

Rules management as source for loose coupling in high-risk systems

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Abstract. A core requirement for resilience is to achieve an adequate balance between stability and flexibility in the functioning of an organization. This balance is framed in terms of the concept of loose coupling and investigated by looking at the use of different types of rules and their effects in organizations belonging to the high-risk domains of civil aviation, medicine and railways. Rules were chosen as a focus because standardization is a crucial element of most safety management systems. Findings indicated important differences in the amount and type of rules employed within and between organizations. Some of these differences appeared to be well-aligned with the demands of stability and flexibility, e.g. finding more open process rules in areas with higher uncertainties. Others appeared to be ill-fitted to the operational conditions, e.g. providing more open rules to actors with particularly low competence levels. Also, interesting interactions between rules and other coordination mechanisms were found, e.g. better performing teams used more leadership in work phases with fewer rules. From these findings, assumptions are derived concerning adequate rules management and a possible approach to testing these assumptions is outlined.

1 INTRODUCTION

High-risk organizations are faced with the problem of having to achieve a delicate balance between centralization and decentralization, that is also between minimizing uncertainties and coping with uncertainties. The concept of loose coupling postulates that organizations can simultaneously ensure autonomy of actors and sufficient binding forces for all actors to use their autonomy in line with the organization's objectives. This can also be considered a core characteristic of resilient organizations, as loose coupling allows for the appropriate mix of stability and flexibility in the organization. In this paper, rules management in organizations is focused on to discuss the challenges of designing loosely coupled systems. This focus was chosen because standardization is one of the core elements of safety management in most organizations. At the same time there is increasing concern that standardization does not help human actors especially in states of abnormal operation where they would need strong, but also flexible guidance. The crucial question becomes which kinds of rules to design for whom and for which processes instead of how many rules there should be. In the following, some theoretical foundations and empirical results on the use of rules and their effects in organizations are presented and a framework for rules management developed.

2 APPROACHES TO HANDLING UNCERTAINTY

In order to understand organizations, it is helpful to conceptualize organizational activities in terms of the management of uncertainties stemming from the transformation processes an organization has to perform and the environment within which these processes take place (e.g. Thompson, 1967; Van de Ven et al., 1976). According to Woods (2006), the "textbook" performance envelope of an organization is defined by its competence in handling designed-for-uncertainties. Resilience refers to the capabilities of the organization to handle unanticipated uncertainties, which arise because of changes in the environment and/or because the textbook envelop is incomplete, limited or wrong. Resilient organizations are therefore characterized by a balance of stability and flexibility that allows for adaptations in the face of uncertainties without losing control.

Two basic approaches to handling uncertainty can be distinguished (Grote, 2004a; see Figure 1). The first one tries to minimize uncertainty or at least the effects of uncertainty in the organization using mainly feed-forward control based on high standardization and programming of work flows. Enormous efforts are put into centralized planning and continuous monitoring of the execution of these plans, providing minimal degrees of freedom to the people in charge of carrying out the plans. The other approach aims to enable each and every member of an organization to handle uncertainties locally and to allow for feedback control. From this perspective, planning is understood primarily as a resource for situated action (Suchman, 1987), not as blueprint for centrally determined and monitored action. Local actors need to be given as many degrees of freedom as possible, achieving concerted action mainly through lateral, task-induced coordination. Disturbances are also regarded as opportunities for use and expansion of individual competencies and for organizational innovation and change.

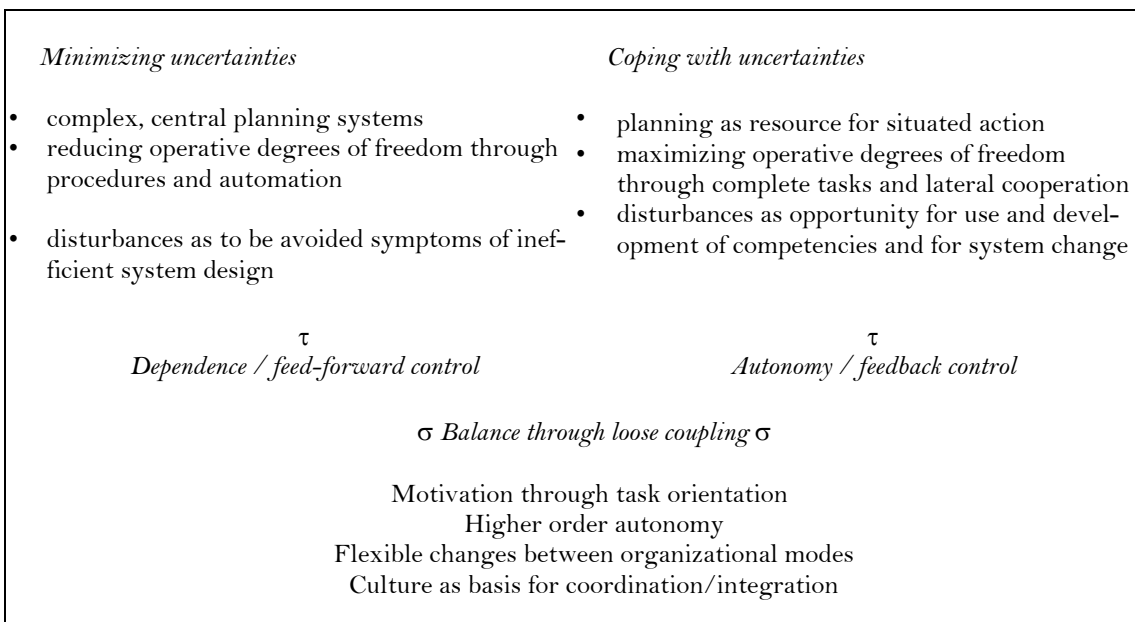


Fig. 1. Two approaches to managing uncertainties in organizations (from Grote, 2004a)

One could argue that the coping with uncertainties approach best supports resilience. However, as Weick (1976) has pointed out, the autonomy and flexibility provided by this approach needs to be counterbalanced by sufficient binding forces for all actors to use their autonomy to promote the organization's objectives. He suggested the principle of loose coupling in order to simultaneously ensure autonomy and dependence, which could also be understood as the balance of stability and flexibility inherent in the concept of resilience. In Figure 1, four examples are given for achieving loose coupling. The concept of motivation through task orientation (Emery, 1959) assumes that tasks allowing for a high degree of autonomy, task completeness and task feedback will further an individual's intrinsic motivation towards fulfilling the goals of the primary task of the organization. The concept of higher order autonomy (Grote, 1997; Klein, 1991) has been suggested to provide autonomy in those situations where in technically tightly coupled systems (Perrow, 1984) little operative autonomy is possible. Higher order autonomy allows the actors in the organization to decide on the restrictions of their own operative autonomy, e.g. through participative design of rules and procedures. In studies of high-reliability organizations (e.g. LaPorte & Consolini, 1991), it has been observed that organizations may also be capable of changing flexibly between the two organizational modes. Weick (1987) has pointed out, that culture serves as a strong basis for a form of coordination and integration that incorporates both decentralization of autonomy and centralization of values and norms as binding forces for local action.

In order to explore the concept of loose coupling further and to provide more concrete design measures for supporting loose coupling, organizational rules and routines are focused on. Especially high-risk organizations are often characterized by a high level of standardization achieved by many and very tight rules. Standardization can be regarded as the key element in the minimizing uncertainty approach, while the competent coping with uncertainty relies much more on personal coordination through mutual adjustment. The question arises whether rules and routines can be designed in a way to achieve loose coupling.

3 ORGANIZATIONAL ROUTINES VERSUS ORGANIZATIONAL FLEXIBILITY

Organizational routines have been defined as "repetitive, recognizable patterns of interdependent actions, carried out by multiple actors" (Feldman & Pentland, 2003, p. 95). This definition first of all points to routines as crucial for coordinated action, without specifying whether these routines are written down rules, technologically determined courses of action, experience based tacit understandings of the right course of action etc. The basic assumption is that routines develop in organizations because they are functional in reducing complexity and uncertainty and increase stability, managerial control and legitimacy. Routines are the product of learning, but once established impede further learning and thereby reduce organizational flexibility.

Feldman and Pentland challenge this prevailing view by arguing that routines always contain the duality of principle and practice. The principle of a routine as determined by

a written procedure, a taken-for-granted norm or some shared procedural knowledge has to be put into practice and in this process adapted to the necessities of a concrete situation. Rules are resources for action, but they do not fully determine action (Feldman & Pentland, 2003, p. 101). There always remains some element of improvisation, which also requires taking into account the actions of relevant others, as described in the concept of "heedful interrelating" by Weick and Roberts (1993). In this process, the routine in principle helps through guiding, accounting, and referring. Guiding is accomplished by the routine serving as a normative goal for action. By providing explanations for what we do, routines also support accounting for actions. Finally, routines can provide simple labels for complex action patterns, which can be used as commonly understood reference to these sets of actions. On the other hand, the routine in practice is essential for the establishment and maintenance of the routine in principle, as routines only develop through repeated action. At the same time, the routine in practice can also modify the routine in principle as new ways of acting are found to be appropriate under specific circumstances. Whether these modifications get incorporated in the routine in principle depends, for instance, on the power of the respective actors to turn exceptions into rules. Routines may therefore also be the source for change and flexibility, for which the exact preconditions are not known, though, as Feldman and Pentland (2003) state.

Based on a case study on the use of project management routines in a chip manufacturer, Howard-Grenville (2005) suggested that actor`s time orientation (to past, present or future) and the degree of embeddedness of a given routine in other organizational structures influence the flexibility with which a routine is applied and how likely the routine will be changed as a consequence of this flexibility. She assumed that present and future orientation and weak embeddedness further flexible use and change, while strong embeddedness hinders change - though not flexible use - even with present and future orientation.

In a study by Gilson, Mathieu, Shalley and Ruddy (2005) the effects of standardized work processes and support for creativity were analyzed in parallel on two outcomes of technical service teams, technical performance and customer satisfaction. They found that standardization was positively related to customer satisfaction, while creativity was positively related to technical performance. These findings indicate the routines do not necessarily have a general effect, but might be appropriate for achieving some outcomes, but not others. One important element presumably is the level of uncertainty inherent in a task, requiring more or less creativity.

These findings show that a more differentiated view on the enactment of routines and their effects is needed. It also indicates that standardization is not a single dimension ranging from few routines to many routines, but that different types of routines may exist, which allow for more or less flexibility in their application. When applying these findings to the design of high-risk organizations, the issue then becomes to define not only the amount of rules, but also the types of rules that will further loose coupling.

4 TYPES OF RULES AND THEIR EFFECTS IN ORGANIZATIONS

Rules as support for loose coupling have not been researched much to date (Grote, 2004b). In the words of Woods and Shattuck (2000) the issue is how to avoid Type A problems where rote rule following persists despite changing circumstances requiring adaptable responses as well as Type B problems where adaptation happens unsuccessfully due to incomplete knowledge or lack of guidance. From an action regulation perspective, rules can concern goals to be achieved (goal rules), define the way in which decisions about a course of action must be arrived at (process rules), or prescribe concrete actions (action rules) (Hale & Swuste, 1998). Systematic research into the design and management of safety-related rules has only recently begun, providing tentative classification schemes mainly based on the rules' relevance for individual action regulation (Hale & Swuste, 1998; Leplat, 1998; Reason, Parker, & Lawton, 1998).

In our own research, we have begun to use these classification schemes to study the interplay between rules and team coordination and to analyze principles underlying rules management. In one project (Grote, Zala-Mezö & Grommes, 2004), we compared coordination behavior in cockpit crews and anesthesia teams as examples of work environments with high vs. low standardization and also analyzed the rules relevant for the observed settings. For this purpose we used the categories suggested by Hale and Swuste (1998), distinguishing between goal rules, process rules, and action rules. There were generally more rules for the aviation setting as was expected and there were also less process rules and more action rules as compared to the anesthesia setting. Considering the higher degrees of operational uncertainty contained in handling a patient as compared to flying an aircraft, the less specific rules in medicine seemed appropriate. Very rare in both settings were rules that also provide a rationale for the rule. Interestingly and contrary to our original assumptions, we found that anesthesia teams coordinated more implicitly than cockpit crews despite having fewer written rules guiding their behavior. For the aviation data, a clear link between higher levels of explicit coordination and higher levels of performance could be established, which hints at the importance of backing up standards with a constant effort to reassure a common understanding of the situation and the relevance of the standards for the situation.

Another set of analyses in that study concerned patterns of coordination within each professional setting, comparing work phases with different degrees of standardization. One important finding here was that high levels of personal leadership in highly standardized situations appeared to be related to worse team performance. Another finding was that cockpit crews performed worse when first officers used higher levels of implicit coordination, pointing to the importance of experience for coordinating action on the basis of shared views of situations and their demands. All these findings indicate the importance of process rules to help teams to deal with the demands of adaptive coordination better. Examples of such process rules could be „Don't use personal leadership when you have standard procedures“ or „Use explicit coordination when you are inexperienced“. Given the overall low level of process rules in both settings studied, the results point to a short-coming in current rules management.

In a second study (Grote, in press) we analyzed rules management processes in a railway company and the corresponding national regulator with the aim to evaluate their current philosophy behind rule making. Interviews with individuals responsible for rule management at the regulator and several rail operators were carried out following the rules management process as laid out by Hale and colleagues in a recent European project on railway safety (Hale, Heijer & Koornneef, 2003). Also, using coupling and braking of cars during shunting operations and train departure as exemplary work processes, observations and interviews with shunters, signallers, train drivers and dispatchers were carried out to better understand the day-to-day handling of rules and their impact on individual work behavior and team coordination. Finally, the formal rules associated with these two work processes were analyzed again using the rule taxonomy developed by Hale and Swuste. One important finding was the prevalence of process rules for shunting operations, which in combination with the shunters' comparatively low level of qualification and reluctance to take responsibility for using the decision latitude offered creates tensions. For the signallers somewhat the opposite pattern was found: This group is highly qualified and very responsible, acting on much more defined and prescriptive action rules, but „stretching“ these in order to accommodate non-routine situations. The findings of the study served as input into a still on-going project on redesigning the railway company's rule book.

All these findings point to the importance of helping teams to deal with the demands of adaptive coordination better. Especially process rules could be well-suited for this purpose, but up to now rules usually are not designed with this meta-level in mind, i.e. having rules on when which type of rule should be used as coordination mechanism and when other coordination mechanisms such as mutual adjustment in a team or leadership are more appropriate.

Besides the rules themselves, the process of generating and modifying rules is crucial in providing or impeding flexibility. Bourrier (1998) showed in her comparative case studies on the organization of maintenance work in four nuclear power plants how the maintenance workers' influence on the writing and modifying of procedures was positively related to them following the ensuing rules. This can be taken as evidence for the importance of higher order autonomy (Grote, 1997, 2004a; Klein, 1991), i.e. autonomy in restricting one's own operative autonomy.

5 STEPS TOWARDS RESILIENT RULES MANAGEMENT

An important distinction apparent in the previous two sections is that of flexible use of a routine and a flexible routine. A flexible routine is characterized by decision latitude for the user of the rule. This can be achieved by goal rules and process rules in the Hale & Swuste rule system (1998), or also by action rules that include an element of discretion. Goal rules only define the goal to be achieved but leave the way to reach the goal completely open. Most rule books contain a few of these rules in order to set overall priorities and to have a fall-back when all other rules are not operable anymore. An example for such a rule from a flight operations manual is the following: "It must be clearly un-

derstood that not all combinations of cumulative operational problems (engine failure plus e.g. terrain, weather, availability of aerodroms etc.) can be covered by this policy. In such situations the solution offering the highest degree of safety should be sought." Process rules are more specific in supporting the decisions needed to determine a concrete course of action, e.g. by defining sources of information to be used or other actors to be involved. Action rules finally define a concrete course of action to be followed, but may include a discretionary element, for instance by including terms such as "when necessary" or "when sufficient evidence for condition X has been identified".

Flexible use of a routine on the other hand may imply that a rule is adapted by the user without the rule itself explicitly allowing such an adaptation. In this case flexible use is usually considered a violation with a number of sanctions attached.

One basic assumption following from the evidence presented above is that flexible use of rules, at best supported by inherently flexible rules, is needed with high levels of uncertainty. Another assumption is that in tightly coupled systems, where rules are embedded in a multitude of interconnected structural elements, rules should be less flexible because adaptations may have unwanted effects elsewhere in the system. And finally, the third assumption is that flexible rules require highly qualified users of these rules. Especially the first two assumptions may produce conflicting demands, mirroring the need for concurrent centralization and decentralization described by Perrow (1984). However, process rules supporting for instance the direct coordination between different actors and subsystems affected may help to bridge these demands.

In order to test these assumptions, an ethnographic approach involving intensive observation of the everyday functioning of an organization should be chosen because it allows to observe both the enactment of formal rules as well as of more informal and possibly implicit organizational routines that may also involve coordination via team interaction, leadership and cultural norms. One important outcome of such a study would be profiles of more or less flexible rule use within specific contexts in terms of uncertainties, coupling, qualification of actors, task requirements etc. These profiles could be translated into design recommendations. By looking very closely at the actual content of rules and at the interplay between rules and other coordination mechanisms - which has not been done previously - a significant step could be taken towards resolving the dilemma of concurrent standardization and flexibility in high-risk organizations lying at the core of achieving resilience.

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