office hours. The interviews were semi-structured or focused, that is, the questions were prepared but answer options were open. All the interviews were recorded and transcribed prior to further evaluation.

#### E. Quantitative analysis

Table 4 below shows the questions in the survey form, and gives an overview of the results. In case I the separate grading from the three sessions with  $n_{tot}=29$  was processed with Kruskal-Wallis 2-tailed variance analysis with margin of error  $p=0.05$ . The analysis showed that the results can be handled as a unified sample of the population. As for Case II with  $n_{tot}=14$ , variance analysis was an excluded possibility in terms of good practice. For the purposes of validating the results, some key figures are also provided. The confidence intervals are also calculated with the standard margin of error  $p=0.05$ . A More detailed account of the results is presented in appendix A

The table shows that the overall scores are high, especially considering that the common verbal key is 1 ‘tolerable’, 3 ‘good’ and 5 ‘excellent’. Notable figures are the confidence interval and standard error in case I; the deviation in the group is within a quarter of a point. On average the scores are good or even very good, but the trustworthiness is lacking. Judging from the open critique given, the reason for low regards in this respect is that the sessions were carried out as assignments, participated solely by students, although the process received some critique of its own. The point was the actual creation of scenarios where the drivers of change were positioned in the matrix and given yes/no-states. This was considered a confusing and incoherent practice.

TABLE 4  
QUESTIONNAIRE RESULTS

Question	Case I			
	Avg	Std. Dev.	$D(x)$	+/-x
1. Do you have previous experience with scenario planning?				
a) I'm familiar with scenario planning	2.64	1.10	0.20	0.42
2. Scenario process				
a) The objectives of the session were clear	3.86	0.92	0.17	0.35
b) The objectives were reached	3.31	0.85	0.16	0.32
c) Do you feel that the process used produces useful results	3.62	0.78	0.14	0.29
d) Do you feel that the key drivers of change were identified	3.31	1.07	0.20	0.41
e) Are the results, in Your opinion, relevant to the operation of LUT	2.62	0.68	0.13	0.26
f) Do you feel that the results are trustworthy?	2.31	0.60	0.11	0.23
g) Are the results logical and coherent	2.97	0.68	0.13	0.26
h) How much of the trust depends on the process itself	2.86	1.06	0.20	0.40
3. GSS in the scenario process				
a) GSS fitted naturally with the scenario process	4.14	0.69	0.13	0.26
b) GSS systematized the process	4.28	0.59	0.11	0.22
c) GSS helped in observing different perspectives	3.76	0.74	0.14	0.28
d) GSS helped in committing to the process	3.52	0.99	0.18	0.38
e) GSS helped in creating trustworthy results	2.97	0.78	0.14	0.30

When it comes to the suitability of a GSS in the process, the overall result in the cases is very good. In the light of the ratings, the advantages of the GSS are systematic processing and increased commitment to the process. Compared to theoretical suggestions about the benefits of a GSS presented above, the results can be seen as supportive.

The quantitative results of case I get reinforcement from case II. Overall the scores are closer to very good, although the standard error is somewhat higher than in case I. Of course it is debatable whether the difference is in the group or the different process, and even the reliability of case II might be viewed as questionable. On the other hand, it might be said that the direction is right. What is

encouraging in the results is that in case II the process got better evaluation in most respects, even though it can be assumed that administrators and researchers would be more critical, at least concerning trust, than engineering students. To investigate the dependencies further, Spearman's Correlation factors were calculated for the material of case I (Appendix B), still with  $p=0.05$ . The most significant correlations were; 1) *GSS helps observing different perspectives* correlates positively with *usefulness and coherence of the results* and *commitment to process* 2) *GSS helps in committing to the process* correlates positively with *identifying the most important drivers of change* and *observing different perspectives*. 3) *The goals of the session were met* correlates positively with *the objectives being clear* and *the trustworthiness of the results*. Interestingly enough there was no statistically significant correlation between the level of prior knowledge about scenario process and the other answers. These correlations could be translated to the notion that the main benefits or added value from GSS is that it improves commitment, which results in deeper substance, and diffuses information between the group, which helps in identifying important pieces of information regarding session goals. A further observation would be that the primary mechanism for improving commitment in the sample is the ability of a GSS to diffuse information. These correlations are consistent with the other data and thus provide further support for the framework.

Summing up the quantitative analysis, it can be said that the empirical results support the formed theoretical concept of supporting the scenario process with a GSS. As can be observed in table 4, the test subjects were fairly unanimous in their answers, so even though the sample is small, the validity of the results can be seen as better than the sample size alone would suggest. Judging from the results the specified process seems to function as intended, even with variation in the actual method of forming the scenarios. The correlation test suggests that the GSS adds value to the process by focusing the group's attention to the task at hand and through supporting commitment in the process. On the basis of these results, it can be suggested that the concept of utilizing a GSS in the scenario process seems feasible.

#### F. Qualitative analysis

The qualitative processing was based on the interviews mentioned above, which were conducted amongst the subjects of case II. In order to investigate the problems and deepen the understanding of the process, the interviews were carried out as semi-structured with predetermined themes, but without pre-chosen answer options or precisely formulated questions. The themes of the interviews are presented in table 5 below. Themes were formed on the basis of the theory proposition and the weaknesses unveiled by the questionnaire, in order to get knowledge of why the process did not work, and how it could be developed.

TABLE 5  
INTERVIEW THEMES

1. How deep was your previous knowledge of scenario planning and how does that compare to the session - Was there something missing - Should there have been more structure or intuition - Was the essence of the scenario process present in session
2. In the survey there were implications that the goals were not clear enough: was the process enough goal-oriented and if not, how would you improve it? - Were the goals communicated clearly - Should the goals have been emphasized more during the action
3. There were also implications that the results lacked logic, what induced these problems in your view? - Was the reason the process, facilitation or the subject - How would you improve the situation
4. Did the final result meet the spirit of the session? - If not, where did the process go wrong - Did you feel that the triangular model (positive-negative-realistic) affected the results - Were the ideas and tacit knowledge transferred efficiently
5. Did you feel that GSS enhanced communication? - Was the communication better or worse than verbally - Do you feel that the meaning of ideas and comments was understood in the group - Was there something important missing in the written communication - Was there enough clarifying verbal communication
6. Do you feel that knowledge was diffused and/or transcended in the session? - What helped or hindered the communication - Do you feel that you gained something from the session
7. Do you feel that using the results of this process in an actual situation would be feasible? - If not, why - Is the trust in the process, participants, GSS or in all of them

The interviews as a whole did not paint as rosy a picture as the numerical evaluation. Interviews were conducted some time after the session, so the novelty of the situation did not affect the results. The interviewees still saw the process as positive, but clear points of critique 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.

On the other hand the triangular scenario creation did not seem to bother the subjects, one factor being that the actual scenario method was not specified in the session introduction, so that it would not affect the situation.

There are two main reasons for the poor logicality or credibility of the scenarios. Some subjects were downright suspicious of the validity of the scenario sets. The other reason for average rating in the survey appeared to be that the subjects did not want to rate the results too high, when they had not seen but a handful of probable events instead of ready scenario stories.

In the matter of knowledge creation, the material leans towards inconclusive. The statements were mostly vague, although pointing to the direction that some knowledge creation took place. One factor was that the definition of 'knowledge' or knowledge creation is none too familiar with the subjects and the definitions are somewhat equivocal. If any creation happened, it would have been mostly combination of explicit knowledge or systemization

of conceptual knowledge assets.

In the concluding question the subjects generally saw the scenario method as a viable tool for large and important decisions, even with its flaws. When asked, the basis of trust was the whole process, the GSS, and the whole situation, rather than one separate factor.

#### G. Summary of the results and findings

The quantitative results are altogether positive regarding the feasibility of using a GSS in supporting the scenario process. Another appreciable note is that the results support the formed theoretical framework. Then again the qualitative analysis reveals that there are some setbacks in the actual scenario method.

Summing up the findings, it seems that the concept of utilizing a GSS effectively to facilitate the scenario process and thus 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 substance from the setting.

### V. VALIDITY AND LIMITATIONS

As always, there is justified doubt whether the results are valid or reliable. First the attention turns into the test setting and conducting. The empirical tests were executed in fairly constant conditions, keeping the process and other factors as same as possible between the tests in each series. Also the tests were executed by the same personnel in order to control variance in conditions. By these standards the testing could be deemed reliable.

Then there is the question of sample size, the total amount of test subjects or participants was 43, which is relatively low compared to some other studies in the field, and the population. However, in the testing the results were consistent between cases I and II, and were also supported by the theory proposition.

Another matter is generalizability; the results are automatically valid only in the population consisting of senior students of Industrial Engineering and to some extent the university administrators. The extent to which these results can be extrapolated into general management of public or private organizations and what is the effect, is a question that cannot readily be answered on these grounds.

With these limitations, this study should be considered as an attempt at proofing the concept of supporting the scenario process with a GSS and a conceptual framework. Although the conduction of the process is documented, the results show that there is need for improving the execution and thus the framework should be used warily for actual scenario creation in the present form.

### VI. CONCLUSION AND DISCUSSION

In this study the focus was on a framework for supporting the scenario process with a GSS and thereby using a GSS as a means for creating actionable knowledge in the form of scenarios. According to the theory proposition a GSS would be an effective means for managing knowledge in the scenario process. When tested, the framework showed potential in scenario process, but the

actual execution was found lacking in practical terms.

The significance of this study is that now when there is a tried conceptual framework and fairly method-independent process for GSS supported scenario work, there is a starting point for developing more efficient and effective ways to create scenarios to be used in organizations. A manageable and documented process creates possibilities for a repeatable scenario process with reliable results. There is also an implication for research; a common process should improve the validity of comparisons of the scenario process and scenarios between different methods, groups or types of organizations.

During the research numerous interesting issues were raised. Probably the first question that rises is whether there is a significant difference in the substance and validity of scenarios when comparing traditional methods with a GSS supported method. Considering the critique toward the methods used for scenario creation, an interesting issue is the effect of group composition and work methods in credibility and validity of the final results. Generally, two different paths could be derived from this framework. One would be that of developing methods for scenario creation and testing of the effect of different GSS settings on group work and knowledge processing. The other path would be finding ways to further support scenario process in organizations for better efficiency and substance.

Referring back to the issues of this study; the preferred qualities of scenarios and the challenges of the scenario process boil down to condensing and connecting the expert knowledge of the participants in the session to an explicit disquisition, and the effect of introducing a GSS in this equation. According to the empirical evidence gathered in the two cases, it would seem that using a GSS as a tool in the scenario process is a viable option for alleviating some of the problems. The empirical results were encouraging, as a whole the GSS was seen as a good tool for scenario creation. The research material points that a GSS can provide an effective means for communication and diffusing information, but question whether the use of a GSS specifically enhances knowledge creation remains unanswered.

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## APPENDIX A: QUESTIONNAIRE RESULTS

Question	Case I									Case II								
	Results			Std. Error			Confidence interval			Results			Std. Error			Confidence interval		
	Avg	Std. Dev.	Md	$D(x)$	$D(Md)$	+/-x <sup>-</sup>	LL	UL	Avg	Std. Dev.	Md	$D(x)$	$D(Md)$	+/-x <sup>-</sup>	LL	UL		
1. Do you have previous experience with scenario planning?																		
a) I'm familiar with scenario planning	2.64	1.10	2.00	0.20	0.26	0.42	2.23	3.06	3.11	1.54	3.00	0.44	0.56	0.91	2.20	4.02		
2. Scenario process																		
a) The objectives of the session were clear	3.86	0.92	4.00	0.17	0.21	0.35	3.51	4.21	4.00	0.71	4.00	0.20	0.26	0.42	3.58	4.42		
b) The objectives were reached	3.31	0.85	4.00	0.16	0.20	0.32	2.99	3.63	3.89	0.78	4.00	0.23	0.28	0.46	3.43	4.35		
c) Do you feel that the process produces useful results	3.62	0.78	4.00	0.14	0.18	0.29	3.33	3.92	4.11	0.33	4.00	0.10	0.12	0.20	3.91	4.31		
d) Do you feel that the key drivers of change were identified	3.31	1.07	3.00	0.20	0.25	0.41	2.90	3.72	3.72	0.57	4.00	0.16	0.20	0.33	3.39	4.06		
e) Are the results, in Your opinion, relevant to the operation of	2.62	0.68	3.00	0.13	0.16	0.26	2.36	2.88	4.06	0.17	4.00	0.05	0.06	0.10	3.96	4.15		
f) Do you feel that the results are trustworthy?	2.31	0.60	2.00	0.11	0.14	0.23	2.08	2.54	4.00	0.71	4.00	0.20	0.26	0.42	3.58	4.42		
g) Are the result logical and coherent	2.97	0.68	3.00	0.13	0.16	0.26	2.71	3.22	3.22	0.67	3.00	0.19	0.24	0.39	2.83	3.62		
h) How much of the trust depends on the process itself (1 small -5 largest)	2.86	1.06	3.00	0.20	0.25	0.40	2.46	3.27	3.11	0.60	3.00	0.17	0.22	0.36	2.76	3.47		
3. GSS in the scenario process																		
a) GSS fitted naturally with the scenario process	4.14	0.69	4.00	0.13	0.16	0.26	3.87	4.40	4.00	0.87	4.00	0.25	0.31	0.51	3.49	4.51		
b) GSS systematized the process	4.28	0.59	4.00	0.11	0.14	0.22	4.05	4.50	4.56	0.53	5.00	0.15	0.19	0.31	4.24	4.87		
c) GSS helped in observing different perspectives	3.76	0.74	4.00	0.14	0.17	0.28	3.48	4.04	3.89	0.60	4.00	0.17	0.22	0.36	3.53	4.24		
d) GSS helped to committing to the process	3.52	0.99	4.00	0.18	0.23	0.38	3.14	3.89	4.22	0.83	4.00	0.24	0.30	0.49	3.73	4.71		
e) GSS helped in creating trustworthy results	2.97	0.78	3.00	0.14	0.18	0.30	2.67	3.29	3.67	0.71	4.00	0.20	0.26	0.42	3.25	4.08		

APPENDIX B: CORRELATION COEFFICIENT TABLE FOR CASE I QUESTIONNAIRE MATERIAL

Statistically significant correlations ( $p=0.05$ ) are marked with bold style. The verbal key for the row and column titles is consistent with the questions in table 4.

		1 a)	2 a)	2 b)	2 c)	2 d)	2 e)	2 f)	2 g)	2 h)	3 a)	3 b)	3 c)	3 d)	3 e)
1 a)	Correlation Coefficient	1	-0.283	-0.188	-0.049	0.22	0.099	-0.171	0.108	0.181	-0.239	-0.145	0.055	0.136	0.026
	Sig. (2-tailed)	.	0.145	0.339	0.805	0.26	0.616	0.384	0.585	0.356	0.221	0.463	0.78	0.49	0.894
2 a)	Correlation Coefficient	-0.283	1	<b>.450</b>	0.083	0.017	0.005	0.175	0.028	0.226	<b>.382</b>	-0.041	-0.17	0.053	0.113
	Sig. (2-tailed)	0.145	.	<b>0.016</b>	0.676	0.931	0.979	0.373	0.888	0.248	<b>0.045</b>	0.834	0.386	0.791	0.567
2 b)	Correlation Coefficient	-0.188	<b>.450</b>	1	0.196	-0.085	-0.027	<b>.498</b>	0.318	0.168	0.203	-0.149	0.22	-0.039	0.154
	Sig. (2-tailed)	0.339	<b>0.016</b>	.	0.317	0.667	0.893	<b>0.007</b>	0.099	0.393	0.301	0.451	0.261	0.843	0.433
2 c)	Correlation Coefficient	-0.049	0.083	0.196	1	<b>.453</b>	-0.079	0.218	0.254	0.058	0.204	-0.13	<b>.550</b>	0.315	0.246
	Sig. (2-tailed)	0.805	0.676	0.317	.	<b>0.015</b>	0.689	0.266	0.193	0.771	0.298	0.509	<b>0.002</b>	0.103	0.206
2 d)	Correlation Coefficient	0.22	0.017	-0.085	<b>.453</b>	1	0.111	0.095	0.044	-0.076	-0.15	0.062	<b>.402</b>	<b>.395</b>	0.373
	Sig. (2-tailed)	0.26	0.931	0.667	<b>0.015</b>	.	0.575	0.629	0.823	0.702	0.447	0.753	<b>0.034</b>	<b>0.037</b>	0.051
2 e)	Correlation Coefficient	0.099	0.005	-0.027	-0.079	0.111	1	<b>.411</b>	0.366	0.326	-0.153	-0.355	-0.053	-0.004	0.295
	Sig. (2-tailed)	0.616	0.979	0.893	0.689	0.575	.	<b>0.03</b>	0.055	0.09	0.436	0.064	0.79	0.982	0.128
2 f)	Correlation Coefficient	-0.171	0.175	<b>.498</b>	0.218	0.095	<b>.411</b>	1	0.146	0.008	-0.135	-0.355	0.264	-0.085	0.291
	Sig. (2-tailed)	0.384	0.373	<b>0.007</b>	0.266	0.629	<b>0.03</b>	.	0.459	0.968	0.494	0.064	0.175	0.669	0.133
2 g)	Correlation Coefficient	0.108	0.028	0.318	0.254	0.044	0.366	0.146	1	0.145	0.094	-0.22	<b>.404</b>	0.261	0.262
	Sig. (2-tailed)	0.585	0.888	0.099	0.193	0.823	0.055	0.459	.	0.462	0.636	0.26	<b>0.033</b>	0.179	0.178
2 h)	Correlation Coefficient	0.181	0.226	0.168	0.058	-0.076	0.326	0.008	0.145	1	0.23	0.068	-0.112	0.23	0.052
	Sig. (2-tailed)	0.356	0.248	0.393	0.771	0.702	0.09	0.968	0.462	.	0.239	0.732	0.57	0.239	0.791
3 a)	Correlation Coefficient	-0.239	<b>.382</b>	0.203	0.204	-0.15	-0.153	-0.135	0.094	0.23	1	-0.015	0.055	0.093	0.223
	Sig. (2-tailed)	0.221	<b>0.045</b>	0.301	0.298	0.447	0.436	0.494	0.636	0.239	.	0.938	0.782	0.637	0.255
3 b)	Correlation Coefficient	-0.145	-0.041	-0.149	-0.13	0.062	-0.355	-0.355	-0.22	0.068	-0.015	1	0.009	0.3	0.131
	Sig. (2-tailed)	0.463	0.834	0.451	0.509	0.753	0.064	0.064	0.26	0.732	0.938	.	0.963	0.121	0.505
3 c)	Correlation Coefficient	0.055	-0.17	0.22	<b>.550</b>	<b>.402</b>	-0.053	0.264	<b>.404</b>	-0.112	0.055	0.009	1	<b>.449</b>	<b>.427</b>
	Sig. (2-tailed)	0.78	0.386	0.261	<b>0.002</b>	<b>0.034</b>	0.79	0.175	<b>0.033</b>	0.57	0.782	0.963	.	<b>0.017</b>	<b>0.024</b>
3 d)	Correlation Coefficient	0.136	0.053	-0.039	0.315	<b>.395</b>	-0.004	-0.085	0.261	0.23	0.093	0.3	<b>.449</b>	1	<b>.421</b>
	Sig. (2-tailed)	0.49	0.791	0.843	0.103	<b>0.037</b>	0.982	0.669	0.179	0.239	0.637	0.121	<b>0.017</b>	.	<b>0.026</b>
3 e)	Correlation Coefficient	0.026	0.113	0.154	0.246	0.373	0.295	0.291	0.262	0.052	0.223	0.131	<b>.427</b>	<b>.421</b>	1
	Sig. (2-tailed)	0.894	0.567	0.433	0.206	0.051	0.128	0.133	0.178	0.791	0.255	0.505	<b>0.024</b>	<b>0.026</b>	.