

Experimental Simulation in Organizational Design: An Example from the Swedish Military

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The purpose was to characterize the design process in an ongoing development project (ROLF) within the Swedish military and to derive theoretical and methodological implications for task and organizational design. The complexity and dynamics that characterize the course of events in war or in a civilian human relief operation place great demands on command and control. To support the design of new, more efficient staffs methodological developments are required. The aim has been to suggest a practicable way to get ahead in the ROLF project by formalizing and goal directing the design activities

1. Introduction

War and large-scale human relief operations such as the recent one in Kosovo place great demands on the command and control exercised by military and civilian staffs. The dynamics and complexity that characterize the modern war requires an organization that can process and act upon information in real time. A central issue in the design and organization of new forms of command and control is how the realities of the chaotic battlefield are represented in the staff. That is, the mapping between what the organization does, e.g. conduct war or rescue people, and the staff activities is of outmost importance.

As a consequence of the anticipated new demands on command and control the Swedish Defense Material Administration (FMV), the National Defense Research Establishment (FOA) and the National Defense College (FHS) have been cooperating since 1995 in a project called the Mobile Joint Command and Control System 2010 (ROLF). The work aims at describing joint commanders' command and control possibilities from mobile or movable command posts in about 15 years time. This paper uses examples from this ongoing project. The purpose was to characterize the design process and derive theoretical and methodological implications for task and organizational design.

New work forms must be developed. The number of participants and hierarchic levels must be limited and the rigid hierarchy of today (e.g. Wikberg, 1997) should be replaced by hierarchical networks. Sundin and Friman (1998) advocate a transition towards a form of command that to a large extent encompasses continuous dialogue, interacting with arising issues and agreements.

1.2 The ROLF Staff.

The ROLF staff module is contained in a shrapnel-proof, flexible metal container that can be transported by a cross-country truck, aircraft or helicopter. Microwave link or fiber optic cable ensures communication between different modules. The staff module has a computerized three-dimensional presentation, an 'aquarium' (Christensson, 1999) in the middle of the floor that shows the current position, in war time regarding the aggressors' as well as own units, the civilian position, terrain and weather, ceiling mounted LCD screens, and individual work stations. The staff members sit in conference positioned on four sides. In a civilian international human relief operation a head of staff, a legal advisor, an ethnic expert, a media expert, a

civilian coordinator, a military coordinator, a rescue, a relief, a Medicare, and police leader would be present.

Brehmer (1998) has extracted five essential and defining characteristics of the ROLF staff: it is small, it is mobile, it has powerful information support compensating for the small number of staff members. The staff members sit around a table 'the aquarium' making normal face to face communication possible, and lastly, the 'aquarium' enables the staff members to have a common focus.

2. Methodological issues.

Entering the second phase of the ROLF project, its orientation will change and the above defining attributes will provide the point of departure. Brehmer (1998) describes a shift from a research task with an explorative orientation in phase one where new forms for command and control were envisioned towards a design task with an engineering orientation. What problems and difficulties then, arise when developing and designing organizational units to be employed in very complex and chaotic situations?

As has been stated elsewhere (Wikman, 1996; 1998) traditional approaches to task analysis do not capture the fast pace of change, the high task variability, the complexity and multiplicity of feedback loops that characterize modern work. Also, in traditional work and organizational psychology, principles such as 'technology' and 'organizational structure' have proven to be too coarse and are not suited for an analysis of complex command and control systems (Wikman and Strangert, 1996).

The complexity and dynamics require an iterative approach firmly anchored in systems theory where preliminary analyses are translated into models to be developed and refined in accordance with successive empirical tests. There is, however, a potential risk in rushing into test situations without first contemplating theoretically what should be empirically tested.

2.1 Modeling and Simulation

In the design of a complex system such as the ROLF staff a necessary step is the development of models and from them deriving performance criteria and qualitative process indicators. Mod er and Wikberg (1999) have tried to specify the ROLF staff in model terms that allow evaluation. They use what they call visual modeling where the system components are mapped graphically so that they systematically describe the parts and the structure of the ROLF staff.

A first preliminary model of the task is derived through a theoretical analysis of the ROLF concept. This model is later refined and extended through simulations where potential staff members are presented with realistic scenarios of, e.g. a human relief operation such as the recent one in Kosovo. Naturalistic observations are conducted of how staff members react to the information they are presented with, how they communicate with one another, how they use the 'aquarium' and other computer support. Questions are asked about why they act as they do, what alternatives they see, what information they require etc.

Outcomes from the simulations are used to correct and extend the preliminary model. The purpose is to achieve a valid mapping that is robust enough to handle different scenarios. This modeling approach is based on oral simulations, where 'validation' of the model is provided through the communication between the designer/researcher and the staff members. It has the iterative character described above but the risk that the discussion, in the simulations, goes astray is clear. It will be very difficult for the designer to integrate and assimilate information that may both be related to the general process and be domain specific, i.e. related to the specific scenario.

A necessary prerequisite in any test is the presence of contrast. To decide if a design solution, say a prescribed communication structure works or not should be done relative an alternative. The development of Mod er and Wikbergs' simulation and modeling approach should focus on strategies to test specific hypotheses that allow the researcher/designer to contrast and examine different expectations, decisions, and actions. The strategies should

include systematic manipulation of conditions, e.g. informations and tasks, driven by hypotheses structurally interrelated in a systems model.

As the theoretical model of the ROLF staff is shaped and developed the evaluation activities must grow more and more goal oriented, i.e. a progression from naturalistic hypothesis generating observations to specific theory driven data collection evaluation activities is required. Following these recommendations, to take the ROLF project further, the question is what input factors, what transformation processes, and what output factors should be manipulated and studied?

3. Design considerations.

Focusing on how the complexity and dynamics of the real time course of events is represented in the staff, it is possible to extract some critical design issues.

3.1 Input.

Input to the ROLF staff may be varied in regard to the degree of information complexity. That is, the heterogeneity or the amount and dissimilarity, e.g. reliability, origin, time aspects etc., of the incoming information can be manipulated. Similarly, it is possible to manipulate the degree of uncertainty in terms of the difference between the amount of information required to perform the control and command task and the information already processed. In the same manner, the dynamics of the input situation allow manipulation.

The reason behind controlling input to the ROLF staff is that information load is probably the primary problem facing the ROLF staff in a real situation. The development of strategies to select information, to execute control over input on the hand of the staff is of ultimate importance because of the overwhelming complexity and dynamics that characterize the course events. Consequently, such strategies should be developed and tested in an early stage of the design process.

3.2 Process.

In describing the ROLF staff, Brehmer (1998), and Sundin and Friman (1998) stress the face to face dialogue, the small number of staff members, participative decision making, the importance of a common conception of the problem, and the three dimensional dynamic representation provided by the aquarium in support of this. There are a number of issues that must be considered in this context, these pertain to: *Communication structure*, i.e. there is a problem of translating strategies to handle large amount of incoming complex and dynamic information into communication structures that serve the overall purpose of the staff activities. *Computer aided communication*, i.e. the choice between channel structures. *The integration of information from multiple sources*, i.e. the inferences and hypotheses about the current or future state of the world is based on cues sampled from the different channels. Many of the cues are afflicted with considerable uncertainty and there is conflicting information that has to be dealt with. *Group Decision-Making*, i.e. in the planning and decision making process, extracted facts and opinions needs to be anchored among the staff members. In this process, task uncertainty can be reduced if explicit decision making rules are integrated into the communication.

4. Discussion

The extremely rich context that the ROLF staff is designed to operate in, combined with the limited number of staff members generates problems. These concern the relations within the staff as well as between staff members and the TODAINFO system. The information access is overwhelming. Due to the limited capacity of human information processing roles within the staff must be separated. The aim of the design activities must be to mould a very manageable wholeness where a limited number of critical parameters are integrated.

In this process, the design focus should be on forms for organizational control aimed at avoiding information overload and biases. Related to this there are issues pertaining to information technology and the use and structuring of information channels. Furthermore, in the design of the task it is probably necessary to structure the internal communication process in phases that contain control loops designed to avoid the apparent pitfalls. These three aspects all depend on each other and on the complexity of the real time course of events that is the focus of the command and control activities.

The design task in the ROLF project is too complex to solve analytically. On the other hand, the risk of losing track when employing a grounded theory approach is obvious. Consequently it is necessary to conduct hypothesis driven systematic experimental simulations anchored in systems theory. The iterative design process of formulating hypotheses, contrasting them in controlled simulations, turning back to an initial model, evaluating and revising it, generating new hypotheses to be contrasted in additional simulations can be compared with a formative program evaluation approach. However, in the ROLF case, the dependent measures or output from the suggested type of simulations would in this initial stage be based on the experiences of the staff members, e.g. what in the controlled situation is regarded as difficult, what was easy, what contacts were taken, etc.. Subgoals are formulated under hand as the design activities' progresses. It would be premature to specify a program and in order to define subgoals there must be a more concrete conceptualization of a functioning ROLF staff.

The aim of this paper has been to suggest a practicable way to get ahead in the ROLF project by formalizing and goal directing the design activities. The suggested focus in such a development is on the transition between model states. The goal direction in the iterative process of developing a theory about the ROLF staff is accomplished through iterative hypothesis testing. In systematically designed simulations these hypotheses must be contrasted for the purpose of theory construction and continuous task and organizational design.

This paper concerns leadership in extremely chaotic situations such as war and other catastrophes. Still, the approach should not be considered limited to this type of applications. In any action research project (e.g. Strangert, 1983; Wikman, 1996) that concerns design of organizations and tasks existing in complex and dynamic environments guidance is needed because of these same factors.

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