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Promoting safety by increasing uncertainty – Implications for risk management

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ABSTRACT

Recent developments in risk assessment acknowledge the need to capture both quantitative and qualitative uncertainties in order to better understand and manage risks. This paper goes a step further yet by arguing that existing uncertainties do not only have to be acknowledged in order to improve risk management and safety, but that in certain circumstances deliberate increases in uncertainty are conducive to more safety. Within a general framework of managing uncertainty, balancing stability and flexibility in work processes and matching control and accountability for these processes are proposed as criteria for decisions on reducing, maintaining, and increasing uncertainty. How operational and strategic decision-making involved in designing, employing and monitoring high-risk systems is affected by considering increasing uncertainty as a viable option is shown for two examples: rule-making where the most appropriate rules are not necessarily those that are most restrictive and thereby uncertainty-reducing, but rather 'flexible rules' that support adaptive action by providing degrees of freedom which initially raise rather than reduce uncertainty for the decision-maker; and speaking up which entails empowering people to voice concerns and doubts about a chosen course of action in ways that allow to incorporate the added uncertainty into sounder decision-making. Finally, decision-making in risk management is discussed more generally by drawing on current debates of what constitutes rational choice. In order to prepare the ground for capitalizing on the benefits of increasing uncertainty, the necessity to reflect on fundamental beliefs concerning human rationality is emphasized.

1. Introduction

Uncertainty is at the heart of risk. Only very recently, though, uncertainty has regained a significant place in debates on risk. In an early economic definition by Knight (1921), risk was distinguished from uncertainty by postulating that risk is measurable, while uncertainty is not. Subsequently, risk has dominated the debate, usually based on definitions where uncertainty is quantified into probabilities, which presumably renders a separate discussion of uncertainty obsolete. By virtue of renewed concerns with improving our grasp of very rare events, as illustrated by the popularity of Taleb's (2007) book "The Black Swan", uncertainty has re-entered academic and practical discourse in risk management. This is reflected in recent, very broad risk definitions like the one by Aven and Renn (2009), where "risk refers to uncertainty about and severity of the events and consequences (or outcomes) of an activity with respect to something that humans value", leaving open whether uncertainty is of a quantitative or qualitative nature and whether it concerns expected gains or losses. In an attempt to disentangle the risk metaphors of 'black swans' and 'perfect storms', Paté-Cornell (2012) differentiates between two types of uncertainty: perfect storms in her view entail rare conjunctions of known events which in principle can be expressed by probability estimates, while black swans involve unknown events that defy any kind of prediction. By arguing for the importance of capturing both quantifiable and non-quantifiable uncertainties in risk assessments, risk researchers aim to increase political and public acceptance of admitting to realms of risk that are difficult if not impossible to control by current methods and instruments in risk management. At the same time, acknowledgement of uncertainty that can neither be reduced nor captured quantitatively is hoped to spur development of new methods in risk assessment and management that build risk control on more realistic scenarios, for instance by integrating weighted costs and benefits of best and worst cases (Farber, 2011).

This paper goes a step further still by arguing that not only do existing uncertainties have to be more fully acknowledged in risk assessment, but that in order to improve risk management and safety more generally deliberate increases in uncertainty may be

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beneficial. This leads to suggesting that risk management – defined as "coordinated activities to direct and control an organization with regard to risk" (ISO3100, 2009, p. 2) – includes decision-making on avoiding, reducing, retaining or transferring risk and uncertainty as well as on increasing uncertainty. A similar extension is mentioned in the ISO 31000 standard by listing "increasing risk to pursue an opportunity" as an option for risk treatment (ISO3100, 2009, p. 6). Spelling out in more detail when this is a viable option and demonstrating the potential value of increasing uncertainty more generally for the risk management process, that is all activities ranging from risk identification and assessment to risk treatment and risk communication, is the main purpose of this paper. Within a general framework of managing uncertainty requirements for decision-making on reducing, maintaining, and increasing uncertainty at the strategic and operational level of organizational functioning are analyzed and implications of current debates on what constitutes rational choice discussed.

2. Managing uncertainty as part of risk management

The final report on the events at Fukushima makes the disturbing claim that Japanese culture should be considered the root cause of the nuclear disaster. "What must be admitted – very painfully – is that this was a disaster 'Made in Japan'. Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity" (NAIIC report, 2012). Thus it is argued that uncertainty avoidance led to the many faulty decisions before, during, and after the Fukushima catastrophe.

Challenging authority by voicing concerns, encouraging divergent thinking in order to bring out more alternatives and criteria in decision-making, and allowing decision latitude in support of adaptive behavior are crucial elements of sound decision-making. This implies, however, a willingness to deliberately increase uncertainty at least temporarily, which seems to have been missing in Japan, but also in many other reported cases such as the two major accidents of US shuttles. Concerning those accidents Feldman (2004) made the interesting observation that uncertainty could not appropriately enter the discussions because the involved engineers were used to taking only quantifiable uncertainties into account, while many of the concerns in these two tragedies were of a qualitative nature. "They (the NASA engineers) were not able to quantitatively prove flight was unsafe, so in this culture it became easy for management to claim it was safe. [...] Under conditions of uncertainty, cultures dominated by the belief in [...] objectivity must be silent. This silence makes these cultures vulnerable to power and manipulation" (Feldman 2004, p. 708). Similarly, Farber (2011) has described the unwillingness of the US Nuclear Regulatory Commission to consider risks that could not be quantified, such as terrorist attacks on nuclear facilities, which led them to ignore those risks in all further decision-making.

These examples illustrate the necessity to manage uncertainty in a more explicit and systematic manner in risk management not only by considering both quantitative and qualitative uncertainty in risk assessments (e.g., Bjelland and Aven, 2013), but also by including options of reducing, maintaining *and* increasing uncertainty in decisions on risk mitigation. In the discussions to follow, uncertainty is understood in its most basic form as 'not knowing for sure' due to lack of information and/or ambiguous information (Daft and Lengel, 1984; Galbraith, 1973; ISO3100, 2009). With this understanding in mind, it is important to note, however, that more information does not necessarily reduce uncertainty, but may open up new perspectives for decision-making for which again further information is required, thereby in fact increasing uncertainty.

The examples also hint at a fundamental difficulty in adequately managing uncertainty in terms of assessing all three options of reducing, maintaining and increasing uncertainty: These three options are founded on fundamentally different conceptions of risk control (see Table 1). *Reducing uncertainty* to a level of acceptable risk is the main thrust in classic risk mitigation. The overall objective is to create stable systems that allow for a maximum of central control. Measures such as standardization and automation help to streamline work processes. *Maintaining uncertainty* follows from acknowledging the limits to reducing uncertainty in complex systems, which has led to the development of concepts like "high reliability organizations" (Weick et al., 1999) and "resilience engineering" (Hollnagel et al., 2006). Flexibility as a source for resilience, that is the capability of systems to recover from perturbations, is sought. For this purpose, control capacity needs to be decentralized, e.g. by means of empowering local actors. *Increasing uncertainty*, finally, aims at flexibility not only in response to perturbations, but also in support of innovation. An important conceptual basis is complexity theory (cf. e.g. Anderson, 1999) and self-organization as one of the theory's fundamental principles. Self-organizing local agents are assumed to not be directly controllable; instead they are indirectly influenced in their adaptive behavior by shaping contexts, for instance through setting incentives and constraints for experimentation.

Carroll (1998) has pointed out that the different conceptions of risk control tend to be prevalent in different professional (sub)cultures within organizations (Schein, 1996). While engineers and executives believe in uncertainty reduction through design and planning, operative personnel are very aware of the need for resilience in the face of only partially controllable uncertainties. Social scientists finally will argue for openness to learning and innovation, thereby even adding uncertainty. Reducing, maintaining, and increasing uncertainty also form the core of the three models of safety postulated by Amalberti (2013) for different industries. According to him, ultra-safe systems like aviation are built on reducing uncertainty through standardization and external supervision, while high reliability organizations, for instance in health care or the chemical industry, are characterized by their ability to collectively cope with inevitable uncertainties. Ultra-resilient systems, finally, are those that seek uncertainty as part of their business models, for instance in stock market trading or in military aviation. The safety performance of these systems is generally lower compared to the other two types of organizations, but will greatly vary based on the level of competence of the highly autonomous actors that run ultra-resilient systems.

Building a shared understanding of the legitimacy of all three options of reducing, maintaining and increasing uncertainty across professional boundaries is paramount to developing a more comprehensive approach to risk management. Once this has been achieved – which is in itself a very difficult task to which I will return in the final sections of this paper – the issue becomes to determine criteria that will allow decision-makers to systematically choose between the three options. Beside all the specific operational, strategic, and political concerns that will govern such choices, there are two fundamental criteria: (1) Optimal balance between stability and flexibility; (2) Optimal match between control and accountability. Both of these are expanded upon in the following.

2.1. Balance between stability and flexibility

Early work in organization theory promoted a contingency perspective which called for either stability or flexibility depending on the level of uncertainty with which an organization is faced (cf. e.g.,