

# Uncertainty Management Through Flexible Routines in a High-Risk Organization

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Paper presented at the  
2nd Annual Cambridge Conference on Regulation, Inspection & Improvement:  
"The End of Zero Risk Regulation: Risk Toleration in Regulatory Practice"

Cambridge, UK  
September 12, 2007

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## 1. Introduction

One of the most fundamental questions in the design of organizations and the coordination of processes concerns achieving the right balance between standardization on the one hand and flexibility and openness to change on the other. There are a number of perspectives from which this question can be approached, from a very theoretical one based on organization theory (Gouldner, 1959; Weick, 1979) to a very pragmatic one focusing on practical issues such as streamlining industrial production processes. The general gist of any of these approaches is, however, that to coordinate processes in organizations routines and rules are essential (Reynaud, 2005), with the need for flexibility and change being recognized as important, though difficult to meet without losing organizational coherence and efficiency.

One important factor in determining the right balance between standardization and flexibility is the amount and nature of uncertainties stemming from within the transformation processes in the organization and from the organization's environment. It is generally assumed that flexibility is particularly needed under higher degrees of uncertainty allowing for competent coping with the uncertainties, while low levels of uncertainty can be best handled through standardized processes aimed at minimizing uncertainties (e.g., Grote, 2004b; Thompson, 1967; Van de Ven, Delbecq, & Koenig, 1976; Wall, Cordery, & Clegg, 2002).

However, while it is found that organizational flexibility enables competent coping with uncertainties there is still a widespread belief that flexibility and change carry risks of system failure. This belief has been particularly influential in the design of high-risk organizations, which combine complexity, tight coupling, and the potential to create catastrophes (Perrow, 1984). Hence, in nuclear power plants, spacecraft, commercial and military aircraft, and railway networks a high level of standardization is seen as necessary (Bierly & Spender, 1995) to avoid system failure and related catastrophes. The concurrent loss of flexibility is considered undesirable, but inevitable.

However, the study outlined in this paper later on aims to show that high standardization through too many and too tight rules and standard operating procedures can not be considered optimal for assuring safety and can in some cases indeed compromise safety in high-risk organizations. If, for example, environmental or internal changes are frequent in a certain part of the organization, too many rules can hinder individuals at adapting their behavior to the new conditions. Therefore it is believed that these organizations should rather aim to achieve a balance between standardization and flexibility. This results ideally in having rules that prescribe procedures for and desired states of the system but at the same time leave decision latitude and leeway. Or, from the perspective of the individual who has to work by the rules, they should offer both flexibility and orientation.

More recent literature on organizational routines – a concept that goes back to March and Simon (1958) and has been put forward by Nelson and Winter (1982) – underpins this ar-

gument: Feldman and Pentland (2003) showed that routines can be a source for change as well as stability by distinguishing between the ostensive (i.e. structure) and the performative (i.e. action) aspect of organizational routines. The central notion of this new approach to organizational routines is that routines (and rules) must be enacted to “come to life”.

In this paper, we aim to develop the concept of flexible routines as a way to achieve a balance between standardization and flexibility. For this, we outline a theoretical background based on literature on uncertainty management (section 2) and organizational routines (section 3). In section 4, we put rules into focus and show how existent typologies for rules can be used as a starting point for this research undertaking. Next, we present the goals, methods and first results of an ongoing ethnographic study in a Swiss railway organization (section 5) and develop implications and further research opportunities (section 6).

## 2. Two approaches to managing uncertainties

In order to understand organizations, it is helpful to conceptualize organizational activities in terms of the management of uncertainties. Uncertainties can stem from the transformation processes an organization has to perform as well as from the environment within which these processes take place (e.g., Perrow, 1967; Thompson, 1967; Van de Ven et al., 1976). Two extreme approaches to handling uncertainty can be distinguished (Grote, 2004b).

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. Coordination is mainly achieved through tight plans and procedures and also automation where possible. 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. Disturbances are seen as flaws in the system design and are trying to be avoided.

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 regarded as opportunities for use and expansion of individual competencies and for organizational innovation and change.

Figure 1 on the next page illustrates the comparison and integration of the two approaches.

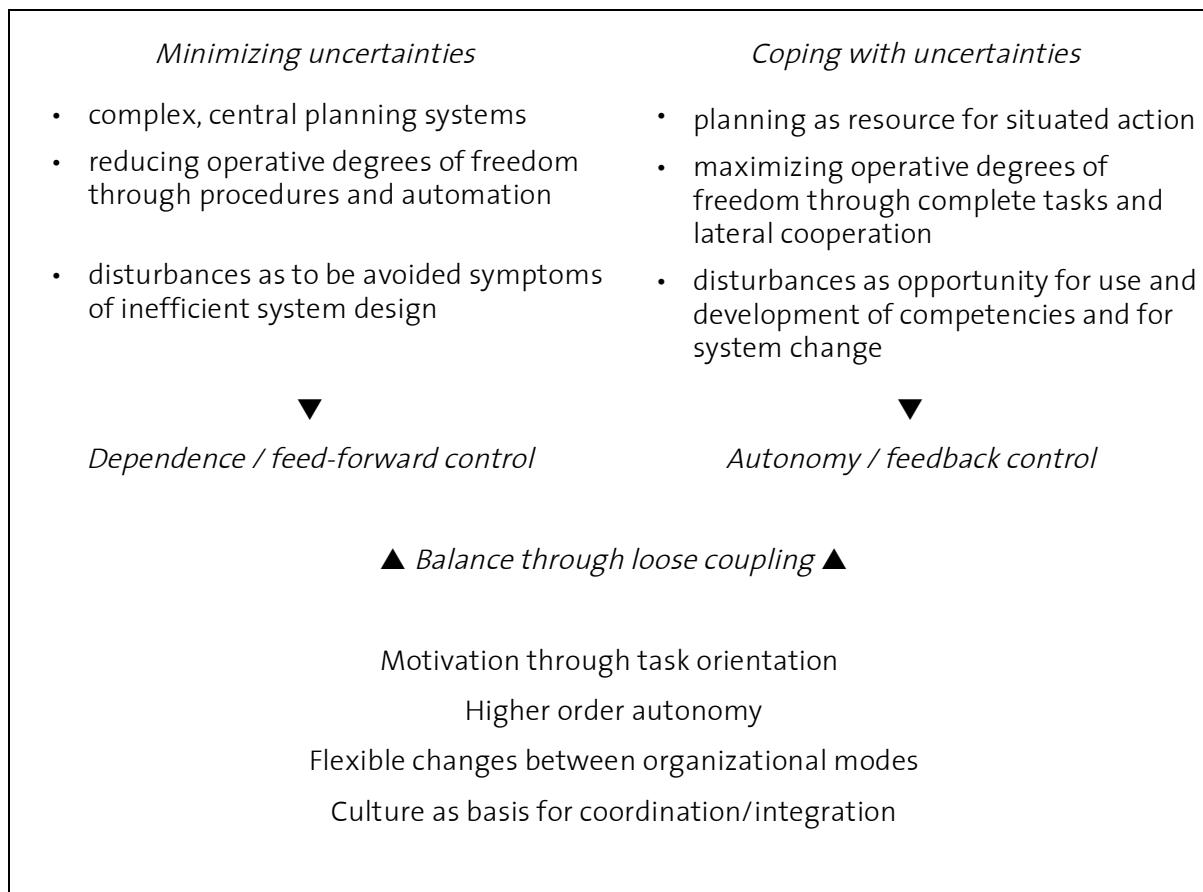


Figure 1: Two approaches to managing uncertainties in organizations (from Grote, 2004b)

Most high-risk systems have relied heavily on minimizing uncertainties. Standardization in the form of standard operating procedures has been developed with ever increasing detail in order to streamline human action and to reduce its influence as a risk factor. Procedures are often a direct consequence of incidents and accidents the analysis of which provides knowledge of unforeseen wrongful courses of action against which new rules are developed as a defense. While generally there is an understanding that rules are useful guides for safe behavior, there is also an increasing concern that too many rules incrementally developed will not make up a good system to help human actors do the right thing especially in states of abnormal operation where they would need strong, but also flexible guidance (e.g., Amalberti, 1999; Dekker, 2003; Woods & Shattuck, 2000).

These concerns go back to basic observations on how rules specifying the exact operations to execute can have a detrimental effect on action because they do not allow the performing person to develop an underlying plan of their own, but instead further the atomization of actions and the focus on micro-difficulties (Vermersch, 1985). Another problem with standardization is that reliance on common standards may turn into an over-reliance, impeding switches to more explicit coordination and to higher levels of common action regulation, i.e. switches from skill-based to rule-based or to knowledge-based behavior (cf. Reason, 1990). This problem can be exacerbated by the fact that standardization is a strong force towards shared

understanding of a situation and its demands in a team, because it creates a common framework for team behavior reducing the need for explicit coordination. The expectation of shared goals, plans, perspectives, and knowledge bases created by reference to the same set of standard operating procedures, as helpful as it is under most conditions, does involve the risk of not realizing the need for explicit coordination, especially in non-routine situations.

While standardization can be regarded as the key element in the minimizing uncertainty approach, the competent coping with uncertainty relies much more on personal and lateral coordination. It can be assumed that standardization will work better in situations with few uncertainties while local autonomy and control are needed when uncertainties are high. In situations with high uncertainty, standardization may even be harmful, but so far few concrete suggestions exist what coordination mechanisms to use in order to improve the predictability and controllability of a system while at the same time increasing its flexibility (e.g. Perrow, 1984).

Weick (1976) has suggested the principle of loose coupling in order to simultaneously ensure autonomy of actors and sufficient binding forces for all actors to use their autonomy to promote the organization's objectives. According to Orton and Weick (1990), who argue for a dialectical interpretation, a system is loosely coupled when there is both distinctiveness and responsiveness. Hence, loose coupling is given in situations in which "elements are responsive but retain evidence of separateness and identity" (Orton & Weick, 1990, p. 203). The concept of loose coupling enables researchers to investigate the paradoxical co-existence of "rationality and indeterminacy without specializing these two logics in distinct locations" (p. 204).

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. Lastly, 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 this paper we argue for a further way to achieve loose coupling in organizations, namely the implementation of flexible routines through flexible rules. In order to support this argument, we draw on newer research on the concept of organizational routines, which the next section is dealing with.

### 3. Organizational routines and 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 basis for coordinated action, without specifying in which form these routines exist, for instance as written down rules, technologically determined courses of action, or experience based tacit understandings of the right course of action. 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 were long regarded as a static product of learning, which – once established – impedes further learning and thereby reduces organizational flexibility.

Feldman & Pentland (2003) 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). Similarly, Reynaud (2005) argues that rules are inherently incomplete due to their general and abstract nature. To fill this "void at the heart of rules" (Bourdieu, 2005; Reynaud, 2005) contextualized and specific routines are to be enacted.

In this enactment 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.

The routine in practice, on the other hand, 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. However, the exact preconditions under which the enactment of routines leads to stability or change are not known.

To sum up, this new way of conceptualizing organizational routines incorporates static as well as dynamic elements, or in other words an ostensive aspect (the more or less static routine in principle, the name of the routine and what people normally associate with it) and a performative aspect (the routine in practice, what people "actually do"). While the routine in principle can guide the routine in practice more or less strictly, it never fully determines action

carried out by individuals. Moreover, the daily practices can shape the routines in principle and even create new ones.

Taking this new conceptualization of organizational routines into consideration puts even more weight into the argument that ever-increasing standardization cannot be the only way to ensure safety in organizations. If routines indeed are enacted and if the enactment process inevitably allows for at least some degree of variation and change, then routines in principle (and for that matter, rules and prescriptions, as they are related) cannot be relied on to determine individual's action fully. Put simply, just because there is a rule does not guarantee that every individual carries out the procedure in this exact way.

By this point, it seems helpful to clarify some vocabulary. For the purposes of this paper, we make a distinction between routines and rules. Routines are seen in the sense portrayed by Feldman and Pentland (2003) and other authors described above, while rules are viewed as tangible organizational artifacts. They can be seen (i.e. read), whereas routines in principle are merely concepts, which are used in language, and routines in practice are viewed as the specific action taken by a specific individual in a specific situation. On the one side, rules are written with the intention to create routines in

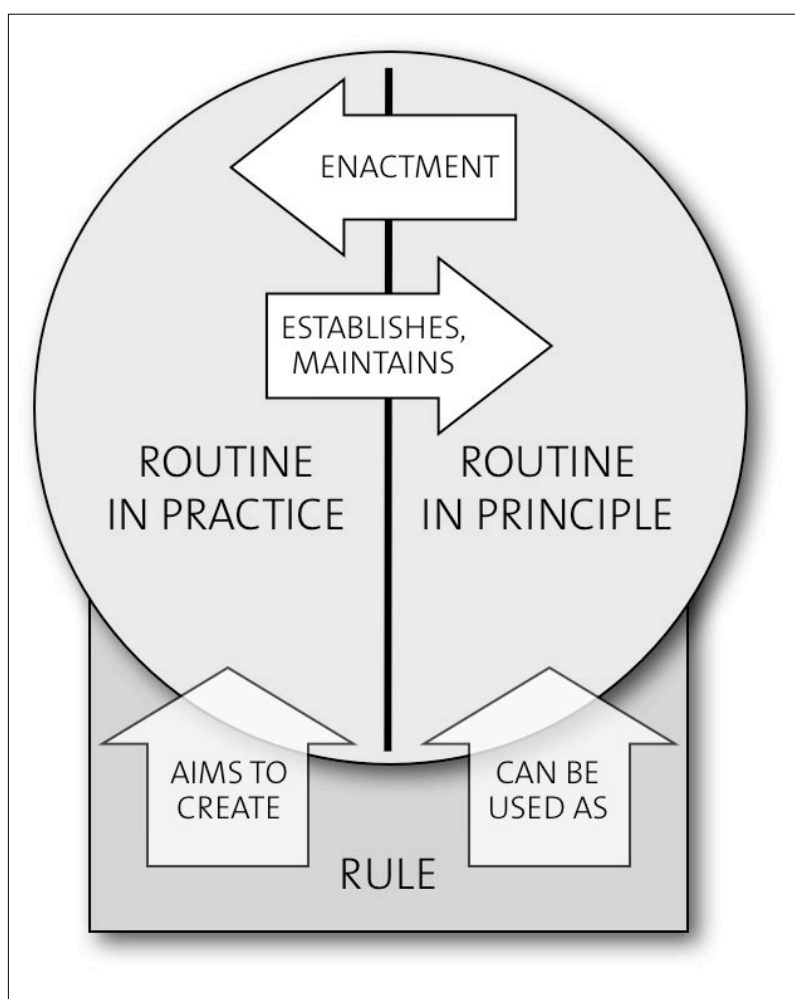


Figure 2: Routines and rules

practice when they are carried out, but on the other side they can also be used as routines in principle: When talking about the “the rule” not as the written text, but rather as “the way we do things here”, a written-down procedure can be used as a conception of an organizational routine. Thus, we argue to view routines in practice, routines in principle, and rules are three different things, as it is illustrated in figure 2.

#### 4. Flexible routines through flexible rules

After having developed the theoretical background for this paper we now turn towards the idea of flexible rules as a way to establish flexible routines in organizations, which is in turn considered to achieve loose coupling.

Rules as support for loose coupling have not been researched much to date (Grote, 2004a) and systematic research into the design and management of safety-related rules specifically relevant in high risk organizations has only recently begun (Hale & Swuste, 1998; Leplat, 1998; Reason, Parker, & Lawton, 1998).

The theoretical background on uncertainty management as well as organizational routines outlined above calls for abandoning the idea that a system of tight detail-prescribing rules is sufficient to ensure safety in high-risk organizations. Instead, rules in general should more be seen as guidance and orientation for individual behavior. However, the degree of flexibility desired for a specific rule depends on a number of situational factors. Some work processes within a system will only require broad guidance by rules, while at the same time it can be necessary for other processes to be prescribed in great detail, depending, for instance on the amount of uncertainty involved).<sup>1</sup>

Similarly, Rasmussen (1997, p. 191, italics in the original) has argued that “rather than striving to control behavior by *fighting deviations* from a particular pre-planned path, the focus should be on the control of behavior by *making the boundaries explicit and known* and by giving opportunities to develop *coping skills at boundaries*”. Rules then would have the function to clarify boundaries and to suggest ways of handling system states close to those boundaries.

In line with this approach to rules, authors have begun to develop typologies of rules in order to help the design of rule systems directly tailored to the needs for guidance as well as for autonomy and control arising in different stages of action regulation (e.g., Hale & Swuste, 1998; Leplat, 1998). Hale and Swuste (1998) aptly distinguish three kinds of rules regarding the level of action regulation they prescribe: *Action rules* define concrete action or a specific required state of the system. *Process rules* can serve as solution search rules, that is, they define the way and by whom decisions about a course of action and should be made. Finally, *goal rules* do not contain any course of action but rather prescribe a goal to be achieved. Especially process rules could be well suited to design stable but flexible systems.

A particularly promising approach is seen in the development of meta-rules, i.e. having process rules on when rules should be used as coordination mechanism versus when other coordination mechanisms such as mutual adjustment in a team or leadership are more appro-

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<sup>1</sup>At this point, an important distinction must be made between flexible rules and flexible use of a rule: As has been pointed out, a flexible rule incorporates a leeway for decision-making. Flexible use of a rule on the other hand may imply that a rule is adapted by the user without the rule itself explicitly allowing such an adaptation. In such a case flexible use is usually considered a violation with a number of sanctions attached.

priate. From comparing patterns of coordination in aviation and in anesthesia, Grote and colleagues (2004) found among others that in highly standardized situations, the standards act as a form of impersonal leadership which does not require additional efforts of personal leadership. However, high performing cockpit crews explicitly coordinated processes even in highly standardized work phases. This finding 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 (Weick & Roberts, 1993). The anesthesia teams, in difference, coordinated their tasks more implicitly despite overall fewer standards, which may be related to more informal rules and the immediacy of common action in a shared visual field (Heath, Svensson, Hindmarsh, Luff, & vom Lehn, 2002). Very rare in both settings were rules that also provided a rationale for the rule.

This finding is interesting in light of a study by Wright, Pocock and Fields (1998) in which the annotations in a Quick Reference Handbook for an airline pilot were analyzed. Almost 40 percent of the annotations concerned explanations on why the procedure was the way it was, indicating the need of users of procedures to understand their reasoning, which then can be used to apply the procedure adaptively, as was indicated by another about 25 percent of the annotations.

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, 2004b; Klein, 1991), i.e. autonomy in restricting one's own operative autonomy.

In summary, the above presented research on rules design covers the following aspects, which are used for a first outline of the concept of flexible rules: Rules in high-risk organizations can be analyzed regarding the *level of action regulation* that they prescribe (action rules, process rules or goal rules). *Meta-rules*, i.e. rules about when to use rules as opposed to other forms of coordination can be considered a sub-type of process rules. By choosing process rules or goal rules, a certain amount of decision latitude is given to the individuals applying the rules. To ensure safety for the system all the same, but also to give further orientation to the individual, *boundary conditions* can be defined and *explanations* can be given. Finally, *participation* in the creation and modification of rules can contribute to rule-following. While these aspects altogether create a good starting point for the development of the idea of flexible rules, several key questions yet remain unanswered, which will be addressed in the following paragraph.

The idea of flexible rules is not to be understood as the opposite to tight standardization and detailed prescriptions. We do not argue to incorporate as much decision latitude as possible

into rules.<sup>2</sup> What this paper argues for is a diverse view of standardization and flexibility. In every organization there are parts and processes that need to be standardized highly as well as ones where flexibility for the individuals operating these processes is a better answer to handling uncertainty than detailed procedures. Consequently, the key questions are: What kinds of processes within high-risk organizations require high standardization and what kinds are best handled with decision latitude for individuals? How can these processes be identified, i.e. what are categories to help making decisions about the amount of flexibility desired? Furthermore, in which exact way should this decision latitude be implemented, what type of rule is best fit for a certain situation?

To elaborate on these questions and discuss the idea of flexible rules further, first results of a field study on rules management in a Swiss railway organization are presented in the following. A set of hypotheses concerning how to implement flexible routines through flexible rules is then derived and opportunities for further research are discussed.

## 5. The field study: rule management in a high-risk organization

The field study is conducted in a railway organization, a setting considered to be particularly suited for investigating rules and routines as railways are among the most proceduralized organizations. Railway organizations have a very long history of using rule books as the basis for coordination mainly due to their highly distributed nature of operation. Further, until very recently no means for direct communication between the different actors such as train drivers, controllers and maintenance workers were given (Hale & Heijer, 2006). At the same time, rule violations and inadequacies of rules and rule management have been found to be crucial safety problems in rail organizations (Farrington-Darby, Pickup, & Wilson, 2005; Hale, Heijer, & Koornneef, 2003; Lawton, 1998).

The field study is an ongoing research project aimed at empirically developing the concept of flexible routines. Overall, an ethnographic approach is chosen, i.e. interviews with different actors are conducted, as well as observations of work routines and how rules are applied in practice. By choosing a qualitative, "hands-on" approach, we aim to find more information on the interplay between rules and the routines in practice. This in turn will be used to develop categories with which work processes can be described with regard to the amount of flexibility needed for the actors. Additionally, qualitative analyses of rule books can give an overview of types of rules in practice.

For the purposes of this paper, results of a pilot study on rules and the rule management process are presented. The general purpose of the pilot study was to provide an analysis of

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<sup>2</sup> Indeed, there are no doubt sub-processes within organizations that ought to be prescribed in great detail and even with sanctions for deviation.

existing rules and the rule management process shared between the state regulator and the railway organization. From a research perspective, the adequacy of existing rules and rule management processes for providing optimal support for the management of uncertainties in rail operations was focused on, using the uncertainty management framework (Grote, 2004b) described above. For the railway company and the regulator, the study was to provide a basis for reflecting upon four themes: adequate detail of rules, interplay of rules and training, interplay between rule design and rule auditing, and distribution of responsibility between actors involved in rule design, rule following, and rule monitoring.

The study was based on data stemming from

- interviews with the executives responsible for rule management at the railway organization and the regulator,
- analysis of documents on rule management provided by both the railway organization and the regulator,
- analysis of incidents and accidents related to rule following,
- rules analysis of a sample of rules based on two work processes (train departure, coupling and braking of cars during shunting operations),
- observations of the chosen work processes and interviews with shunters, signalers, train drivers and dispatchers.

For the rules analysis, categories suggested by Hale and Swuste (1998) were used in a slightly modified form:

1. Level of action regulation (goal, process, or action rule)
2. Obligation (advice vs. command)
3. Decision latitude (with vs. without decision latitude)
4. Distribution of responsibility (responsible person(s) mentioned vs. not mentioned)
5. Exceptions (with vs. without exceptions)
6. Reasons (with vs. without reasons)

The interviews and document analysis concerning the rule management process followed the model of rule management suggested by Hale, Heijer and Koornneef (2003), which has been used in previous investigations of rule management in railways.

The following presentation of results will focus on the findings of the rules analysis, using information from observations, interviews, and document analyses to interpret the results and to provide some further context for the findings.

On the next page, table 1 presents the results of the analysis of rules concerning the coupling and braking of cars during shunting operations and traffic regulation. Regarding traffic regulation, train departure was focused on, for which new rules had recently been devised by the regulator.

Table 1: Results of the rules analysis

Rule type	Shunting		Traffic regulation (all rules)		Traffic regulation (old rules related to train departure)		Traffic regulation (new rules related to train departure)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
<b>Total</b>	28	100	155	100	38	100	32	100
Goal rule	0	0	1	1	0	0	1	3
Process rule	6	21	19	12	2	5	9	28
Action rule	22	79	135	87	36	95	22	69
Advice	0	0	3	2	0	0	1	3
With decision latitude	20	71	61	39	14	37	15	47
With resp. person/s mentioned	2	7	46	30	13	34	17	53
With exceptions	7	25	34	22	7	18	6	19
With reasons	1	4	5	3	1	3	0	0

The analysis surfaced a number of interesting issues, which have to be interpreted cautiously, however, given that only a sample of rules was analyzed that may or may not be representative of all rules in the rail organization studied. Rules for the rail organization are written by different people depending on the topic and the organizational groups affected with very few content-related guidelines provided. In fact, only one content-related statement was found in the existing documents on rule management: “Rules should only contain normative statements and/or recommendations and should define the handling of exceptions; informative statements should be restricted to the absolute minimum.” Therefore, it is unlikely that any subset of rules could be representative of all rules in this organization.

Table 1 shows that very few goal rules exist, which on the one hand side can be regarded positively as goal rules by their very nature do not offer much guidance for the actors on how to pursue the goal. On the other hand, some goal rules may be helpful in order to stress priorities in certain situations and thereby support the actors in their individual priority setting. This may concern very basic priorities such as punctuality versus safety or more specific priorities such as the timing of own actions and communication to other actors about these actions.

Compared to the old rules for train departure the new rules included more process rules and also a clearer distribution of responsibility. Especially the latter had been a declared goal of the rule revision in order to avoid diffusion of responsibility. At the same time, the discussion about the stricter definition of responsibility with the people affected indicated the potential problem of too little sharing of responsibility, thereby reducing information flow and cross-checking between the various actors. This problem is assumed to gain importance due to different actors like train drivers, maintenance crews, shunters, and signalers belonging to different companies

within a holding structure with fewer and fewer of them having had the experience of belonging to the one previously existing company.

The higher level of process rules in the new rules on train departure was generally considered positive as they provide guidance without restricting flexible action. Signalers and train drivers are well qualified with high professional ethics, who still have to act to a large part on very defined and prescriptive action rules, but “stretching” these in order to accommodate non-routine situations. So an even higher level of process rules might be appropriate.

The high percentage of process rules and even more so of rules with decision latitude was evaluated more critically with respect to shunting operations. The prevalence of more open and less prescriptive rules on how to handle shunting operations has to be seen in the context of the shunters’ comparatively low level of qualification and their reluctance to take responsibility for using the decision latitude offered. When discussing this obvious mismatch with the people responsible for rule making, it was pointed out that shunting occurs in so many different contexts (within stations, on shunting yards with varying degrees of automation etc.) that rules have to be less specific. So the issue becomes more whether the current level of qualification and training is sufficient for handling this flexibility. Efforts are underway to improve training for shunting accordingly. One may also raise the issue, though, which has been brought up in other rail organizations as well (Hale & Heijer, 2006), whether rules for shunting are paid less attention to by rule makers as they mainly concern the safety of the individual workers and less the politically far more prevalent safety of passengers.

A high percentage of rules with exceptions was found, which can mainly be explained by the fact that a variety of local conditions has to be covered, e.g. regarding the level of automation, the number and distribution of personnel (trains with/without conductors, stations with/without signalers etc.), or the particular geographical layout. The main issue to be discussed with respect to these exceptions is the level of detail the rules should have and whether local knowledge should be incorporated in the rules or rather be provided by complementary training. The fundamental dilemma of not being able to have general, simple, and detailed prescriptions at the same time became obvious here.

Finally, rules very rarely included reasons, raising the question of whether training is designed to provide the necessary background information. Given an increasing pressure for interoperability of rail systems, thereby requiring personnel with more and more diverse educational and training backgrounds having to work together, rules might have to include more explanations in the future.

## 6. Implications and opportunities for further research

Findings from the pilot study clearly show – on a broad level – difficulties in aligning rules with given uncertainties. The field study finds a partially insufficient match between the distribution of uncertainties and resources for coping with them. Two opposite patterns of mismatch were observed: On the one hand, uncertainties in shunting operations apparently need to be reduced through more detailed and prescriptive rules and/or individual competencies need to be increased to adequately use the provided decision latitude. On the other hand, for signalers and train drivers there seems to be a need to be supported more in coping with uncertainties, potentially through more process rules including rules that support adaptive coordination (e.g. switching from proceduralized, implicitly coordinated action to explicit coordination through direct communication and mutual adjustment between different actors).<sup>3</sup>

Ongoing field studies as part of the research project have therefore taken place primarily on shunting locations and railway control centers. To broaden the field, a railway construction site has also been visited. As a conclusion for this paper, first insights and further ideas for research are presented.

Overall, the considerable differences between shunting operations and traffic regulation found in the rules analysis in how safety is handled, were confirmed by the observations and interviews. Two further aspects found important were the “built-in” safety and abstractness of danger. Firstly, work in railway control centers is characterized by a great deal of automation and safety measures can be easily incorporated into software and automated processes, whereas in shunting yards safety relies much more on whether or not the individual workers carry out the safety measures. Secondly, while risk and potential danger could be generally considered larger in control centers (small actions can have dramatic consequences), the danger inherent in this workplace is nevertheless a lot more abstract. Signalers often don't see the actions of their consequences in real life, but rather have to imagine the things and places they control, as well as how their actions can put these objects (and people) at risk. For shunters, in contrast, the danger connected to their work is very tangible, and they are also at greater risk for themselves, while signalers are at no peril during their work.

From what workers and managers at the railway organization told during interviews, another subject seems worthy to be dealt with. This regards the way in which safety rules are viewed by different individuals within the organization. Interview statements indicate that there is a

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<sup>3</sup> However, in providing signalers with more scope of action, a critical balance with the decision latitude for other actors has to be maintained. Analysis of some incident reports seemed to indicate that the signalers sometimes handle uncertainties in a way that reduces other actors' possibilities for handling their part of the situation appropriately, e.g. by providing not enough or untimely information about their actions or the actions required by the others. Here also a power differential between different professional groups is apparent, as signalers have the power to shift uncertainties to other actors who sometimes do not even have the adequate resources to handle these uncertainties (Hale & Heijer, 2006; Marris, 1996).

great difference in the perception of rules and what they are for. For managers responsible for creating and modifying rules, on the one hand, rules have a considerable legal protection function for the company. For them, rules are not only behavior regulating and coordination mechanisms, but also a way to assure that the organization is hedged towards claims from the outside: Since we wrote the rule, it is the worker's fault if he or she didn't adhere to it. Workers (especially shunters), on the other hand, not surprisingly often see rules as a hassle for their daily work. Interestingly though, it was indicated in one interview that more and more rules have led to a point where workers seem to work *only* by the rule, and when criticized, in turn ask to "show me the rule". Hence, in conflicts rules apparently are used as an instrument of power for both the supervising and the executing side.

A final subject raised by the individuals interviewed so far is that of education and experience. As indicated above, the example of shunters having to work by a lot of process rules and rules with decision latitude poses the question whether they are trained well enough for this flexibility (or alternatively, rules are written with enough explanations). While process rules generally are considered to have the potential to improve workflow and safety, it becomes evident that in order to make use of the decision latitude offered by them, individuals need more individual competencies, training, and overall experience than when working under strict action rules. This in turn reveals a dilemma: Process rules require experience, but experience requires opportunities for making mistakes. At least for train drivers and signalers, a solution could be increased use of simulator trainings.

To recapitulate, on a general level the solution to the dilemma of concurrent standardization and flexibility is written out relatively well by the concept of loose coupling (Weick, 1976). In this paper, we have introduced the idea of flexible routines as a concrete measure to achieve loose coupling. The core notion of this concept is that in different parts of an organization, different workplaces, and with different workers there is each a different degree of standardization or flexibility needed, and that this can be achieved by very carefully selecting the type of safety rules for each process.

In order to further understand how different conditions call for a different amount of flexibility, criteria are needed that can be used to describe work processes with regard to this research question. The ethnographic field study that is currently undertaken has already brought up some useful aspects: the relationship between decision latitude and training, the amount of system-immanent safety and abstractness of danger, and lastly the perception of rules by different actors. Further research will reveal more important aspects, and thus it will be possible to develop criteria for better rule management and organizational design through flexible routines.

## 7. Literature

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