COMBINING NARRATIVE AND NUMERICAL SIMULATION: A SUPPLY CHAIN CASE

Mette Sanne Hansen[1], Klaes Rohde Ladeby[1], Lauge Baungaard Rasmussen[1], Peter Jacobsen[1]
(1) Technical University of Denmark, DTU Management

ABSTRACT
Strategic foresight deals with the long term future and is used for strategy making. It involves strategy formulation in combination with an analysis of the likely evolution of the business environment, in order to detect and handle opportunities and threats that arise from emerging trends. Strategic simulation is the combination of narrative and numerical simulation and can be used as a tool to support strategic decision making by providing different scenarios in combination with computer modelling. The core of the combined simulation approach (CSA) is to make it possible for decision makers to systematically test several different outputs of possible solutions in order to prepare for future consequences. This paper contributes to the decision making in operations and production management by providing new insights into modelling and simulation based on the combined narrative and numerical simulation approach as a tool for strategy making. The research question asks, "How can the CSA be applied in a practical context to support strategy making?" The paper uses a case study where interviews and observations were carried out in a Danish corporation.

Keywords: Strategic simulation, corporate foresight, scenario analysis, computer modelling, design management, process modelling

1 INTRODUCTION
Short-time to market, changing customer specifications, and global competition characterise many business contexts. Some companies respond by using foresight to analyse the long-term prospects in business environments, markets, and new technologies, and their implications for corporate strategies and innovation. Strategic foresight is a systematic way of managing knowledge, which can be crucial for companies in order to gain competitive advantages and cope with the rising challenges of the increasing turbulent business environment [18]. The term covers a wide range of approaches and methodologies to improve future-oriented decision-making some of these methods are amongst others scenario analysis and modelling.

There is a growing tendency to view supply networks and offshoring as complex systems [2], [14], [3], [11], [12], meaning that there is a high degree of systemic interconnectedness interdependence [5]. There is also a tendency to model and simulate such systems [2], [14], where an example is the agent-based model where attention is focused on the nature of interactions among agents and how changes in the rules governing those interactions can lead to different outcomes [6]. Criticism has been directed at the overly simplified assumptions and interaction rules of agent-based models and stems from the recognition that any outcome is only valuable if it leads to further insight and more fitting simulations [6]. The CSA attempts to use a less simple approach to strategy making as it both includes narrative and numerical simulation.

The CSA was used in a case in a Danish company in order to support strategic decisions regarding the development of the supply chain of the company. A need for investigating different possibilities companies encounter when developing their supply chain and how these can be addressed seems to exist. Strategic simulation is a tool which early on in the decision phase allows managers to explore different scenarios and possible outcomes. In this manner different decisions regarding strategy development can be explored and addressed. The research question is, "How can the CSA be applied in a practical context to support strategy making?".

The findings in this paper are based on a case study in a Danish manufacturing company and its supply chain development. This paper is structured as follows; first a literature review is presented. Hereafter the empirical method and the case are shown. The results are presented and discussed and finally the conclusion is presented.

2 SIMULATION LITERATURE

2.1 Narrative Simulation

Narrative simulation is more specifically defined as Interactive Scenario Analysis, which is concerned with the development of pictures of what might be as well as how to get there by the means of dialogue between scenario builders and relevant stakeholders. Scenarios can help decision makers, planners and stakeholders to get an overview and deeper insight of the possible outcomes of particular decisions. The special feature of scenario analysis is the long term perspective as well as the combination of vision making, story-telling, and strategy formation [16]. Telling stories about systems helps ensure that stakeholders share a sufficiently wide view to avoid missing vital aspects of problems. Scenarios are applicable to systems of all types, and may be used for different purposes such as strategy development, environmental planning, and product development [1]. Though scenarios can never be value-free explorations [8], they help the user to see the future through various sets of lenses, stretching beyond the 'conventional wisdom' or 'conventional mental map' [17].

2.2 Numerical Simulation

Numerical simulation is defined as "*an analytical technique in which a mathematical or logical model of a real system is built in order to draw conclusions about the behaviour of the real system by studying the behaviour of the model.*" [15]. This refers to simulations, not as replicas that give exact results but instead show trends and indicate consequences of a scenario rather than showing the best solution [15]. It is important to point out that depending on the situational context and the purpose of the simulation, a simulation model should be perceived as a representation of reality and not be a complete replica of a real system. In this sense modelling can be used to gain a better understanding of processes and their behaviour [19]. Simulation should strictly adhere to including the relevant factors with respect to the needed results and evaluations [7].

3 METHOD AND CASE

As mentioned the CSA was used in cooperation with a company (company Y). The organisation is a medium sized manufacturing company with headquarters in Denmark and approximately 3.100 employees. The company is represented through subsidiaries (sales- and service companies) in several countries, through a distributor network in more than 70 countries, and through own production facilities in the world, placed both in Denmark and in China. The two production facilities each have their own competencies. The manual assembly of the product is based in China, where low labour costs ensure the competitive advantage. The production here is relatively labour intensive. The production of the core competency of the product and some of the part production is placed in Denmark. Some components are produced in Denmark until the products are mature for production and then they are transferred to a 3rd party supplier in China. The Danish production site also functions as a supplier to China. The core competency part of the product that is produced in Denmark represents a substantial part of the products total cost price. The production facility in Denmark is automated to a high degree in order to reduce the effect of the higher Danish salary level. The production of most of the plastic components has been outsourced to suppliers primarily in China, but due to a high level of competency required to make the plastic component a larger part of the plastic production now takes place in Denmark. In each sales company there is a production of some of the products as they are customised and adjusted to the individual customer. Most of the spare parts and the products are sent to the distribution centre in Denmark. From the distribution centre the products are distributed to the local sale companies, which are responsible for the final distribution to the customers. The remaining spare parts and products are sent directly from the production in China to both the local sales company in China as well as the sales company in USA. Due to the products size the total cost of shipment is only a marginal cost in comparison to the total logistic costs. It is more the ability to sustain the delivery times that is important. The company was interested in addressing their distribution- and production network in order to asses which strategic issues existed and how the

distribution network could be developed in order to be both cost efficient and to improve delivery performance. The case study was carried out in the company and a model of the method used in the study can be seen below.

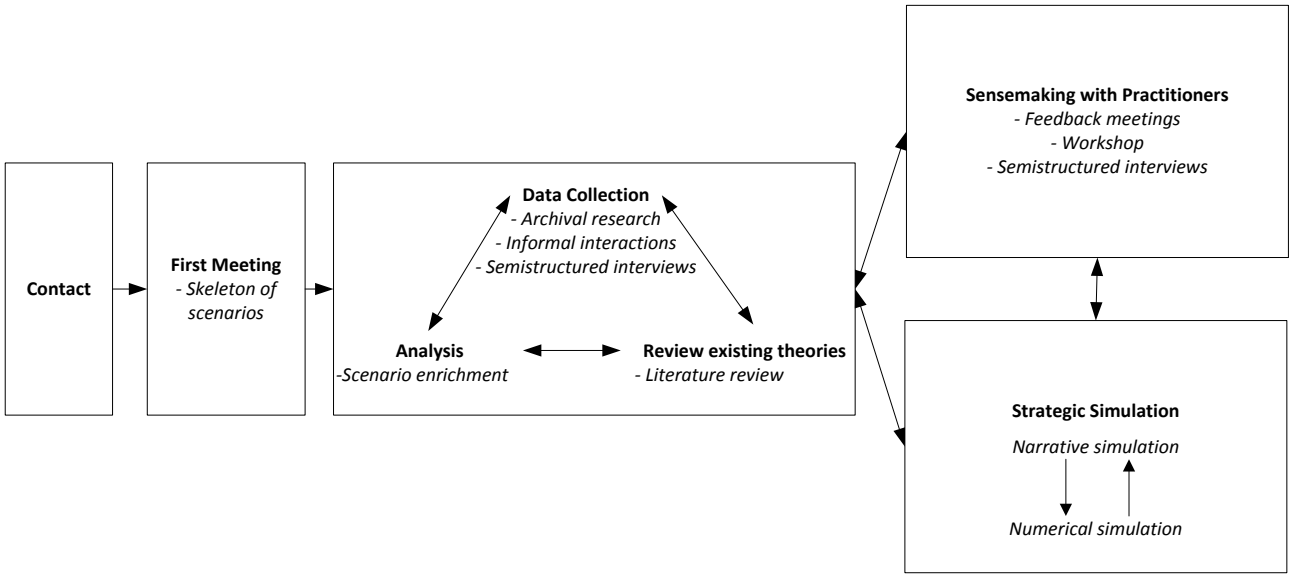

Figure 1: The work process of using narrative and numerical simulation to support strategic decisions

As the model shows observations, interviews, existing data (archival research) was used in the data collection. This data collection was used to form the basis of the strategic simulation so that the the initial scenario description was made as a starting point. The interviews and informal interactions also provided meaningful quotes from the stakeholders in the company, which were used to elaborate the narrative part of the simulation. The idea of combining the two methods as an approach to strategy development is that the two methods can enhance each other as the narrative model often is the starting point offering input to the numerical model, and then the numerical model offers feedback to the narrative model, which then again can be further developed and expand the numerical model and in this way creating an iterative process. It can be seen how responsive an outcome is to changes in some parameter or condition and exploring the boundaries of the model can provide valuable insight to both the narrative and the numerical model. This means that many different situations can be researched and adapted as things evolve. The interaction between the scenarios and the model is important as the idea is to find the narrative points in the numerical simulation. The model emphasises this interaction by the arrow pointing between the scenarios and model. This is a very important point for the process as the interaction is where the creativity is enhanced as the combination of the different approaches highlights different aspects.

4 RESULTS

The distribution situation of company Y was explained on an initial meeting with two stakeholders in the company and was as mentioned based on one distribution centre placed in Europe, which resulted in that most of the products and spare parts were sent to the distribution centre placed in Europe, which then again distributed the goods to diverse sales companies. This could in certain cases mean that sometimes a supplier from e.g. USA send goods to the distribution centre in Europe, which then again sends the goods to the sales company in USA. This increased the level of transport, the level of complication, and the level of inventory as a manager from the company illustrated;

"Sometimes spare parts are sent from a supplier in USA to the GDC in Europe and then back to a sales company in USA. That is not optimal"(Global Planning Manager).

The company was working on an idea that it should have three distribution centres placed in Europe, USA and Asia. Based on this idea and a presentation of the CSA an interaction between the authors

and the two stakeholders began. The idea with three distribution centres resulted in questions from the authors regarding which issues the company was experiencing with the current situation and how they imagined the three distribution centres should distribute to different locations. This interaction also resulted in other ideas regarding the distribution in the company, but such as a distribution centre placed at the Chinese production site. This interaction resulted in the basic ideas behind the scenarios. The more concrete development of the scenario was open, but the idea behind them started to form at the first meeting. Based on this meeting it was agreed upon that the CSA method could be used to explore possible future distribution structures and make a strategy for the future distribution of the company.

4.1 The scenario cross

In order to agree with the company on what the scenarios should contain the authors decided to make a scenario cross. A scenario cross is a matrix which can help structure the scenarios. There are several advantages to building scenarios on a matrix:

- It assures that scenarios are qualitatively different in a logical, non-random way.
- It assures that the identified driving forces or assumptions will be a frame of reference for all the scenarios in the matrix.
- It assures that once the axes of the matrix have been identified, the scenario builder can decide the different scenario features to be included [16].

The scenario cross could help highlight the differences between the different scenarios and to examine which possibilities there were for developing them. The first part of the process was to define the axes of the scenario cross. This process was primarily carried out by the author based on the information given by the two stakeholders at the first meeting and in correspondence the contact person the company. To find the parameters of the scenario cross it will most often be necessary to make an iterative process combining brainstorming, critical discussion and reflection, and 'trial-and-error'. A careful and profound selection process of the parameters is very useful in the remaining steps of the Interactive Scenario Analysis [16] . Much organisational and system research focuses on centralised versus decentralised control [5] and this also reflects one of the axes in the matrix and the situation in the company. Based on the information regarding the company and the situation the first parameters were found by the authors to be:

- Centralised distribution centre versus decentralised distributions centres
- Direct shipments to end customers versus direct shipments to subsidiaries

The parameter centralised distribution versus decentralised distribution was chosen because this was one of the key points of making the scenarios. The current situation today has one distribution centre (the distribution is centralised) and one idea is to go towards a situation where there are three distribution centres (the distribution is decentralised). This parameter reflects the focus that the company has on delivery performance as this parameter will influence this. This also made the scenarios different as two of the scenarios centralises the distribution and the other two decentralises the distribution. The second parameter used in the scenario cross was whether it is possible to ship directly to end customers in order to possibly enhance the delivery performance as well as reducing the costs of having inventory in sales companies and unnecessary steps in the distribution. The figure below shows the four scenarios placed in the scenario cross according to the parameters.

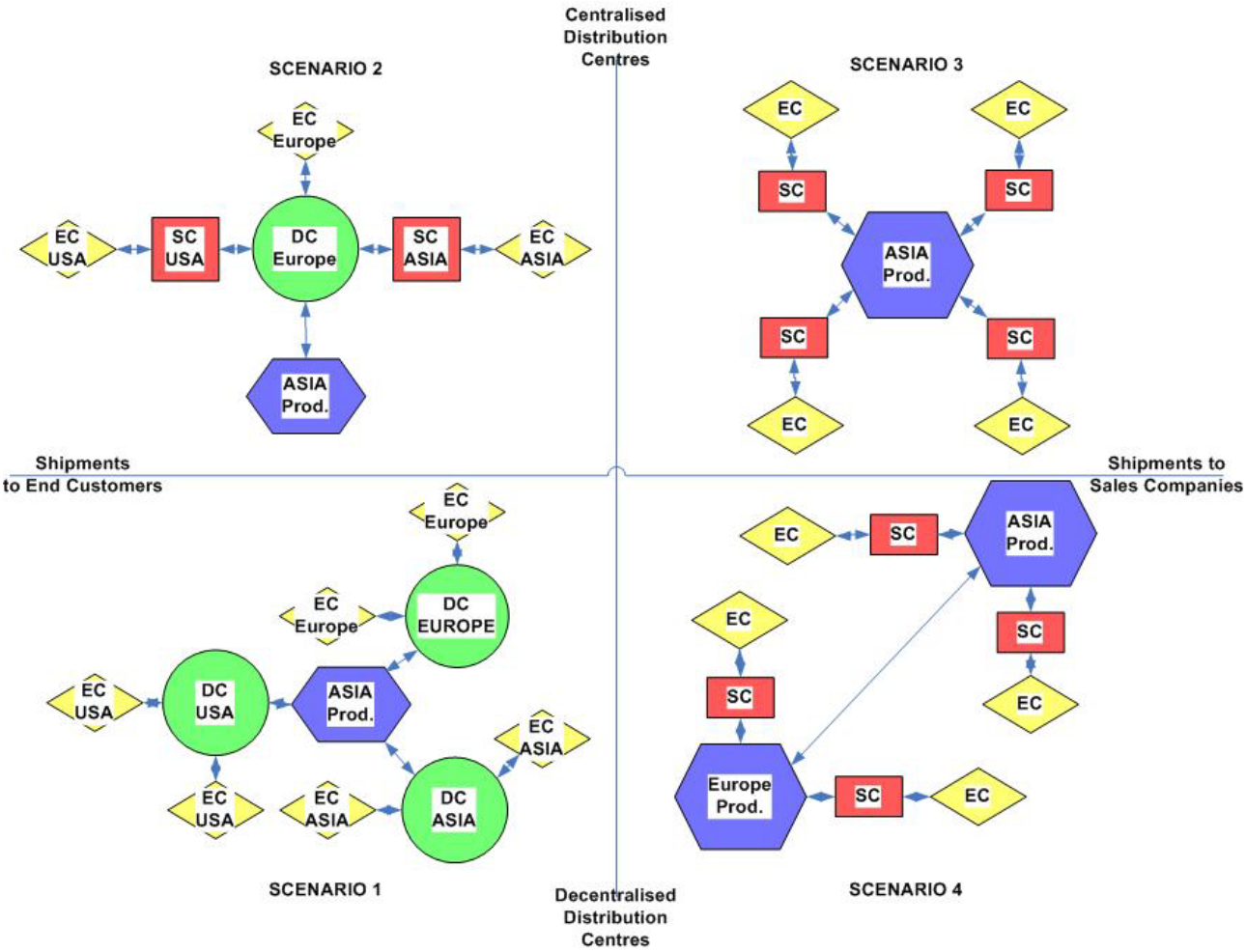

Figure 2: The Scenario Cross

The figure shows four scenarios placed in the matrix with the above mentioned parameters. The blue hexagon represents the production sites – one in china and one in Denmark in scenario 4, the green circle represents the Distribution Centre (DC) in the various countries, the red square represents the Sales Companies (SC) in the various countries, and the yellow rhomb represented the End Customers (EC) in the various countries. Scenario 1 represents one of the new scenarios described by the company where the distribution centres are decentralised to three distribution centres on different locations; Asia, Europe, and USA. This scenario allows for direct shipments to end customers from all the distribution centres. Scenario 2 represents the reference scenario as this is a representation of the current situation with the only difference that there are direct shipments to end customers in Europe. This scenario keeps one global distribution centre in Europe and allows for direct shipments to end customers in Europe, but not for direct shipments to customers outside of Europe. Scenario 3 describes another new scenario described by the company and here the distribution centre has been centralised to be located at the Chinese manufacturing site. This scenario does not allow for direct shipments to end customers, but only through sales companies. Scenario 4 represents a situation that was not indicated by the company itself, and describes a situation where the distribution centre has been decentralised into two locations, namely the Chinese manufacturing site and a European manufacturing site. This scenario does not allow for direct shipments to end customers, but only through sales companies.

This matrix and first draft of the scenarios was introduced to two stakeholders at a meeting. This was necessary partly to agree on the scenarios, but also as there was much information to be collected in the beginning and as the information was gathered from many different persons it was not always in agreement. So the meetings with the stakeholders were a way to try to delimit the complexity of the system. At the meeting an example of a simulation was shown in order to give the stakeholders an idea of what the simulation could be used for, such as tracking the transport costs, evaluate the number of

logistics worker needed, compare the scenarios based on certain parameters. This visual image of the scenarios as well as a visual example of a simulation resulted in both of the stakeholders being very enthusiastic regarding the possibilities of the combination. Based on the presentation they also started to get ideas about how the narrative simulation could include issues such as political implications, custom implications, the company situation etc so that it would not only be the cost factors determining which scenario was the one to pursue, but also other issues that the company dealt with in their work as the ones mentioned above. This made the two stakeholders appreciate that the combination of narrative and numerical simulation can enhance and explain strengths and weaknesses regarding the different simulations that cannot be shown in the simulations at the same time that it makes it possible to evaluate the scenarios based on numbers so that the alternatives are evaluated on both quantitative and qualitative aspects.

"It could be interesting to be able to evaluate the scenarios not only based on numbers, but also from a more qualitatively aspect, as the scenarios can show strengths and weaknesses of the different simulations"(Vice President Global Supply Chain).

This interest in the qualitatively aspects opened up for new information regarding the scenarios.
Interviews, expert panels (stakeholder panel), a SWOT workshop, and observations were used in combination with scenario analysis to understand the context of the case as well as to identify trends and drivers relevant for the case. These methods were found to be relevant as they could give a more qualitative input to the process than just basing the analysis on numbers found in the system.

4.2 The systems

The authors were also given access to the systems with the help of different employees as the systems were quite complicated and as it was difficult to get an overview and use the within a short time frame. The data was vast and somewhat unstructured as it had to be found partly in the systems and partly through different people's knowledge of where the data was actually placed. For example the systems were not all linked together as well as the different countries had different platforms for their MRP (material requirements planning) systems, which is a production planning and inventory control system used to manage manufacturing processes [13]. This resulted in some inconsistency between the data for example the data regarding the weight of the products:

"…You cannot rely of data in the system regarding the weight of the products. Often something that weighs 200 grams is set to 2 kg"(Project Manager).

This meant that information at times had to be found through different sources and it was at times difficult to get structured information as it was not always explicitly available as a lot of the information was personal and tacit. The data in the system regarding the weight was off and it was found through the person responsible for the distribution centre because one of the stakeholders knew that he had the correct data. As a result of being placed in the company it was easy to get the information when it first had been determined who possessed the data. The authors had been on tours of different departments and this helped in getting the data quickly when it was first discovered where the data could be found. The CSA also helped highlight which data was needed as the example of the weight as it was the process of developing the first numerical model that resulted in the authors finding out that the weight of the products was needed in order to calculate the transportation costs. The way of calculating the costs also had to be described in the narrative part and in this way the process was iterative in that the two methods constantly helped enhance each other.

The data was at times difficult to analyse as the authors received many different documents regarding the throughput of spare parts and products in both the distribution centre, but also in the sales companies. This data was not consistent with each other which took some time to decipher with the help of a supply chain analyst.

”Our MRP systems do not run on the same platform, which makes it complicated”(Vice President Component Manufacturing).

The result was that the data input to the models had to be based on the data generated from the distribution centre and that the data from the sales companies had to be disregarded. This made the company aware of the fact that the data they had in the system regarding the sales companies could not be relied on.

“I don´t think we have an overview of what is at the inventories at the different sales companies” (Supply Chain Analyst).

The whole process of collecting the data did help to get a deep understanding of the company, its structure and the network of production and distribution and in order to be able to make the first enrichment of the scenarios. It was also done in order to gain an overview of what was needed for the process of working with CSA and what kind of data could be collected and used. The fact that the author could be a part of the department also meant that it was possible to talk to several different persons that could give information. These talks occurred when needed and the relevant persons had time, meaning that they were not scheduled and planned. This meant that the persons opened up rather fast as the author became a weekly part of the department and that this kind of information was quickly accessible. The findings were in general discussed with the Global Planning Manager in order to verify what was found.

4.3 The parameters

The CSA can help investigate different solutions depending on which parameters are valued. These parameters can for example be costs, quality, delivery time, and delivery quality. The Danish company Y was very focused on cost as one of the managers pointed out;

“...regarding the parameters we are basically cost-driven” (Global Planning Manager).

This meant that the data for the numerical simulation was chosen to be primarily based on measurable costs as this also added a measurable part to the scenarios. A brainstorming regarding the relevant costs for the numerical models was carried out and resulted in a list.

INPUT	OUTPUT
Products and spare parts	Inventory Costs
Shipments	Resource Costs
Transport	Logistic Costs
Supplier information	Supply Performance
Subsidiary information	The Use of Resources
End Customer information	Utilization Degree
Resources	Etc.
Salary	
Etc.	

Figure 3. Example of the input and output variables (clustered) for company Y.

The variables for the scenarios were not limited to costs, but also included system complexity, the flow of products, culture, and closeness to market as it became clear from the numerical models these were necessary to consider. These variables had to be described in the narrative part as it was not

possible to quantify them in the current project. To make the numerical models the input and output data were based on the possible logistics flows described in the scenarios. These variables were described in the scenarios as they influenced the decision making. The variables were changed to be more accurate and to reflect the data that was actually available. This also supports the idea that the narrative simulations help create pictures of which routes should be studied and give an overview of the situation. The input and output data were the same for each scenario as this would make it possible to compare the scenarios. The process resulted in drafts of the numerical simulations of the scenarios. The simulations were carried out in interaction with the company in order to get feedback and in order to use the knowledge and ideas created by both the narrative and numerical simulations in order to enhance each other. This interaction resulted in clarification of certain areas such as the way to deliver directly to end customers was not possible in all scenarios and the scenarios could be further developed as well as additional needed information could be gathered. The data in the scenarios and the information given was more and more refined and the scenarios were continuously reviewed by the stakeholders in order to get feedback. This is an important point of the combination as the process is carried out simultaneously and in parallel. When both simulations are commenced the two forms of simulation will result in further development of the other as clarification of certain areas become necessary and as the combination can spark creativity that results in new developments. The process of developing the CSA continues as a project with further developing one of the scenarios for the company is currently being carried out. The purpose of the continued project is to examine and simulate direct and indirect costs of various possible outsourcing scenarios for the company in order to support decision making in the company. This project is still in progress. However, the collaborating key managers from the company are becoming still more convinced that the CSA method is very useful clarifying points of uncertainties and enhancing adaptability in a continuously changing business environment.

5 DISCUSSION

The core of the CSA is to make it possible for decision makers to systematically test several different outputs of possible solutions in order to prepare for future consequences. The CSA could be a way to evaluate risks and address possible unforeseen problems in a more methodical way than either guessing or forecasting. The CSA is a methodological way that can support and assist companies engaged in global networks in their decision process. The CSA consists in this context of the combination of narrative and numerical simulation. The combination of narrative ad numerical simulation has been used for environmental analysis and to validate requirements from stakeholders [10].

The strength of the CSA is to enhance creativity, clarification, and communication [9] among other to improve transparency. *Creativity* can be improved as the numerical model offers feedback to the narrative model, which then again can be further developed and expand the numerical model and in this way creating an iterative process. It can be seen how responsive an outcome is to changes in some parameter or condition. Exploring the boundaries of the model can provide valuable insight to both the narrative and the numerical model. This means that many different situations can be researched and adapted as things evolve. *Clarification* can be enhanced for both sides as the idea of CSA is to start with a scenario and then translate this narrative into a computer model, which forces a precision and clarification. However, CSA does not stop there as the important point is the interaction between e.g. mangers in the headquarters and the subsidiaries, which again should help clarify uncertainties and ambiguities in the narrative and the scenario. CSA promotes an ongoing iterative process between the two methods constantly clarifying uncertain points and unforeseen factors. *Communication* is increased as the narrative and numerical models are an opportunity for others to share their insights and critique of the models as they are developed, and furthermore by making the models explicit it can be subjected to outside review.

The CSA helped the decision makers test different solutions possibilities before making the decision of what scenario to pursue. The CSA supported their assumption of what scenario would be the most sensible and gave them a tool that supported their indications with calculations. Different factors were taken into account in the CSA so that more factors than the cost factor determined which solution would be the most sensible. The idea of the CSA is to help decision makers both test different

solutions, but also to plan on a long tern perspective. If only planning for the lowest cost several issues can arise. The quality of the product also has to be taken into consideration as well as several factors influencing the overall costs.

The CSA gives a visual image of systems and can in that way help make tacit knowledge more explicit. The numerical models need specific information in order to function which forces the stakeholders to clarify uncertain issues such as how to deal with different cultures and the misunderstandings they can create. This way clarification can be enhanced for all parties as the idea of the combination is to start with a scenario and then transform the parts of the narrative that can be transformed into a computer model, which requires a precision and clarification of terms and mechanisms. In the Danish company Y the scenarios and the numerical models were continuously presented to different stakeholders resulting in the clarification of different issues in the scenarios that were not discovered before the visual images were seen, this were for instance the issue of the possibility of direct shipments to end customers in the different scenarios. The misunderstanding of this issue had been between stakeholders from the same department in the same location meaning that different knowledge systems can influence the outcome of a decision drastically.

6 CONCLUSION

In this paper, new insights into strategic simulation related to strategy development have been demonstrated. Especially the iterative process of combining narrative and numerical simulation has been in focus. Findings from a Danish company who was developing its supply chain showed that the CSA can be used to explore different scenarios. The authors suggest the use of strategic simulation to examine different possibilities when developing a new strategy for the supply chain. The important aspect of the CSA is that it promotes an ongoing iterative process to constantly clarify points of uncertainty and enhance adaptability in order to promote an effective process. The iterative and interactive features of the CSA are important to enhance the transparency of possibilities especially in today's changing business environment. The CSA is a promising method to help managers regarding strategy development and decision making. However, it is imperative that they and the organizational culture as a whole are open towards the iterative CSA way of constantly updating current data and developing several combined simulations of possible futures. If not, the company can quickly end up with an outdated model and strategy. The value of the CSA is also dependent on the learning intention of using it. The CSA method is only as valuable as the input to the approach as well as the actual learning process taking place during the use of the approach.
From a research perspective, CSA can contribute to the scientific knowledge development of how companies can improve their ways of handling strategic simulation and decision making.

REFERENCES

[1] Alexander, I. *Introduction: Scenarios in System Development.* In: I.F. Alexander and N. Maiden, eds, *Scenarios, Stories, Use Cases,* 2004 *(*John Wiley & Sons, Ltd).

[2] Baldwin, J.S., Allen, P.M. and Ridgway, K. *An evolutionary complex systems decision-support tool for the management of operations,* 2010 (Emerald Group Publishing Limited).

[3] Frizelle, G. and Woodcock, E. *Measuring complexity as an aid to developing operational strategy, 1995 (*MCB UP Ltd).

[4] Hansen, M.S., Rasmussen, L.B. and Jacobsen, P., The Interaction Between Narratives and Numbers. In *International Workshop on Socio-Ethics and Interactive Technologies: From Judgment to Calculation.* Middlesex University, London, October 2007.

[5] Hazy, J.K., Goldstein, J.A. and Lichtenstein, B.B. *Comlex Systems Leadership Theory. New Perspectives from Complexity Science on Social and Organizational Effectiveness,* 2007 (ISCE Publishing, USA).

[6] Hazy, J.K., Millhiser, W.P. and Solow, D. *Mathematical and Computational Models of Leadership: Past and Future.* In: J.K. Hazy, J.A. Goldstein and B.B. Lichtenstein, eds, *Complex Systems Leadership Theory: New Perspectives from Complexity Science on Social and Organizational Effectiveness,* 2007(ISCE Publishing).

[7] Jacobsen, P. Production of Modularised Product Systems. In *IFAC-MIM Conference on Manufacturing, Modelling, Management and Control,* 2004 .

[8] Kahn, H. and Wiener, A. *The year 2000, 1967(* Macmillan, N.Y.).

[9] Kemp-Benedict, E. *From Narrative to Number: A Role for Quantitative Models in Scenario Analysis,* 2004 (last update).
[10] Loucopoulos, P. *Evaluating Scenarios by Simulation*. In: I.F. ALEXANDER and N. MAIDEN, eds, *Scenarios, Stories, Use Cases, 2004 (*John Wiley & Sons, Ltd).
[11] Macbeth, D.K. *Emergent strategy in managing cooperative supply chain change,* 2002 *(*MCB UP Ltd).
[12] Macintosh, R. and Maclean, D. *Conditioned emergence: researching change and changing research,* 2001 *(*MCB UP Ltd).
[13] Michelsen, A.U. *Produktionsstyring - Begreber, principper og modeller,* 2010 (Nyt Teknisk Forlag).
[14] Nilsson, F. and Darley, V. *On complex adaptive systems and agent-based modelling for improving decision-making in manufacturing and logistics settings: Experiences from a packaging company,* 2006 (Emerald Group Publishing Limited).
[15] Pidd, M. *Computer Simulation in Management Science,* 2004 (Wiley).
[16] Rasmussen, L.B. *Interactive Scenario Analysis*. In: L.B. RASMUSSEN, ed, *Facilitation of Change. Using interactive methods in organisations, networks, and communities,* 2011 (In Print) (DTU, Denmark).
[17] Van Der Heijden, K. *Three Competing Paradigms in Strategic Management*. *Scenarios - The Art of Strategic Conversation,* 2005 (John Wiley & Sons, Ltd, West Sussex, England).
[18] Von, D.G., Vennemann, C.R. and Darkow, I. Corporate foresight and innovation management: A portfolio-approach in evaluating organizational development. *Futures,* 2010, **42**(4), 380-393.
[19] WYNN, D.C., ECKERT, C.M. and CLARKSON, P.J., Applied Signposting: A Modelling Framework to Support Design Process Improvement, *Proceedings of IDETC/CIE 2006 ASME 2006 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference,* September 10-13, 2006 .

Contact: Mette Sanne Hansen
Technical University of Denmark
DTU Management
Produktionstorvet, Building 425
2800, Kgs. Lyngby
Denmark
+45 26 79 33 91
mesa@man.dtu.dk

Mette Sanne Hansen is a PhD student at the Department of Management Engineering at theTechnical University of doing research of the usability of strategic simulation within production and distribution networks in a global context. She holds a master degree of Engineering Planning and Leadership from the Technical University of Denmark with focus on team work in product development. She has also worked as a project manager in TDC, a large Danish Tele company.