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Interactive foresight simulation

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ABSTRACT

The Combined Simulation Approach (CSA) is a way to evaluate risks and address potential unforeseen problems in a more interactive way than what is often observed in practice in companies or sectors. The approach is based on a combination of scenario analysis and discrete-event computer simulation with which the strategies can be continuously developed. The contribution of this paper is to narrow the knowledge gap between strategic, tactical and operational levels of an organization. The paper demonstrates how it is possible to work proactively with both the breadth and depth of strategies using a Danish knowledge intensive company as an example.

1. Introduction

Future studies can be based on either forecast or foresight methodologies. Forecasting is the attempt to estimate or predict future occurrences (Roper et al., 2011; Martino, 1983; Porter and Rossini, 2015; Linstone, 1989; Jantsch, 1967; Makridakis et al., 1998; Twiss, 1992; Spithourakis et al., 2015). In contrast, foresight studies do not attempt to predict future events, but to imagine and analyze the impacts of several possible futures (Rasmussen, 2011; Van Der Heijden, 2005; van der Heijden et al., 2002; Lindgren and Bandhold, 2009; Rasmussen et al., 2010; Tuomi, 2012; Miles, 2010; Brabandere and Ivy, 2010; Bezold, 2010). This paper focuses on foresight, especially how foresight studies can benefit from a combined narrative and numerical simulation approach, as well as the potential pitfalls of such an approach. The combined use of narrative and numerical methodologies in foresight studies has been the subject of intense debate (Haegeman et al., 2013; Kemp-Benedict, 2010; Wood and Welch, 2010; Teddlie and Tashakkori, 2009; Johnson and Onwuegbuzie, 2004; Olsen, 2004; White, 2002; Howe, 1992; Mathison, 1988; Jick, 1979; Feilzer, 2010; Kwakkel and Pruy, 2013; Scapolo and Cahill, 2004; Brannen, 2005; Kemp-Benedict; Hazy et al., 2007; Peter and Jarratt, 2013; Bryman, 2007; Castro et al., 2010; Hirch et al., 2013; Loucopoulos, 2004; Lindgren and Bandhold, 2009).

The majority of foresight practitioners have used narrative approaches, because they consider the extrapolation from past and current data as insufficient to address future possibilities. Nevertheless, an increasing number of foresight practitioners argue that a combination of narrative and numerical methodologies are promising but also a challenging way to proceed (Haegeman et al., 2013; Kemp-Benedict, 2010; Teddlie and Tashakkori, 2009; Johnson and Onwuegbuzie, 2004; Feilzer, 2010; Kwakkel and Pruy, 2013; Scapolo and Cahill, 2004; Brannen, 2005; Castro et al., 2010; Bryant and Lempert, 2010; Bãban, 2008; Bazeley, 2004; Cameron, 2011; Howe, 1988; Sale et al., 2002; Laes et al., 2013; Kok and Delden, 2013; Kemp-Benedict, 2013; Terk, 2013; Alcamo, 2008).

It is argued that more robust strategic tools emerge from the interaction between the narrative and numerical contributions (Bryman, 2007; Kljajic et al., 2000; Phaal et al., 2010; Baramichai et al., 2007). A combined narrative and numerical approach can strengthen strategy development (Hazy et al., 2007). The anticipation is that a Combined Simulation Approach (CSA) can be used to consider future options and risks by combining initiatives at the strategic, tactical, and operational levels. "CSA" is the researchers' formulation of an approach that has been discussed widely and combines two well-known methods: scenario analysis and computer simulation. This combination has been examined by the researchers in multiple settings (Kemp-Benedict; Kosow, 2011; Loucopoulos, 2004; Laes et al., 2013; Kok and Delden, 2013; Kemp-Benedict, 2013; Terk, 2013; Alcamo, 2008).

In this paper we will show how CSA proved to be useful for management in a Danish production company to examine different outsourcing/backsourcing strategies and their possible impact on the strategic, tactical, and operational levels. However, first we will clarify how we define narrative and numerical foresight methods. A methodology is numerical when it applies only statistical/mathematical tools and data (Pidd, 2004;

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Howe, 1992; Olsen, 2004; Johnson and Onwuegbuzie, 2004). It is narrative when it consists of stories written as words and/or visualized by drawings and words (Rasmussen, 2011; Kemp-Benedict, 2010; Kosow, 2011; Lindgren and Bandhold, 2009; Van Der Heijden, 2005). CSA is characterized by the use of text, images, and numbers in a sequential and/or interactive manner. Finally, a participatory approach, regardless of whether narrative or numerical data is used, is one by which the outcome requires interactions between the foresight practitioners and relevant types of decision makers and stakeholders (Rasmussen, 2011; Rasmussen et al., 2010). How participatory CSA was executed is explained later on in this paper.

The approach in this paper addresses complex, real-world problems. The modeling of this approach is iterative and can refer to the numerical modeling itself, but also to different sources of knowledge. In large organizations, specific knowledge issues are commonly distributed between several units. A context-oriented foresight approach necessarily involves many different knowledge sources in order to create a cohesive knowledge base. However, the participating members of the organization should not just be reduced to "information wells". A more beneficial approach that will motivate participants to think creatively and constructively is to provide an explicit contextual understanding of why and how their knowledge is important. This means that, throughout all of the different phases, the foresight process must remain transparent and contextualized (Rasmussen et al., 2010; Gallati and Wiesmann, 2011; Rasmussen, 2011). This also includes the validation (Illgen, 1995; Sargent, 2005; Champagne and Hill, 2005) aspects of the modeling process, because the output from the different steps of the combined simulation approach is discussed on an ongoing basis with the stakeholders (Gallati and Wiesmann, 2011). Before we describe how CSA was applied to a specific project, we will briefly introduce the two methods — narrative simulation and numerical simulation.

2. Narrative simulation

In this paper, scenarios are defined as different images of the future. Underestimating the importance of analyzing future uncertainties can lead to policies and strategies that neither protect against possible threats, nor serve to take advantage of the opportunities connected to these uncertainties (Peter and Jarratt, 2013; Tuomi, 2012; Miles, 2010). Scenarios can help decision makers, planners and stakeholders gain an overview of and deeper insight into the possible outcomes of particular decisions. The special feature of scenario analysis is the long-term perspective on top of the combination of vision-making, storytelling and strategy formation (Rasmussen, 2011). Scenarios vary from brief statements to richly elaborated narratives, but are almost always based on the idea of a sequence of actions. To reach their target audience, narratives must be able to fascinate their stakeholders by containing points and events that clearly transcend the present state in a desirable direction. But they must also allow the stakeholders to identify with at least some of the actors or actions in them (Rasmussen, 2011; Van Der Heijden, 2005; Lindgren and Bandhold, 2009; Brabandere and Ivy, 2010; Bezold, 2010; Vecchiato and Roveda, 2010).

3. Numerical simulation

There are many different applications of numerical simulation, but the one used in this paper refers to the analysis of the consequences of a narrative scenario becoming a reality in the future (Jacobsen, 2005). A model is a representation of reality and not a complete replica of a real system (Pidd, 2004; Jacobsen, 2005; Sokolowski and Banks, 2009). Simulation building should be strictly limited to inclusion of the relevant factors with respect to the needed results and evaluation (Pidd, 2004; Jacobsen, 2004; Ross, 2006; Harrell and Tumay, 1995; Chaharbaghi, 1991). Numerical simulation consists of two aspects; the simulation tool, such as a simulation language, and the "modeler", who uses the simulation tool to build a model and analyze it. Computer simulation is needed to assist people in capturing the inbuilt dynamics of a feedback model, and in handling the complexity of a system, such as a large number of variables. It can also be used to reveal unexpected or unintended side effects that occur as a consequence of the deliberate actions. The program ProModel was used to create the numerical simulations. ProModel is a standard commercial off-the-shelf software program developed by the ProModel Corporation (www.ProModel.com). It is a discrete-event simulation technology that is used to plan, design and improve new or existing manufacturing, logistics and other operational systems (www.promodel.com). ProModel was considered easy to work with for both the designer and user as it has elements that the designer builds with using a minimum of programming and as the model can run with graphical representations and the output can also be shown in graphical representation which make it easy to communicate with the decision makers.

4. The combined simulation approach (CSA) — The model and discussion issues

CSA's structure and processes are shown in Fig. 1.

Fig. 1 shows the combination of narrative and numerical simulation and the elements involved in combining narrative and numerical simulation. It emphasizes 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. The CSA method is a collaborative approach that combines scenario building with computer simulation. This combination serves to enrich scenario creation. As can be seen in Fig. 1 above, the narrative component was in this case driven by the researchers/observer in cooperation with the stakeholders in order to find the area of concern and create relevant scenarios. The result from the narrative component of the CSA method was then 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. This is indicated by the arrow between the scenarios and the model in Fig. 1 that depicts continuous interaction between the two methods.

The CSA does not aim to model all aspects of reality, but to look at certain aspects of a system and then generate scenarios based on this area of concern. The narrative simulation can describe aspects that cannot be numerically simulated, and the numerical simulation can clarify the complexities and inconsistencies hidden in the narrative simulation. The combination and interaction of the two methods can enhance the clarification of both the narratives and the numerical models (Kemp-Benedict; Laes et al., 2013; Kok and Delden, 2013; Kemp-Benedict, 2013).

Usually, the process will start with a scenario, and then proceed to translating this narrative into input and output variables usable in a computer model. This combined approach can also enhance creativity because the numerical model offers feedback for the narrative model, which can result in new and useful additions to the narratives. The improved narrative model can reciprocally impact the numerical model. In this way, an iterative process occurs between the two methods of simulation. This can illustrate how responsive an outcome is to changes in specific parameters and under certain conditions. The examination of the boundaries of the model can provide valuable insight into the resilience and usability of both models. This means that many different situations can be researched and adapted as things evolve. Making the models in visual form means that they can more easily be subjected to outside review. The model structure can also be re-used by either the model builder and/or the model user (Kemp-Benedict; Hansen, 2012). This means that the stakeholders can follow the work on the scenarios and the computer simulations as they evolve over time and provide concrete feedback on them.