Report on the output of a research project on Strategic Simulation

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Background

This report summarizes the background, the key findings and the main outputs of a two year research project, done by post doc Mette Sanne Hansen, associate professor Lauge Baungaard Rasmussen and associate professor Peter Jacobsen at DTU Management Engineering. The project was fully and generously financed by the Danish Maritime Fund and took place from September 2012 to August 2015 (with a pause from March 2013 to March 2014).

The future offers both opportunities and pitfalls for the shipping industry as the challenge companies’ face today is how to strengthen resilience in the face of increasing systemic turbulence caused by resource and environmental stresses – posing new risks to business continuity. Today’s business environment in the shipping industry is characterized by global competition, changing conditions, and uncertainty. These challenges make it ever more important for shipping companies to develop and implement strategies in order to manage risks and plan for the changing circumstances.

Strategic tools are crucial for decision makers in organisations particularly in rapid changing environments. Traditional risk management for example “Value at Risk” calculations assume that risk distributions are normal. However, most systems have non-normal risk distributions that undermine the very essence of traditional risk management tools. Hence, resilience management focuses on combination of simulation methods that include the search for both normal and non-normal risks. It helps a company to deal with both systemic changes and acute, unforeseen events.

Many approaches to strategy development exist, but most of them are based on either qualitative or quantitative approaches. However, it is the assumption of this approach that there is a need to develop combined approaches to strategy development and risk management exists. Such a Combined Simulation Approach (CSA) can be used to support strategic and operational decision making.
Figure 1 shows the idea that the two methods should be used interactively, and that the stakeholders should be involved in the process through interaction with the observer/modeler or foresight practitioner. It also shows that it is a multi-disciplinary approach that combines scenario building with computer simulation. The result from the narrative component of the CSA method is used by the researcher/observer to build a numerical model in cooperation with the stakeholder/model user. This numerical model can be used by the stakeholder/model user to guide strategic decisions and also acts as a method to check the scenario assumptions and stimulate the generation of new ideas on how the scenarios could develop further. It is a way to systematically test possible impacts of making strategic, tactical, and operational choices in order to make robust decisions about future investment and optimization strategies.

**Strategic Simulation**

During the project narrative and numerical simulations have been developed in cooperation with NORDEN A/S based on relevant aspects for a shipping company. This work have formed the basis for examining how strategic simulation can be used in combination with risk management and strategy development in the shipping industry.

CSA has been conducted at the strategic, tactical, and operational levels of NORDEN A/S. CSA has been used systematically to test possible impacts of making strategic, tactical, and operational. Figure 2 illustrates how it is possible to move interactively between the strategic and operational levels by using CSA.
CSA has been used to intensify the raising of awareness about possible challenges in the future ("awareness raising"), for capacity building of cooperation between decision makers, participatory stakeholders and facilitators of the process, and decision making based on the simulations.

**Awareness raising**

The main objectives of awareness raising are the formulation and dissemination of socio-economic, environmental, infrastructural and/or technological trends that must be recognized and analysed before policy decisions are made. Awareness raising by means of CSA included the following types of activities:

- **Trend-tracking**, to detect weak and strong signals to gain insight into emergent drivers of change
- **Risk analyses**, to increase awareness of the potential risks attached to different routes
- **Trust building**, to agree on the needs, values, and benefits of using CSA for the target audiences

**Capacity building**

The main objectives of capacity building are to institutionalize interactions between CSA practitioners, stakeholders and policy makers. Here we draw a distinction between two institutional levels that are closely interrelated:

- **Procedures**, including structure, rules and methods of communication and decision making

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*Figure 2*

CSA promotes strategic conversations about the future by handling complexity and complicatedness of uncertain future.

CSA promotes strategic conversations across organizational hierarchy.

Combine effects of CSA to promote more dynamic strategic conversations.
- **Roles**, including the anticipations and interaction patterns between the institutionally related actors

The method developed in the project can be used by other maritime companies in order to support the strategy process and risk management. In this research case conducted at NORDEN A/S fuel efficiency was in focus.

![Figure 3](image)

For example, CSA can also be used by other maritime companies to compare several different ship types on several parameters such as for example freight rates, speed, fuel costs, cargo load, distance, fuel consumption, equipment, sailing routes, maintenance, emissions, capex, opex and other relevant parameters. Figure 3 is a concrete example of a visualization of the model showing different ships sailing on different routes as well as the location of the ships, the income, expenses, and CO2 emissions.

**Research output**

The project has produced three academic papers, which are currently under blind peer review in international academic journals. For the review process, the papers have been anonymized, and links to each publication will be provided to the Danish Maritime Foundation upon publication.

- “Interactive Foresight Simulation” (under review)
- “Learning Facilitation of Participatory Foresight” (under review)
- ”Strategic Simulation as a Tool for Strategy Development and Risk Management in the Shipping Industry” (under review)
In addition several conference papers and posters have been published during the project:


The first two were published at an early stage of the project and focus on the generic aspects of the combined method for the maritime industry. The third contribution focuses on the overall aspect of the methods and their use in the maritime sector. The fourth and fifth contributions are based on cases and the use of the methods in relation to strategic subjects in the maritime industry. The sixth contribution focuses on how the methods are taught to students at DTU.

These conference papers and findings have also been presented and discussed at international conferences. These conferences have provided additional values for validation and dissemination of key findings. The presentations had the following titles:

- “Interactive Simulation of Technology Management Foresight”, held at the 22\textsuperscript{nd} IAMOT International Conference for Management of Technology in Porto Alegre, Brazil on April 15, 2015.
- “Using Facilitative Skills in Project Management”, held at the 22\textsuperscript{nd} IAMOT International Conference for Management of Technology in Porto Alegre, Brazil on April 15, 2015.
- ”CSA as a Facilitative Foresight Tool”, held at the 5\textsuperscript{TH} International Conference on Future-Oriented Technology Analysis in Brussels on October 26, 2014.
- ”Ballast Water Management that Adapts to Climate Changes and Reduces Harmful Bio-Invasions in Marine Eco-Systems”, held at the 3\textsuperscript{rd} International Symposium –
Effects of Climate Change on the World’s Oceans in Santos, Brazil on March 24, 2015.
- “Strategic Simulation in The Industrial Sector – Exemplified by a case in the Shipping Industry”, held at the 7TH Global Supply Chain Management Conference in Hangzhou, China on the 27-29 March 2015.

The research results have also been used for teaching the course ”42432 Strategic Simulation” (5 ECTS) at DTU in the fall 2014. The methods have been taught to the students and been used in a case based on the shipping industry. ” During the course several presentations from the industry were made and the level of the reports was very high. The course will in the spring 2016 be integrated in a new bachelor direction and become mandatory for the students that choose ”Strategic Analysis and Systems Design” at DTU.

Furthermore, the research has been used in a master project “Scenario Analysis in the Maritime Sector”, by Casper Hjaltelin in 2014. This work was based on several interviews in the industry and several possible future scenarios for the industry were developed. This work was graded in the high end of the grading scale.

Selected References


P. Jacobsen. “Simulation”, Unpublished compendium notes used in the course 'Simulation in Production and Services', Technical University of Denmark, Department of Management Engineering (2005).


