

Effects of Standardization on Team Coordination: Cockpit Versus Emergency Room

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New Directions for Thinking about Standardization

In most high risk systems, 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. While generally there is an understanding that rules are useful guides for safe behaviour, 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).

Another basic problem with standardization is that especially in non-routine situations reliance on common standards may turn into an overreliance, impeding switches to more explicit coordination and with that switches to higher levels of common action regulation, i.e. switches from skill-based to rule-based or from rule-based to knowledge-based behaviour.

Some authors (e.g. Hale & Swuste 1998) 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. From an action regulation perspective, rules can concern goals to be achieved, define the way in which decisions about a course of action must be arrived at, or prescribe concrete actions.

From an organisational perspective, rules should also be discussed as elements of the coordination mechanisms operating within and between parts of an organization. During the last decade, coordination in high-risk environments has been addressed in an increasing number of studies. Usually, coordination on team level has been analysed with no explicit reference to organisational coordination mechanisms and the types of rules the teams have to adhere to, however.

The vast majority of the studies have been carried out in aviation settings, taking for granted a high level of standardization. Following, the evidence on coordination re-

quirements for successful performance provided by these studies will be reviewed.

Studies on Coordination in Work Teams in High-Risk Environments

A core concept in many of the studies on team coordination is the distinction between explicit and implicit coordination in relation to coping with high levels of workload. Explicit coordination is considered necessary when an agreement must be arrived at about how an action should be organised. It occurs typically during new tasks and new situations or when a new group of people make up a team to accomplish a job. People have to devote extra resources (very often communication) to organize the activities. Implicit coordination occurs when every one in a team knows his/her job, the actions harmonise with each other based on some kind of shared understanding (Cannon-Bowers & Salas 2001), and therefore little noticeable effort for coordination is required.

It is assumed useful to prepare high workload situations with a phase of explicit coordination to be able to reduce communication and co-ordination "costs" in the high workload phase (Orasanu, 1993). Weick and Roberts (1993) have provided case-study based and more qualitative accounts of similar phenomena of more or less effective team coordination in their analyses of high-reliability organizations. In order to explain effective team coordination, they suggest the concept of "heedful interrelating". A core idea of this concept based on Asch's theory on group interaction is that safety operations in highly complex situations require deliberate efforts by all actors to constantly (re-)consider effects of their own actions in relation to the goals and actions of others, or in Weick and Roberts' (1993: 363) words: "... (to) construct their actions (contribute) while envisaging a social system of joint actions (represent), and interrelate that constructed action with the system that is envisaged (subordinate)."

As was stated already, research on team coordination in high-risk environments usually has not explicitly addressed which organizational coordination mechanisms (which level of standardisation) provide the framework for the observed team behaviours. A more theoretically guided approach to what coordination is and how different kinds of communication can contribute to fulfilling different demands on coordination is needed in order to develop

more systematic indicators of coordinated action. A more qualitative and systematic approach to team coordination seems also warranted because situational demands can vary drastically within the generally used classification of high vs. low workload, potentially requiring very different communication and coordination strategies.

Standardization and Coordinated Action: A Research Proposal

Team coordination as measured by indicators for heedful interrelating and for explicit vs. implicit coordination should be studied in task environments with different degrees and types of standardization as evidenced by different sets of rules laid out by the organization. In order to do this, we have chosen the comparison between cockpit crew coordination and coordination in the emergency room. Regarding aviation, one scenario from a flight simulator training session was chosen, during which an approach and landing has to be performed without flaps and slats. This so-called clean approach entails high landing speed, unusual visual information due to unusual attitude of airplane and the requirement of very good manipulative skills by the pilot flying. For the medical setting, polytrauma treatment in the emergency room of a large hospital was chosen. The sample for aviation comprises 80 videotapes and for the medical setting- where data collection is still underway – a sample of 20 is aimed for.

In our study we are asking the following four questions:

- Are there differences in patterns of coordination behaviours between teams in cockpits and emergency rooms as a result of differences in degrees of standardization?
- Can these differences be linked to team performance under varying degrees of workload?
- Can these differences be described in terms of explicitness vs. implicitness of coordination and in terms of heedful vs. heedless interrelating?

Based on the answers to these three questions, we hope to also find first answers to a fourth question:

- Which types of rules in what combination, and derived from that which specific forms of standardization support successful coordination?

Workload is operationalized by means of the NASA Task Load Index (Hart & Staveland 1988). An external expert also rates task load for the overall situation based on the NASA-Index. Standardisation was broadly operationalized in terms of the two setting studied, i.e. low standardization in the emergency room and high standardization in the cockpit. A more fine-grained analysis of the types of rules relevant in the two settings will be performed by means of document analysis and expert interviews based on the categories developed by Hale and Swuste (1998). Team performance is rated by the team members themselves and by an external expert (same as for external workload rating) according to technical and social performance.

Coordinating behaviours are analysed based on observational categories. We developed four main groups of categories driven by both theoretical and practical considerations. We used two behavioural marker systems for the

evaluation of crew resource management, LOSA (Line Oriented Safety Audit, Helmreich et al. 1999) and NOTECHS (NON-TECHNical Skill proficiency, Avermate & Kruijzen 1998), as references. While LOSA and NOTECHS have been developed to obtain overall ratings of individual and/or team performance in cockpit crews on a number of quite general characteristics (leadership, decision making, planning, situation awareness etc.), our categories are intended to allow coding of all utterances in the two settings cockpit and emergency room. Therefore we could use the LOSA/NOTECHS-categories as an orientation regarding relevant areas of communication in the cockpit, but had to develop more specific categories within each topic and also develop categories that are applicable to both the flight and medical situation.

The first set of categories concerns the information flow on a general level without much reference to the content of the information. The aim was to create mutually exclusive categories and to be able to code all utterances made during the observed situation. Also, it was attempted to differentiate elements of explicit and implicit coordination as described in the previous sections of this article. The category type *Information flow - explicit coordination* contains categories such as Provide information, Request information, Provide information upon request, and Asking for help. The category type *Information flow - implicit coordination* contains categories such as Provide unsolicited information and Offer assistance. The information flow categories also provide a general quantitative account of the observed communication, concerning e.g. speaker dominance and proportion of standard versus non-standard information exchange.

The other two groups of categories are not fully exclusive and don't cover all utterances made. The second group of categories is connected to leadership, which was chosen as a focus due to the strong relationship between type of leadership and coordination and the effects of standardization on this relationship. In general, standards can be regarded as a form of depersonalised leadership, with personal leadership being made redundant in some respects and obtaining a different function as complementing or overriding standards. The fourth group of categories contains elements of *heedful interrelating* such as Considering others, Considering the future, Considering external conditions, and Giving feedback about performance.

Outlook

In this article, a research proposal and some specifics about the methods to be used have been outlined. So far, the analyses have only served the testing of the categories, therefore no results regarding the research questions can be provided yet. Regarding the theoretical benefits of the proposed research, its main contribution is seen in filling the void concerning detailed knowledge on the effects of different forms of standardization on team behaviour. From research on implicit team coordination, for instance, one could derive the assumption that a high degree of standardization reduces the need for explicit, i.e. conscious and

overt, coordination due to the reliance on a shared set of rules and derived from that also the expectation of shared goals, plans, perspectives on the situation, knowledge activated in the situation etc. summarized under the heading of shared mental models of the task and the team. This assumption is also quite obvious, given the fact that in organization theory standardization is defined as a form of depersonalised coordination. If this assumptions turns out to be correct, it depends strongly on the specific nature of standards chosen. So more specifically, it is to be asked which degree of standardization based on which types of rules can support teams in developing and maintaining flexible and situation-adaptive patterns of coordination. This as of now is a completely unanswered question.

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