

Organisational learning; a path to safety and efficiency

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Abstract

The paper gives an introduction to a session on "Organisational learning in nuclear safety". It discusses connections between organisational factors and nuclear safety. It gives a short description of the LearnSafe¹ project and it discusses challenges and research needs in the field of organisational factors. A conclusion is that more research is needed to establish an understanding of how organisation and management influences safety.

1 Introduction

Organisational learning has been mentioned as one important characteristic of ensuring a continuing safety of nuclear power plants (NPPs). Organisational learning is one specific issue in a more general frame of investigating how organisational factors influence safety in high-hazard industries.

This paper gives a brief introduction to work in the field of organisational factors. This work has aimed at establishing relationships between issues connected to organisation and management and the safety of NPPs. The second part of the paper gives an overview of the LearnSafe project, which investigated challenges that are seen at European NPPs, strategies for coping with them, attributes of learning organisations and hindrances for organisational learning. The third main part of the paper gives a brief overview of research needs as seen from LearnSafe results.

A conclusion of the paper is that in spite of a large anecdotal evidence of the safety importance of issues connected to organisation and management, there is very little tangible results available for how these influences should be handled. Only two types of results seems to be available, on one hand rather theoretical ponderings with minor practical applications and on the other hand rather general statements on good and bad practices that are poorly validated and difficult to apply. To proceed there is a need for more work, where theoretical models are empirically validated at the NPPs.

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2 Organisational factors in nuclear safety

It has been widely recognised that factors connected to organisation and management at NPPs have important influences on the safety through various mechanisms [1]. There have been attempts to include organisational factors in the probabilistic safety analyses [2, 3, 4], but approaches and models have been difficult to validate. More qualitative approaches to organisational factors have been initiated by IAEA in attempts to define the concept of *safety culture* [5].

Safety culture has since its introduction got a large amount of attention in conferences and publications [6, 7]. In spite of its popularity, the concept of safety culture has many interpretations and there are even diverging views on the need for its formal definition. Instruments have been constructed that attempt to measure the level of safety culture [8, 9], but again it is difficult to validate the results against other measures of safety and to convert the measurements into concrete actions of improvements.

One activity that was initiated as a response to these difficulties took a slightly different approach [10]. It aimed more at a description of certain methodologies in approaching organisational factors together with practices that are in use at the NPPs. The perhaps most important outcome of this rather small project was that it was the main initiator of the LearnSafe project.

3 The LearnSafe project

3.1 Structure and content

The main objective of the LearnSafe project was to create methods and tools for supporting processes of organisational learning at NPPs [11]. Organisational learning has become increasingly important for the nuclear industry in its adaptation to changes in the political and economic environment, changing regulatory requirements, a changing work force, changing technology in the plants, and the changing organisation of NPPs and power utilities. The danger during a rapid process of change is that minor problems may trigger a chain of events leading to actual degrading of safety and/or diminishing political and public trust in the safety standards of the particular NPP, utility or corporation.

The focus of the project was the senior managers at NPPs and power utilities who are responsible for strategic choice and resource allocation. This focus was selected with the understanding that their decisions, approaches and attitudes have an important influence both on safety and economy of the NPPs. The LearnSafe project has addressed methods and tools that are used in the management of change, and in ensuring efficient organisational learning.

The project was set up in two major phases that covered both theoretical considerations and empirical investigations. The first phase placed an emphasis on *management of change* and the second on *organisational learning*. One important feature of the project was a continuous interaction between researchers and managers at

the NPPs in addressing issues connected to organisation and management that are important for safety and efficiency. Preliminary results of the project have been presented and discussed in small workshops held at the NPPs. A total of 14 partners have co-operated in the project, which has a total budget of about 1,2 M€. The LearnSafe project was started in November 2001 and it was completed in April 2004.

3.2 Achievements

The LearnSafe has collected impressive data sets on challenges that senior managers see in the present operation of nuclear power plants together with strategies, plans and actions they use to cope with them. This data has been analysed using two different methods [12]. The two methods showed to support each other in the overall analysis, but they also have their own strengths.

After the data collection and analysis a further step in the project was to survey strategies, plans and actions that are used at the NPPs to cope with the challenges. This data was collected in several case studies carried out together with people from the participating NPPs. The case studies gave a picture of the NPPs as fighting with largely similar problems, although some of them are national. The strategies, plans and actions were discussed at the LearnSafe Mid-Term seminar in May 2003, to generate suggestions for possible improvements. The improvements suggested have been sorted with respect to both challenges and stakeholders that have to be engaged to implement the improvements.

The data collection to identify typical characteristics of learning organisations together with hindrances for organisational learning has used similar methods as the collection of challenges. Results show that available theoretical models have a quality to generate intense discussions in groups of people that have not seen them before. In these discussions respondents were often able to give example of events in which characteristics and attributes of the models were illustrated. In some cases the model even seemed to provide missing concepts that helped in a post hoc explanation of events that were difficult to understand in the earlier analysis.

LearnSafe has included several spin-off activities together with the participating NPPs. Such activities were initiated when it was felt that some ongoing activity at a NPP had a generic interest for the LearnSafe partners. The spin-off activities have included investigation of cases of organisational change, changes in management and quality systems, programmes for event analysis [13], organisational development [14] and competency planning, etc. These activities have generated useful background data for an understanding of ongoing activities at the NPPs and the results have had an immediate application for various improvements at the plants.

3.3 Findings

The challenges collected illustrate a rather complex setting. Most of the challenges are initiated through changes in the operational environment of the plants and the process of adaptation to these changes. Other challenges are due to normal processes, such as the ageing of plants and people. The final set of challenges is connected

to an increased understanding of crucial components of nuclear safety that has been reflected in new regulatory requirements.

The NPPs have approached the challenges in their strategic and operational planning processes to initiate an adaptation to changed conditions. There are large similarities the approaches applied, but also some interesting differences. Most of the differences are connected to differences in national regulations and in the way nuclear power was introduced in the country in consideration.

Another finding is that the strategies, plans and actions taken in responding to the challenges sometimes generate a new set of challenges. It can also be seen that there often is an interaction between challenges and selected strategies for coping with them. Different programmes that are implemented at the NPPs are seldom approaching one challenge in isolation, but rather a set of challenges that may have many different causes. Such interactions between primary challenges, strategies, secondary challenges and so on, actually imply that a rather complex web of interacting issues that has to be understood by senior managers and acted upon.

In an assessment of possible improvements in the strategies, plans and actions the NPPs use in coping with the challenges, they seem to fall into a few general categories. In a similar way improvements seem to be directed in slightly different ways, depending on the stakeholders in consideration. In a gross simplification of the results obtained, it may be said that the NPPs themselves should engage more in a long term planning for the future, which should involve all important issues of economics and safety. The corporate management in the nuclear utilities should on their hand ensure that a thorough understanding of nuclear safety is retained on all organisational levels through organisational changes. The regulators should on their hand ensure that regulatory interventions are correctly targeted also in a longer time perspective. International organisations do a large effort in the exchange of operational experience and this should continue, but more efforts should be invested in ensuring that important information is reaching its targets. Research organisations and universities should network to avoid a duplication of resources and skill, but they should also avoid the trap of a too large unification of views and approaches.

Organisational learning and the concept of learning organisations have been considered rather extensively in the literature [15]. Models of organisational learning can be used to suggest different characteristics and attributes for learning organisations and possible hindrances for effective learning. These models have been used to device data collection methods that have been used at the participating NPPs. The collected data gives several hints by which NPPs may approach their own internal cultures in a search for safer and more effective practices in work.

4 Challenges and research needs

The main challenge in approaching organisational factors in nuclear safety is connected with the complexity of organisations. To create an understanding of various mechanisms of influences it is necessary to have a very good understanding of human behaviour in various situations. Already an identification of situational characteristics that influence human behaviour and choice is a large task that has not yet been satisfactory solved.

In an assessment of work done so far in connecting organisation and management to nuclear safety, it seems to fall into two different categories. The first category is connected to the work of various management consultants, who sell services to the nuclear power plants. In assessing this part it seems that, in spite of the sometimes large enthusiasm connected to specific suggestions, this type of work is difficult to prove to be reliable and valid. This implies that a transfer of solutions from one setting to another always will be problematic. The second part is connected to academic research, which seldom is practically oriented enough to provide guidance on specific problems that the plants are fighting with.

In the practical work at the nuclear power plants one difficulty is connected to the transfer from identified organisational weaknesses to specific actions that are likely to introduce sustainable improvements in organisational performance. Just to take one example, the common suggestion to any problem, which is to write a new procedure, is not likely to introduce major changes in work practices and could even be counterproductive in some cases.

One response that may improve the present situation is to argue for a better exchange between theoretical and empirical aspects in the research done. The present situation seems to be hampered by very little communication between the development of theoretical models and the solving of practical problems. It would be necessary to improve this situation to find a structure according to which empirically based recommendations can be structured. Another issue that seems to hinder an efficient combination of models from different scientific fields is the lack of systemic thinking. If a better understanding of organisational factors in nuclear safety can be achieved, there might be possibilities to include them in risk based decision making on needs for various improvements at the NPPs [16].

5 Conclusions

The construction and management of safety in nuclear power plants includes two major steps. One is connected to the design of safety into technical systems and work practices. This relies on the well known principles such as *defence-in-depth* and the construction of *barriers* against various threats. The other is connected to the analysis efforts by which it can be concluded that technical systems and work practices make the operation of the plant *safe enough*. When organisational factors are considered there is very little practical guidance for how these steps should be achieved.

In ensuring a continued safety of the NPPs in the world, it would be important to reach a better understanding of the mechanism through which organisation and management influence their safety. Optimally it should be possible to produce similar principles for the design and assessment of organisations that are used for technical systems. This means that present analysis methods should be amended with a framework in which it would be possible to discuss both *claims* of organisational reliability and the necessary *evidence* that these claims can be considered fulfilled. The claims would represent a forward design based consideration and the claims a feedback path based on analysis. If such a framework can be constructed, it will be one important step the continuing quest in achieving a safe and economic operation of the nuclear power plants in the world.

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