Chapter 9
On the Importance of Culture for Safety: Bridging Modes of Operation in Adaptive Safety Management

Gudela Grote

Abstract There is no one best way to improving safety performance. Rather, organizations need to have the ability to operate in different organizational modes depending on external and internal conditions. Organizational actors need to recognize and implement switches between modes of operation, e.g. changing from more centralized to more de-centralized work processes and vice versa. It is argued that organizations are confronted with but also actively construct different conditions for safety with respect to the amount of uncertainty they have to manage. Choices about reducing, absorbing, and creating uncertainty along with external demands on the organization require teams to operate in the face of various mixes of stability and flexibility demands. Culture is a strong stabilizing factor, needed particularly when teams have to be very flexible and adaptive. Culture can also help to build the interdisciplinary appreciation required for integrating highly diverse knowledge in search of the most effective solutions to safety problems.

Keywords Uncertainty · Adaptive capacity · Safety culture · Switching operational modes

1 Introduction

A key question in the long-standing debate between proponents of different conceptual approaches to safety is whether there is one best way to achieve it (Grote, 2012). Many well-known safety theories and models would seem to imply that indeed one size fits all, be it the organizational abilities of responding, monitoring, anticipating, and learning in resilience engineering (Hollnagel, Pariès, Woods, & Wreathall, 2011), the reporting, just, flexible, and learning culture advocated by Reason (1997), or the five characteristics of high-reliability organizations (HRO): preoccupation with failure, reluctance to simplify, sensitivity to operations,

G. Grote (✉)
ETH Zürich, Zürich, Switzerland
e-mail: ggrote@ethz.ch

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commitment to resilience, and deference to expertise (Weick & Sutcliffe, 2001). However, a closer look at the reasoning for these characteristics reveals that they all build on the fundamental insight that organizations need to be able to switch between different modes of operation in order to respond to changing internal and external demands (LaPorte & Consolini, 1991; Weick & Roberts, 1993).

The requirement for organizations to be adaptive and the specific measures organizations need to take in order to fulfill this requirement are the starting point for the discussion to follow. First, it will be argued that organizations are confronted with but also actively construct different conditions for safety with respect to the amount of uncertainty they have to manage (Grote, 2016). Second, the modes of operation needed to respond to these conditions will be reflected upon with respect to requirements for safety management. Lastly, the role of culture in helping to bridge different modes of operations will be discussed and recommendations for building and maintaining an appropriate culture presented.

2 Approaches to Uncertainty Management

Uncertainty is understood in its most basic form as 'not knowing for sure' due to lack of information and/or ambiguous information (Daft & Lengel, 1984; Galbraith, 1973; ISO 31000, 2009). There is a growing consensus that managing risk and safety not only entails the systematic consideration of quantitative and qualitative uncertainty in risk assessments (e.g., Bjelland & Aven, 2013), but also choices between reducing, absorbing *and* creating uncertainty as part of risk mitigation (Amalberti, 2013; Griffin, Cordery, & Soo, 2016; Grote, 2009, 2015; Pariès, 2016). These choices are influenced by the conditions organizations face with some having to operate in more uncertain environments, e.g. due to strong competition, or having to accomplish tasks which inherently contain more uncertainty, e.g. complex problem solving. Additionally, choices are impacted by requirements for risk control, such as, for instance, those prescribed by regulatory agencies. Moreover, decision-makers in organizations may hold different worldviews regarding adequate risk management, which will also influence preferred approaches to managing uncertainty.

Grote (2015) summarized existing approaches to uncertainty management into three broad categories (see Table 1). *Reducing uncertainty* to a level of acceptable risk, the main thrust in classic risk mitigation, is built on the belief that safety can only be achieved in stable systems with a maximum of central control. This belief favors safety measures such as standardization and automation in order to streamline work processes. *Absorbing uncertainty* comes from acknowledging the limits to reducing uncertainty in complex systems and the corresponding belief that safety stems from a system's resilience, that is its capacity to recover from perturbations. Within this belief system, control is to be decentralized, based for instance on the empowerment of local actors and fast feedback loops. Finally, the importance of *creating uncertainty* is inherent in a worldview that stresses

Table 1 Approaches to uncertainty management

	Reducing uncertainty	Absorbing uncertainty	Creating uncertainty
Objective	Stability	Flexibility	Innovation
Conceptual approach	Classic risk mitigation	Resilience	Self-organization
Control paradigm	Central control	Control by local actors	Shaping contexts for local actors
Examples of safety measures	Standardization; automation	Empowerment; fast feedback loops	Setting constraints for experimentation

Adapted from Grote (2015)

self-organization and innovation as drivers for safety. Local agents are assumed to be controllable only by shaping contexts for their adaptive behavior, for instance through setting incentives and constraints for experimentation.

Carroll (1998) has pointed out that different conceptions of uncertainty management tend to be prevalent in different professional (sub)cultures within organizations. 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. Lastly, social scientists, in their role as consultants or human factor specialists for example, will also argue for openness to learning and innovation, thereby promoting the benefits of uncertainty creation.

3 Different Modes of Operation in Response to Changing Uncertainty Landscapes

Depending on external and internal conditions and the choices made regarding reducing, absorbing or creating uncertainty, organizational actors find themselves confronted with different demands on the stability and flexibility of their behavior (Grote, 2015; Pariès, 2016; Vincent & Amalberti, 2016). The main drivers for seeking stability are demands on predictability, reliability, and efficiency, or more generally on control. These demands are created within organizations, but they may also stem from external sources such as regulatory bodies. Highly dynamic and uncertain environments tend to form the main source of flexibility demands (Thompson, 1967). However, flexibility needs also arise from within the organization due to complex production processes or possibly the opposite—highly routinized work processes, where over-routinization and complacency are to be avoided by introducing variation and change (Gersick & Hackman, 1990).

Table 2 illustrates how organizations in different industry sectors, different functions within organizations and different work tasks may rely on the three options for handling uncertainty. Thus, in organizations which overall are geared

Table 2 Illustration of options for managing uncertainty at different organizational levels

	Reducing uncertainty	Absorbing uncertainty	Creating uncertainty
Industry sector	Nuclear power	Health care	Oil exploration
Organizational function	Production planning	Operations	R&D
Work task	Routine task	Problem-solving	Inventing

Adapted from Grote (2015)

towards reducing uncertainty there will be certain functions and work tasks that require absorbing or creating uncertainty and vice versa. Accordingly, demands on stability and flexibility will vary across different parts of the organization and possibly within single units when work tasks change. Additionally, Vincent and Amalberti (2016) have pointed out that the most effective uncertainty management even for the same work task within the same organizational unit can vary due to changing working conditions, e.g. staff shortage or time of day.

How the actual organizational processes may differ in response to varying demands for stability and flexibility can be illustrated for the coordination within work teams (Grote et al., 2018):

- When both stability and flexibility demands are low, as for instance in team debriefings where the focus is on sharing knowledge and learning outside of acute work pressures, coordination mostly happens among team members without much reliance on formal leadership or organizational rules.
- When stability demands are high and flexibility demands are low, as in many process control tasks, the emphasis is on efficient production, usually enabled by structural coordination mechanisms embedded in technology and standard operating procedures, leaving little need for leadership or mutual adjustment among team members.
- When stability demands are low and flexibility demands high, for instance in teams that have to innovate at all cost, coordination happens by mutual adjustment and shared leadership to bring all team members' competences and resources to bear on idea generation and implementation.
- When stability and flexibility demands are high because both highly reliable performance of complex tasks and fast reactions to unpredictable change are required, a broad range of coordination mechanisms has to be employed in parallel, helping teams to maintain control, e.g. through directive leadership and/or strong shared norms, and be adaptive, e.g. through sharing leadership tasks.

Teams may have to move quickly between the four conditions and switch their mode of operation accordingly. A surgical team may perform a routine operation (high stability, low flexibility) followed by a complex emergency operation (high stability, high flexibility). It will also undertake team debriefings (low stability, low flexibility) and may engage in experimenting with a new operating technology (low stability, high flexibility). As a consequence, continuous monitoring of stability and

flexibility requirements and of necessary adaptations following decisions on reducing, absorbing or creating uncertainties is crucial for the comprehensive management of risk and safety.

An additional distinction to be made in order to define the best possible modes of operation for any given situation is that between personal or occupational safety and process safety. Personal safety is related to hazards that can directly damage the worker's health and well-being, such as exposure to toxic substances or mechanical forces. Workers need to protect themselves against these hazards which often creates tasks outside of their primary work task, for instance by having to wear personal protective equipment when repairing high voltage power lines. The second kind of safety is process safety. Here the work process contains risks for others beyond the workers themselves, such as passengers on a train or aircraft, patients being operated on, or people living next to a power plant. Safety requirements are inherent to the performance of these work processes and do not create extra tasks for the workers involved.

Personal and process safety may be related to different parts of work processes and may or may not coincide for workers and other affected individuals. During an operation, a surgeon handles process risks for his or her patient which do not contain personal safety issues for him or herself. However, the risk of infection exists for both the patient and the surgeon. An interesting example to illustrate this distinction is hand hygiene. Health care personnel wear gloves to protect both the patient and themselves. However, depending on which function is salient for them, they will be more or less careful about touching non-sterile objects with their covered hands (Jang et al., 2010).

Demands on personal safety tend to be predictable and the required behavior is prescribed in safety rules and monitored by the team itself and by supervisors and auditors. Accordingly, personal safety can be said to increase demands on the stability of team behavior. Demands on process safety also increase stability demands, especially when the level of risk embedded in the work process is very high. However, inasmuch as work processes are complex and only partially predictable due to high levels of external or internal uncertainties, process safety needs to be ensured by concurrently responding to high flexibility and high stability demands. As discussed earlier, flexibility demands may not only be imposed on the team, but also wilfully created in search of innovative solutions to problems and opportunities for learning. These are the situations that according to Perrow's (1984) seminal analysis are unmanageable because organizations are ill-equipped to handle concurrent centralization and decentralization demands stemming from tightly coupled and highly complex processes. Seeking ways to manage these situations has motivated much of the research on fostering resilience and adaptive capabilities in teams and organizations.

Griffin et al. (2016) in their summary of research on organizational adaptive capabilities required for adequate safety management have gone a significant step further still. They argue that there is not only a need to be adaptive in day-to-day operations, but also in response to demands for major organizational change. This "dynamic safety capability" includes three components (Griffin et al., 2016, p. 254):

- sensing, which refers to the ability to scan and interpret the external environment for opportunities and threats to safety;
- seizing, which refers to the ability to integrate complexity by managing contradictions and competing goals related to safety;
- transforming, which refers to second-order change aimed at modifying core safety capabilities and transforming processes and procedures.

4 The Role of Culture for Adaptive Safety Management

The requirement to manage multiple organizational forms and to help organizational actors switch between them in response to changing external and internal demands is broadly discussed in the management and organizational literatures, especially under the headings of managing paradox (Smith & Lewis, 2011) and organizational ambidexterity (O'Reilly & Tushman, 2013). For the most part, the role of culture is touched upon in very generic terms in this research, pointing to the necessity to build common norms and values that help bridge apparent contradictions such as discipline and stretch, control and flexibility, or diversity and shared vision (Gibson & Birkinshaw, 2004; Lewis & Smith, 2014; Wang & Rafiq, 2014). Some authors argue that ambidexterity—the ability to concurrently exploit existing knowledge and to explore new ideas—can only be achieved by having dedicated organizational units operating in flexible versus stable modes supported by the respective cultural mindsets. They stress the crucial role of senior management who have to create an overarching vision, while also communicating the need for resolving the inevitable trade-offs and conflicts inherent in organizational ambidexterity (O'Reilly & Tushman, 2008).

With respect to safety management, the role of culture as a source of adaptive change has not yet received systematic attention, as stated by Griffin et al. (2016). One attempt to describe linkages between culture and adaptive safety management has been made by Reiman, Rollenhagen, Pietikäinen, and Heikkilä (2015). Based on the literature on complex adaptive systems, they outline a number of tensions similar to those already mentioned (e.g., trade-offs between repeatability and flexibility or between global and local goals) and argue that a more mature safety culture will develop when these tensions are explicitly addressed. Another approach to capturing the contribution of culture to organizational adaptiveness has been to define certain core values which should be shared, foremost mindfulness (Weick & Sutcliffe, 2001), that is the readiness to continuously scrutinize existing and emerging expectations within a larger context. A mindful culture, or to use Reason's (1997) terms, an informed culture, contains four components: reporting culture, just culture, flexible culture, and learning culture. The latter two components in particular refer to an organization's adaptive capabilities, supporting, for instance, sensing mechanisms in teams that allow them to recognize changing environmental demands and switch modes of operation accordingly.

Where does all of this leave a dedicated senior manager keen to develop adaptive capacity and the cultural basis to support that adaptive capacity in his or her organization? Three general recommendations can be derived from existing research, which will be described below.

4.1 Recommendation 1: Understand the Limits to Managing Culture

As has been stated most prominently by Schein (1992), organizational culture comprises patterns of shared basic assumptions that groups develop as they learn to cope with internal and external challenges in their organization and that are taught to newcomers in the organization as the correct way to see the world. From this definition follows that cultural change is usually slow and not fully predictable. Culture is affected by safety management measures as through all other activities in the organization, but this process cannot be centrally managed nor prescribed. Culture generally shows itself most clearly during organizational change when basic assumptions are challenged. Therefore, instead of prescribing a certain kind of culture, senior managers should be alert to any indication of resistance to change towards more safety, aim to identify specific cultural norms and assumptions that may be the source of this resistance, and work towards changing those norms and assumptions.

Attempts to assess culture are generally only meaningful if they can serve as leading indicators of safety, that is if they help to identify norms and assumptions that potentially hurt safety performance. When used as part of post hoc explanations for accidents and incidents, culture tends to obscure the picture because, by focusing attention on very broad assessments of norms and values, it distracts from manifest organizational and management problems. An example is the expert report on the BP Texas City accident (Baker, 2007), where many problems in the work organization were mentioned, but not analyzed in much detail, only to conclude that inadequate safety culture was a major cause of the accident. Due to the inherent difficulties in observing culture and in evaluating what a "good" culture is, organizations are best advised to assess safety management rather than culture. Shared perceptions of safety management, which are captured by safety climate questionnaires (Flin, Mearns, O'Connor, & Bryden, 2000) have been shown to be a valid leading indicator for safety performance (Christian, Bradley, Wallace, & Burke, 2009).

4.2 Recommendation 2: Foster Culture as a Stabilizing Force in Adaptive Organizations

Culture itself is a coordination mechanism, which helps to integrate work processes and build a shared understanding of work goals and means to achieve them. Thereby culture serves as a 'soft' centralization mechanism for decentralized operations in organizations. As Weick (1987, p. 124) has described it:

> (Culture) creates a homogeneous set of assumptions and decision premises which, when they are invoked on a local and decentralized basis, preserve coordination and centralization. Most important, when centralization occurs via decision premises and assumptions, compliance occurs without surveillance.

Shared basic assumptions encapsulated in organizational and team culture are a crucial stabilizing mechanism for otherwise highly adaptive behavior including switches between different modes of operation (Grote, 2007). For instance, a shared norm of always speaking up with concerns and ideas will better help to master unexpected challenges than any attempt to cover all the possible turns situations can take by means of standard operation procedures (Grote, 2015). Another example is psychological safety, which refers to the shared belief that it is safe to take interpersonal risks in a team (Edmondson, 1999). Psychological safety acts as a stabilizing factor in teams, freeing resources for handling the substantial cognitive demands arising from highly-uncertain situations.

4.3 Recommendation 3: Build Culture by Bridging Worldviews and Accepting Ambiguity

Building an overarching culture of interdisciplinary appreciation (Grote, in press) is crucial for bridging the worldviews embedded in the different approaches to uncertainty. Adaptive safety management depends on a shared understanding across professional boundaries of the legitimacy of reducing, absorbing and creating uncertainty in response to complex and dynamic situations. This can be achieved by promoting perspective taking and cross-learning among the different professions involved in safety. The diverse belief systems have to be reflected on and sufficiently reconciled to create shared views on problems and on ways to solve them.

Acknowledging different perspectives on problems and possible solutions also results in a high tolerance for ambiguity. Rather than declaring one perspective as being correct, decision-makers have to balance different perspectives and make difficult trade-offs. This also holds for leaders more generally who cannot follow one best way of leading, but have to have a broad portfolio of behaviors at hand to answer to changing stability and flexibility demands. Formal leaders may have to step back to let team members do the leading at one moment and may have to resume control in a directive fashion shortly after if conditions change fast (Klein,

Ziegert, Knight, & Xiao, 2006). The importance of this dynamic capability has long been recognized in the management literature (e.g., Denison, Hooijberg, & Quinn, 1995), but acquiring it in practice remains a challenge.

5 Final Remarks

The main argument in this chapter has been that organizations need adaptive safety management in order to make adequate choices between reducing, absorbing, and creating uncertainty and to support teams in changing their modes of operation in response to those choices as well as external conditions. Beyond building the mindful or informed culture that is generally considered a solid foundation for adaptive safety management, the fundamental role of culture as a powerful stabilizing force that helps to coordinate action and integrate work processes in decentralized and flexible modes of operations should be taken into account and employed wisely. Regarding the particular nature of cultures that are beneficial for adaptive safety management, one crucial aspect is respect for the viability of different perspectives on problems and their solutions. Such a culture of interdisciplinary appreciation is at the heart of bringing all knowledge in organizations to bear on finding the most effective ways to promote safety.

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