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Three experiments: The exploration of unknown unknowns in foresight

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ABSTRACT

Emerging uncertainties present a challenge to decision making. On the basis of a review of existing scenario methods, we examine how ontological uncertainty, that is, the situation in which we do not know what we do not know, is included in scenario processes. We present three experimental foresight methods applicable for cases dominated by uncertainty; structural scenarios, shock scenarios and action portfolio and Agent-Based Modeling. The main finding of our experiment is that in order to address uncertainty, we have to relax the plausibility requirements and focus the analysis on futures that are perceived to be non-probable. In this way we are able to challenge existing perceptions and multiply the number of mental models of the futures.

> "*The word reality can never mean anything more than the mental model of the user of that word*"
>
> [*Meadows et al., 2004*, *p 132.*]

1. Uncertainty remains and is increasing

Uncertainty is a real challenge to planning and decision making. This situation is not unknown to policy and business planners, but nowadays uncertainty is more dominant than it used to be. The phenomenon seems to remain with us (OECD, 2011; World Economic Forum, 2013) and to shape our environment. Strategists have to make their strategic choices and decision makers have to make their decisions, even if they know that their perception of the future will prove, with a high probability, to be inaccurate in the course of time. A recent example is a rushed decision by German government to shut down about 40% of the country's nuclear reactors immediately and to phase out the remaining ones by 2022[1] as a reaction to the Fukushima Daiichi nuclear reactor accident which took place on 11 March 2011. The German nuclear ban was passed by the German parliament by the end of June 2011. When the reality brings sudden surprises as in this example, what should be the appropriate tools to meet the increasing information requirements and support planning and decision making?

The global social environment is so complex that it would be unrealistic to hope that we will ever have sufficient information to reduce uncertainty (Anderson, 1999; Courtney, 2003; Walker et al., 2010) to such an extent that we can revert to traditional planning methods. While organizational planners are wise to focus on the "most probable" futures, namely, those that are driven by mega trends and trends, it is equally important to elaborate uncertainties involved in "less probable" events and to plan for these.

In this paper we will focus on decision making specially in the operating environment where uncertainty[2] is dominating development. Surprises — both negative and positive — are part of every decision making at all levels: global, national, organization, and individual (Goodwin and Wright, 2010). For decision makers the ultimate goal for every decision-making situation is to come up with strategies and structures that are designed with uncertainty taken into account (Hamel and Valikangas, 2003; Ansoff, 1984, Raynor 2007). Underestimation of uncertainties and the cost of failure seem to be increasing (Walker et al., 2010). The increasing impact of fat tails (Fig. 1) of probability distribution of futures may potentially require some method adjustments or even new foresight methods. The "fatness" of the tails emerge from the fact that the very low probability (or no-probability) events are more likely to shape our futures (Taleb, 2007).

In this paper we will describe three methodologically very different attempts to explore this field: i) structural scenarios where we apply network topology; ii) the Seven Shocks process that is benefiting from participatory planning and robust portfolio modeling; and iii) quantitative Agent-Based Modeling (ABM) simulation as a vehicle for understanding the impact of uncertainty. First we will present the outcome of our analysis of some of the most-used scenario methods and

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[1] SOURCE http://en.wikipedia.org/wiki/Nuclear_power_phase-out#Germany.

[2] When speaking about uncertainty we refer to a situation where there is not sufficient information about existence of drivers, or we are lacking information about the behavior and/or timing of the drivers, or we do not have understanding of the impact of drivers of change. Modification of Walker et al. (2010) definition.

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0040-1625/

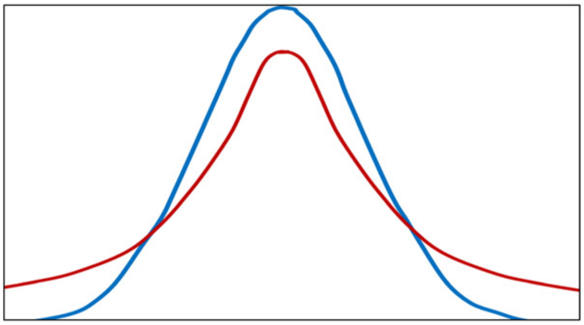

Fig. 1. Events that shape our environment are more often located in tails of the probability distribution. A fat tail is a property of some probability distributions (alternatively referred to as heavy-tailed distributions) exhibiting extremely large kurtosis.
Casti, 1994.

comment on the way they deal with uncertainty. Then we will describe the methods and outcomes of structural scenarios, followed by the Seven Shocks method and Agent-Based Modeling (ABM). The last chapter is dedicated to a comparison of the methods.

2. Literature review

2.1. Epistemological and ontological uncertainty

Foresight is designed for dealing with uncertainty. That is the core reason why the foresight community speaks about "futures" instead of one predicted future (Bishop et al., 2007; Godet, 1993, 2000; Schwartz, 1991). There are two principal strategies for dealing with uncertainty within foresight. The horizon scanning processes are established to collect better information about early signs of change so as to gain some preparation time for changes (Ansoff, 1965, 1979, 1984; Weick, 2001), or we try to anticipate futures by increasing complexity of the analysis and thus the resources used for scenario planning (Godet, 1993; Bishop et al., 2007; Miles, 2010; Miles et al., 2008; Varum and Melo, 2010). In this study we will focus on the latter and try to understand how epistemological and ontological uncertainty can be processed in scenario planning. With scenario planning we refer to the processes of scenario building and reporting (Bishop et al., 2007) and the concept "scenario" in this paper is used to cover both the pathway to the future state (Godet, 1993) and the final outcome the scenario story (Schwartz, 1991).

Lane and Maxfield (2005) refer to three kinds of uncertainties; two of these refer to epistemological uncertainty — truth uncertainty and semantic uncertainty; the third category they call is ontological uncertainty. According to Lane and Maxfield (2005), p.10 ontological uncertainty "resists the formation of propositions about relevant future consequences." The entities and their relationships are simply not known at the time the propositions would have to be formatted.

Epistemology is a study of knowledge; it analyzes the truth of knowledge and the justification for it.[3] In scenario planning, epistemological uncertainty manifests itself, for example, as uncertainty of trends: we do not have solid evidence that these trends will behave in the future as they did in the past, nor do we have enough information about the mechanisms and functional relationships of drivers of change (Makridakis et al., 2009; Walker et al., 2010). To overcome epistemological uncertainty in scenario planning the process can collect more evidence (Daft and Weick, 1984), that is, provide reasons why our beliefs on futures would be right. Recognition of epistemological uncertainty leads scenario planners to conduct more detailed trend analysis, to probability assessments (Godet and Roubelat, 1996), invest time and computer capacity to consistency elaborations (model techniques by Kahn and Wiener, 1967) or alternatively to maximize the number of scenarios (Cook et al., 2014; Loveridge and Saritas, 2012) and to multiply mental models (Miles et al., 2008), or to practice methodological doubt. Or we can simply accept (as Descartes did, more in Walton, 2008) the fact that our knowledge can never be infallible even in the best of cases it is only a social construct (Milojevića and Inayatullah, 2015).

The analysis of fat tails events requires elaboration of ontological uncertainty. Ontological uncertainty is the situation where we do not know what we do not know. We do not know what the entities are that will operate; we do not have knowledge of their interactions; thus we can have no understanding of what will happen (Lane and Maxfield, 2005). We can call this group as unknown-unknowns.

2.2. Uncertainty and scenarios

Several studies that assess different scenario methods have recently been published. Bradfield et al. (2005) classify scenario methods into three different schools. Dana Mietzner and Guido Reger conduct a comprehensive analysis of scenario approaches that, in addition to the Anglo-American and French schools methods, also cover German scenario approaches (Miezner and Reger, 2005). Bishop et al. (2007) review all the scenario techniques[4] — both theory and practices. Amer et al. (2013) continue to analyze foresight methods using the classification of Bradfield et al. from the data perspective.

We rely on methodological examples from each of the categories presented by Bradfield et al. and some comments on the nature of the data by Amer et al.; and we also have added some of the German methods described in the Miezner and Reger paper. The Bishop et al. (2007) analysis has provided us with exact concept definitions. Our review is complementary to those cited above in the respect that neither of these analyses pays special attention to the nature of uncertainty included or the amount of uncertainty processed.

The key points of both of these assessments are summarized in Table 1. Our examples of the Intuitive Logics school are Schwartz's method (Schwartz, 1991); the Reibnitz scenario process (Von Reibnitz, 1991, 1999) from the German school also belongs to the same Intuitive Logics school. The difference is that Reibnitz includes some quantitative data as well. Godet represents the *La Prospective* or the French school. Two American examples from the Probabilistic Modified Trends school are the i) integrated Trend Impact Assessment (TIA) & Cross Impact Assessment (CIA) (Bradfield et al., 2005) method, and ii) the Interactive Futures Scenarios (IFS) method (Millet, 2003) quantitative analysis.

To analyze these examples and their approach to uncertainty, we also have to look at their methodological relationship to and techniques used to deal with uncertainty from the following three perspectives:

- Choice of information/data (trends, expert opinions etc.) used as an input to the scenario process;
- Selection of information/data for the next phase of the process, filtering (Ilmola and Kuusi, 2013);
- Choice of substance to be reported as an outcome of the process.

We perceive that the power to deal with uncertainty is defined mainly within these three domains.

As we see from Table 1, the more or less common denominator for the data sources is a high probability requirement; the methodologies applied use probability assessment of potential drivers in order to distinguish trends/megatrends that will be contributed to scenario building. Typical for IFS is a systematic use of a large set of variables as their input. The quantitative nature of process is naturally based on the data of the past behavior.

3 http://en.wikipedia.org/wiki/Epistemology.

4 Bishop et al. (2007) make a distinction between scenario methods (phases of the process) and techniques (how phases are conducted).