Safety Science 49 (2011) 65–74

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

Organisational learning – Reflections from the nuclear industry

Björn Wahlström *

Djurholmsvägen 2, AX-22920 Brändö, Finland

ARTICLE INFO

Article history:
Received 19 August 2009
Received in revised form 24 November 2009
Accepted 28 November 2009

Keywords:
Nuclear safety
Organisation and management
Organisational learning
Models

ABSTRACT

Organisational learning has attracted scholarly interest for some time. In parallel a recommendation has been expressed to nuclear power plants to become learning organisations. I start from systems and practices of organisational learning that can be observed within the nuclear industry. After that I give a short description of the LearnSafe project and its main results. Next, I suggest a model that may provide help to nuclear organisations in structuring their discussions of organisational learning. Finally, in the last main section of the paper I discuss implications for the nuclear industry. At the end conclusions are drawn to give suggestions for future research.

1. Introduction

Organisational learning has attracted scholarly interest for some time (Easterby-Smith, 1997; Easterby-Smith et al., 1999, 2004). In parallel the recommendation to the nuclear industry has been that operators of nuclear power plants should become learning organisations (IAEA, 2002). Unfortunately however, this recommendation has been given without concrete guidance for how this could be achieved. The aim of this paper is to explore models that can provide help to the nuclear industry in structuring their own discussions on facilitators and hindrances of organisational learning.

Organisational learning has in the management literature been seen as adaptations to changed operational environments. The deregulation of the electricity market represented such a period of change for the nuclear industry, which during the years 1995–2005 due to low prices for electricity introduced many tensions in the operation of nuclear power plants. Increased prices during recent years have caused a revival of nuclear power and the plants are now seen as very profitable. Fulfilling the requirements for safe operation is however still the major challenge to managers and organisations at the nuclear power plants.

In the first major section of the paper I give a description of practices in the nuclear industry, which have an application to organisational learning. After that I describe briefly how data was collected in the LearnSafe project[1] and how it was analysed. From there I develop a model that may provide help to nuclear organisations in structuring their discussions of organisational learning. Implications for the nuclear industry form the last section of the paper. At the end I draw some conclusions and give suggestions for future research in the area.

2. Organisational learning in the nuclear industry

2.1. Organisational characteristics

Organisational structures in use at nuclear power plants are designed to meet the need to manage areas of deep technical skills and knowledge that are necessary to run the plants. Organisational innovations such as lean structures with few organisational levels, empowerment and process orientation have been tried, but requirements for accountability and repeatability have preserved structures with line organisations and formalised procedures for decision making and work control. Modifications of the plants are handled through a parallel use of project organisations.

Nuclear power plants have a very long operational life. Most nuclear power plants that are in operation were initially designed for 30–40 years of operational life, but today many plants are planned to run for at least 60 years. The long operational life places many challenges on the plants. One challenge is connected to technical development, which at some point in time will force the plants to modernise due to a combination of more stringent safety requirements, opportunities for power upgrades and difficulties to get spares. Another challenge is connected to maintaining skills and competence over two or more generations of staff.

Regulatory oversight implies that it is not enough that the plants are safe, but they are in addition forced to provide continuous proof to the regulator that they are safe. International practice

* Tel.: +358 400 448710; fax: +358 9 8030781.
E-mail address: bjorn@bewas.fi

[1] LearnSafe – Learning organisations for nuclear safety. This work was funded by 5th Euratom Framework Programme 1998–2002, Key Action: Nuclear Fission by the European Commission with the contract number FIKS-CT-2001-00162.

0925-7535/$ - see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ssci.2009.11.010

places the sole responsibility for safety on the operator of a nuclear power plant. This is a straightforward requirement, but it also carries a subtle contradiction in the assumption that the regulator should not manage the plants, but still influence what they do (Wahlström, 2007a).

Nuclear power is a political technology, which stirs emotional reactions from politicians, media and the general public. This means that the nuclear industry's words and deeds are watched closely. Decision power also is exercised in political processes when power companies apply for building and operation permits. If something unexpected happens during plant construction or operation scrutiny is started immediately and efforts to restore public confidence and trust may be considerable.

2.2. Plant, people and processes

Since the first commercial plants were built in the 1960s, the nuclear industry has gone through several cycles of learning. Unfortunately, this learning has been partly reactive in response to incidents and accidents that brought earlier shortcomings in plant design and operation to the surface. Early safety concerns were focused mostly on technical matters and considerable efforts were spent on defining principles to be applied in developing requirements that would ensure safety of the plants. The deterministic safety principles that were created are still used today, but a few incidents in the early 1970s demonstrated the need for amending them with probabilistic safety criteria.

The Three Mile Island accident brought focus on the people who operate and maintain the plants. The accident brought many improvements into control room design, procedures and operator training to nuclear power plants all over the world. This development also triggered research in human behaviour and probabilistic safety assessments to provide estimates of the likelihood of human errors. Attempts in the early 1980s to elevate the influence of organisation and management on safety to the agenda did not at that time influence the thinking of the nuclear community.

The Chernobyl accident changed this situation. The post-accident meeting hosted by IAEA identified deficient safety culture as the root cause for the accident (IAEA, 1986) and a new cycle of learning was initiated. Today it is common practice to address the three systems of plant, its people and work processes or with a different set of terms man, technology and organisation. In hindsight it may be considered surprising that it took nearly half a century and two major accidents to create this insight.

2.3. Management systems

The management systems in use at nuclear power plants build on quality systems and organisational handbooks that were introduced in the late 1970s (Wahlström, 2004). At nuclear power plants today different concerns such as quality, safety, environmental protection, labour safety and security have been integrated into a single management system that also includes various non-safety related systems. The management systems of today typically have a hierarchical structure starting from the top with descriptions of mission, organisational values and vision and ending at the bottom with detailed instructions for carrying out specific activities and tasks.

Instructions that control daily activities form an important part of the management systems and they can on a general level be divided into three groups: operational, maintenance and administrative instructions. The operational instructions are further subdivided into instructions for start up and shut down as well as disturbance and emergency instructions. The operational instructions are usually validated at simulators and they are assumed to be followed literally. Maintenance instructions are also assumed to be followed literally, but administrative instructions are often seen more as ensuring repeatability in work activities.

The management of change at nuclear power plants goes through strictly controlled procedures, which are enforced by the regulator. Special administrative instructions are written and used to control this process. At nuclear power plants a separation is usually made between technical modifications and organisational changes. The formal procedures for the management of change are sometimes perceived as preventing even well motivated changes, but experience has clearly demonstrated the need for thorough reviews of all modifications and changes before they are introduced (OECD/NEA, 2005).

2.4. Organisational culture

Whereas the management system can be seen as the formal part of the organisation, the organisational culture can be seen as its informal part. Organisational culture has to do with shared values, attitudes and beliefs that members of the organisation have towards different things. One model of organisational culture separates between artefacts, espoused values and basic underlying assumptions and argues that organisational culture is difficult to assess and change (Schein, 1992).

A common view is that organisational culture is an emergent property that does not lend itself to conscious control. Organisational culture will however change over time in response to external events and to achieved and perceived performance. Good performance over extended periods of time has a tendency to enforce organisational beliefs in continued success, which may introduce more lax attitudes towards thorough safety precautions. Incidents and accidents have shown that gradual drift in organisational culture can create careless attitudes for example towards instructions. A common practice today is that nuclear power plants carry out organisational surveys that reflect prevailing organisational culture.

IAEA has since the Chernobyl accident actively been marketing the concept of safety culture to nuclear power plants (IAEA, 1991). Safety culture can be thought of as an organisational culture that safety oriented organisations should have (IAEA, 1998). IAEA has been active in developing guidance for activities that can support a good safety culture and the property of being a learning organisation has also been associated with a good safety culture (IAEA, 2002).

2.5. Systems facilitating organisational learning

The nuclear industry has a long tradition of sharing knowledge. These traditions have resulted in formalised systems for the exchange of information, which are operated by IAEA and WANO. One example is the feedback of operational experience that documents and shares lessons learned from incidents all over the world. These systems lay a dual responsibility on the nuclear power plants to report and analyse their own incidents and to extract and apply lessons from incidents at other nuclear power plants in the world.

IAEA and WANO also support organisational learning by peer reviews. A team of 10–20 persons from several plants visits a host plant for a period of 2–3 weeks to assess performance in several organisational areas. This practice gives a learning opportunity both for the host plant and for the people taking part in the review. The effect of learning is enhanced by revisiting the host plant some 18–36 months later after the peer review.

The management systems contain several functions that facilitate organisational learning. One example is the yearly planning in which plans are compared to performance outcomes to analyse deviations and to suggest improvements. Regular audits of work