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A DISCUSSION OF CORE COMPETENCIES

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Summary: This report describes a study of core competencies that was conducted together with FKA and TVO as one of the spin-off activities within the LearnSafe project. The concept of core competency is important as seen from a LearnSafe point of view, because it has several connections to learning organisations, organisational learning and knowledge management. In the study the views of a total of 15 persons were collected and reflected on. The study brought insights on the concept of core competency and gave a larger perspective on human resource management. A conclusion of the report is that core competency should be seen as an important instrument facilitating the strategic planning process of organisations.

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1 INTRODUCTION

LearnSafe¹ has investigated processes of *management of change* and *organisational learning* at nuclear power plants across Europe. The focus of the project was on tasks and activities of senior managers, who are responsible for strategic choice and resource allocation. This focus was selected due to the importance of senior management decisions, approaches and attitudes, which have an influence on the safety and economy of the plants. In the LearnSafe project a number of spin-off activities were initiated to investigate issues of an immediate interest for the participating nuclear power plants. This report describes one of these spin-off activities that were initiated in co-operation with FKA and TVO.

The concept of core competency is a topical issue both at FKA and TVO. It has been introduced to support the strategic planning process connected to human resources management. Human resource management has become increasingly important for both companies, because in the coming five to ten years many persons in the personnel will retire. Another reason for the topicality of considering core competency is a decreasing vendor support and a growing difficulty of recruiting competent people to the nuclear field. A regulatory concern that an outsourcing of various activities will lead to a decreased safety for the plants, has also increased the interest in the concept of core competency.

The study was carried out by interviewing a selection of people from both FKA and TVO. The interviews were recorded and transcribed. A total of 15 people expressed their opinions on the same questions (cf. Appendix 1). The interviews at FKA were conducted in Swedish and took place 11-12 September 2003 and at TVO in Finnish in the period 25 September to 31 December 2003. The practices reported were generally similar and there was a large agreement in opinions. Both FKA and TVO have invested efforts in thinking and documenting their needs for competency far into the future. Activities at FKA and TVO seem to be well adapted to needs that can be seen within the nuclear industry.

The concept of core competency is important as seen from a LearnSafe point of view. The concept has several connections to learning organisations, organisational learning and knowledge management, which are crucial for efficiency and competitiveness especially in a process of adapting to changing operational conditions. It is hoped that this documentation of discussions and activities that are connected to human resource management at FKA and TVO can provide nuclear power plants and other reliability centred organisations with food for thought in their own planning processes. The study gives in this way its own contribution to the continuing quest of ensuring that potentially high risk facilities in the world are operated safely.

2 DEMANDS SET ON THE NUCLEAR INDUSTRY

This chapter goes through demands and requirements that are set on the nuclear industry as reflected in the interviews. There were no significant differences in the responses from FKA and TVO and they were complementary in many aspects.

¹ The LearnSafe project "Learning organisations for nuclear safety" was funded by 5th Euratom Framework Programme 1998-2002, Key Action: Nuclear Fission during the years 2001 to 2004 by the European Commission under the contract FIKS-CT-2001-00162. Additional information from the project can be obtained at the web-site <http://www.vtt.fi/virtual/learnsafe/>.

2.1 An absolute demand for safety

The nuclear industry is characterised by a demand on safety that in practical terms can be considered absolute. This demand has many implications on how work is organised and managed at the plants. From an operational point of view the most important is the 24 hours a day and seven days a week oversight that has to be given by people, who have a thorough understanding of plant systems and equipment. This oversight has to be extended with emergency preparedness, to give plant operations a support of the whole organisation during disturbances and abnormal conditions.

The operation of nuclear power plants has a global aspect in two ways. The first is that an accident anywhere can be considered to be an accident everywhere, because problems anywhere in the world will diminish public trust in nuclear power. The second dimension is connected to the feedback of operational experience, which has to reflect relevant information collected through international channels from all nuclear power plants in the world. A nuclear power plant has to have a good understanding of the global nuclear industry, to be able both to react on new safety relevant information and to give an account of international events to their own stakeholders.

Nuclear power has in some countries been confronted with an extreme opposition of action groups, which often have the view that the end to stop nuclear power sacrifices all means. This implies that nuclear power plants have to protect themselves not only against natural threats, but also against threats that are connected to acts of sabotage.

2.2 Regulation

Due to the special characteristics of nuclear power the operation of nuclear power plants is governed by special legislation. This legislation typically defines a regulatory body, which on behalf of the society is given the responsible for issuing regulation and implementing an oversight to ensure that the regulation is fulfilled. The applied principle is that the plant operator has the full responsibility for safety and that the operating license can be revoked if safety requirements are not fulfilled.

The regulation implies in principle that it is not enough that a nuclear power plant is safe, but it has to be proven that it is safe. This may lead to situations, where even a suspicion that the plant is not safe can lead to extended shut downs during which the plant accumulates the evidence needed for its restart. Regulation is continuously updated to reflect new operational experience. A relatively recent requirement is for example that a precondition for the operation of the plants is a high safety culture, which however has shown to be difficult to judge on purely objective terms.

2.3 Changes in the nuclear field

There have been many changes in the nuclear industry over the last couple of decades. The perhaps most important is that there has been a growing political opposition to nuclear power, which at some level has influenced career choices of people. There have not been many new plant construction projects, which has lead to a hollowing out of vendor competency. The plants and the personnel operating the nuclear power plants have been ageing.

A large change was introduced in the deregulation of the electricity market, which started in the mid-1990ies and is moving forward in Europe. The deregulation has forced the nuclear power plants to put a larger emphasis on cost structures, because operational costs could not

after the deregulation be recovered in tariffs. The deregulation has forced the nuclear plants to do more with fewer resources. These changes have all had their own influences on the human resource management at the nuclear power plants.

2.4 Competitive aspects of nuclear power plants

Continued operation of nuclear power plants implies that they have to be competitive as compared with other electricity sources. Nuclear power plants have due to the technology a different cost structure than other means for generating electricity. For example the fixed costs are large in relation to the running costs, which means that nuclear power plants have their main advantage in supplying base load. The prices on the Nordic electricity market give an incentive of placing refuelling outages in the period of April to September of each year. Correspondingly it is important that production during winters is not disturbed by unexpected outages.

The nuclear power plants in Finland and Sweden do not compete directly on the market, but are integrated in a fleet of production capacity that is dispatched on the interconnected electric grid according to a production plan. In spite of this formal decoupling from the fluctuating prices there is a large management interest in the productivity of the plants.

A third component of competitiveness is connected to the general requirement that the competition on the market should be real. This requirement is monitored by the national and European competition offices, which try to ensure that competition can occur on identical terms. To some extent this is however difficult on a market that is governed by strong national regulation. There have been indications that the earlier open exchange of information between the nuclear power plants has decreased after the deregulation.

2.5 Management and quality systems

The high demand for safety and the need to be able to demonstrate the safety has led to the introduction of management and quality systems. It is also a regulatory requirement that there is a documented quality system in use at the nuclear power plants. The management and quality system has an important position in ensuring that all activities are performed according to requirements. It is therefore important that the management and quality systems are not only built and enforced, but also understood and used.

Building and maintaining management and quality systems require specialised competencies in updating them and in enforcing their use through audits and reviews. The management and quality systems are sometimes seen as bureaucratic and stifling on efficiency and innovation, but already a shallow scrutiny of their importance for safety reveal their necessity.

2.6 Work at international organisations

The competency in the workforce at the nuclear power plants has been identified as an important precursor to safety. This recognition has led international organisations to investigate various aspects of competency and to issue guidelines. IAEA has for example collected guidance in ensuring a proper competency for nuclear power plant managers.² The need to transfer knowledge from the generation of people that took the nuclear power plants into operation to

² IAEA (1998). Selection, competency development and assessment of nuclear power plant managers, TECDOC-1024.

a new generation of people has also been an important issue to address.³ The deregulation of the electricity market has been an issue of concern, which was addressed in a recent report from OECD/NEA.⁴ Finally some of the general requirement connected to competency has been recorded in an IAEA Safety Guide.⁵

3 CORE COMPETENCIES IN THE NUCLEAR INDUSTRY

This chapter reflects the views of the respondents when asked about their understanding of core competencies and various ways to approach and define the term. There were large similarities in the views and they provided complementary pieces of a consistent description of activities within human resource management.

3.1 Perceptions of core competency

The respondents viewed core competency rather similarly, although minor differences in the emphasis could be felt. The common responses were that core competency is what is necessary and important to operate the facilities, both in short and long term. This implies a thorough understanding of demands and requirements that are given from the society through the regulator. Furthermore it implies that necessary competencies are found to manage the plant, the personnel and the organisation in such a way that demands and requirements are met. As one of the respondents noted, because the plants are responsible for the safety, the core competency is everything that is needed to take that responsibility.

Many of the respondents noted that skills and knowledge through which the core competency is reflected, actually is something that everyone in the company has to have at least on some level. In addition there are various specialist competencies that should be found within the company, which however may not be as important for everyone to have a deep understanding of.

3.2 Dimensions of competency

Many dimensions of core competency have been identified. At one level one could separate between competencies needed in the functions of operations, maintenance and technical support. In addition to these general functions there are also other important support functions all with their own competencies that have to be related to the specialised needs of nuclear power. Such competencies could for example be found under the headings of economics, administration and management.

Asked about how respondents viewed a division according to technical, intellectual and cultural assets⁶ in a discussion of core competency, they found this division stimulating and well fitting into some of their internal discussions. Many respondents also noted that the technical competencies are well understood and that more work would be needed to identify intellectual and cultural competencies that are needed for safe and economic operation.

³ IAEA (2004). The nuclear power industry's ageing workforce: Transfer of knowledge to the next generation, TECDO-1399.

⁴ OECD/NEA (2000). Nuclear education and training: Cause for concern?, ISBN 92-64-18260-8.

⁵ IAEA (2002). Recruitment, Qualification and Training of Personnel for Nuclear Power Plants Safety Guide, Safety Standards Series No. NS-G-2.8.

⁶ Khalid Hafeez, Yang Bing Zhang, Naila Malek (2002). Core competence for sustainable competitive advantage: A structured methodology for identifying core competence, IEEE Trans. on Engineering Management, Vol.49, No.1, pp.28-35, February.

Many respondents pointed to the need for both breadth and depth in the competency, which is related to a distinction between specialists and generalists. Some respondent stressed the importance that bearers of organisational culture create an environment, where important competencies are acquired and shared. Most respondents agreed that core competency is something scarce and unique, which is difficult to substitute. Core competencies have also a close connection to values, strategies and practices of the company in consideration.

3.3 Competency connected to specific fields

In a more detailed discussion of competencies in various fields many respondents pointed to the need to know what certain actions will accomplish. This is possible only with a thorough understanding of plant systems, their functions and how they are operated and maintained. Because a large amount of the work at nuclear power plants is controlled through instructions, it is important to know relevant parts of the management and quality system to know where to look for specific instructions and guidance. Many respondents expressed as their view that it is not enough to know the instructions, but also to have an understanding of the salient characteristics of the systems they work with.

At the nuclear power plants there are certain systems that cannot be found elsewhere and it is therefore important that the competencies they need are properly identified. In operation and maintenance it is important to have an appropriate understanding of the plant and its basic safety principles to understand why and how certain activities could interfere with plant safety. When failures are detected it is not enough to correct them, but there should also be a reflection started on why they have occurred and how they could be prevented in the future. This kind of interactions between systems and functions was considered as one of the most important components within the field of technical competence.

3.4 Other competencies

Within the area of economics the nuclear field has a large demand for being able to do capital management in a prudent and conservative way. This has to do with the large amount of money invested in a plant and the accumulation of funds in the trusts for decommissioning and the back end of the fuel cycle. Within the area of management the needs for and components of enlightened leadership have to be understood and acted upon.

As a counterbalance to the need for formality and accuracy, there is a need for creativity and flexibility. Sometimes nuclear plants are engaged in large projects, such as for example when new plants are built or when present plants are modernised, then a good understanding of project management can be an asset. Contacts to society and good media relationship are also valuable assets for the nuclear power plants.

3.5 The concept of an intelligent customer

There are many specialised skills that have to be utilised and it is therefore evident that the plants themselves cannot have all these competencies in their own organisation. The concept of an intelligent customer has been coined as a response to these needs. Broadly taken an intelligent customer should be able to specify, supervise and check work quality that is bought from outside vendors and contractors. The concept of an intelligent customer also has the implication of not involving oneself in design and construction, but to analyse work and deliverables. The concept of an intelligent customer implies a good technical competency to understand why and how specific things are done.

One difference between the nuclear power plants in Finland and Sweden is that it has been relatively common in Sweden to have a buy and sell system for internal services. Such systems have not been used in Finland. The benefits with the systems are said to be connected to the creation of an understanding of costs among the personnel and to support the formation of clear roles between parties within the organisation. The view in Finland is that these arrangements add an administrative burden and that they may hollow out the responsibility for common goals of the company.

Buying services to the nuclear industry always carries the responsibility to ensure that requirements are fulfilled in the delivery. For suppliers that have an earlier experience of supplying services to the nuclear industry, this need for supervision and inspection may be relatively straightforward to fulfil, but for others it may require a large degree of detail in specifying conditions of the deliveries.

3.6 The placement of competencies

The placement of competencies to physical locations and within the organisational structure is important for internal communication. In the nuclear power plants work is often done in teams in which different competencies are combined. This would suggest a plant unit and team oriented structure, but on the other hand the professional development in certain competencies would instead suggest a functionally oriented structure. Many of the respondents pointed to this dilemma and noted that has to be resolved on a case by case basis.

In a consideration of proper locations of competencies, there is a spectrum ranging from competencies that have to be within one specific organisational unit, at the site, within the mother company, what can be bought from specialised companies or what can be bought on the open market. It is also clear that these needs will vary with time. One general observation is that communication over organisational borders always seems to be more difficult than communication within one organisational unit. This observation may in fact suggest the need to circulate people between various positions in the organisation to create better links over functions and professions.

3.7 Understanding the facilities

One of the crucial competencies in the nuclear industry is to understand when the plant is in a safe state. Without such an understanding responsible managers cannot make correct operational decisions. Due to the complexity of the plants it is necessary to have clearly defined operational regimes, where decisions on an hourly and daily basis should be based on clearly defined rules and instructions. Correspondingly decisions with a range from weeks to months can rely more on detailed analytical assessments. Both the rules and the analytical reasoning have to be based on the safety philosophy and the design basis of the plant. Acquiring a full understanding of these issues may require many years of full time participation in activities connected to analyses of risk and safety, incidents, plant modifications, etc.

One important issue in acquiring a thorough understanding of the plants is connected to making theoretical knowledge operational. This has to do with the design base of the plant and how different requirements have been translated into plant design. In Sweden there have been large projects that have aimed at regenerating the design base of the older units. Both FKA and TVO are operating newer BWR units for which this need has not been as large. There have however been some needs to clarify aspects of old documentation, which at FKA have

generated various updating activities. At TVO a similar update of the design basis was done in connection with the modernisations that were carried out at their plants in the late 1990ies.

The so called MTO concept (man, technology, organisation) has in the nuclear industry been coined to underscore the need for a systemic approach to safety. This concept is stressing the importance of a broad understanding of interactions between technical systems, people and the organisation.

3.8 A proactive mode of operation

One of the virtues in the nuclear industry is to adopt a proactive mode of operation. This implies that upcoming problems are identified and prepared for in advance. This gives the possibility to act thoughtfully on problems and also the benefit of refraining from temporary solutions that have to be changed afterwards. The proactivity introduces its own needs for specialised skills and competencies. It is necessary to follow up even small indications at the plant and understand the mechanisms by which they may influence safety or economy. Proactivity also implies that resources are allocated when indications of emerging problems are seen.

The need for proactivity is seen especially in the maintenance work, where preventive and condition based maintenance can support both safety and economy. This proactivity is to some extent also connected to risk informed approaches, which have been used in the optimisation of testing and inspection programmes. Generally one could say that a good indication of a proactive approach is that backlog lists are kept short.

4 MAINTAINING CORE COMPETENCIES

This chapter gives a reflection of strategies, plans and actions that are in use at FKA and TVO within the area of human resource management. Some differences can be seen, but they seem to be more connected to local conditions than to significant differences in views. This chapter gives also a reflection on emerging issues, which both FKA and TVO have identified that will warrant attention in the future.

4.1 Definition of core competencies

Definition of core competencies is closely connected to the strategic planning process. All respondents found it valuable to define core competencies as explicitly as possible. They also saw the benefit of engaging a broad participation from the personnel in the definition process. Several of the respondents reported that they had encountered some differences in views, but concluded that discussions of the differences usually had been quite fruitful.

Several respondents reported that a participation in discussions of core competency over organisational borders had proved to be useful in creating a better understanding of interconnections between various tasks. Respondents also noted that for the definition of core competencies to be successful, they presuppose an active involvement and oversight of senior managers. When the initial work has been done in defining core competencies, the results can be transferred to an operational level, where regular updates are brought into the documents in accordance with usual planning cycles.

4.2 Competency surveys

Both FKA and TVO have carried out competency surveys in which present competencies have been documented and the need for competencies in the future has been assessed. These surveys give the possibility to identify competency gaps and to initiate corrective actions. Both companies use the surveys as living instruments to reflect various changes, such as reorganisations and changes in the operational environment. TVO is using their system also as a documentation of certain qualifications of people, where a regulatory acceptance is needed. TVO has an ambition to document also competencies of contractors that are turning up at the plant site.

Respondents stressed the need for making the competency surveys systems operational and used at all levels in the organisation. To achieve this, it would be important to make it easy to record and update information for example during regular performance appraisals. Future needs for competency would in the same way be updated at least once a year in connection to the strategic planning process. Many of the respondents stressed the need of documenting not only technical competency, but also more generally various soft competencies.

At FKA and TVO there has been some resistance to the competency survey systems. This resistance seems however to be related more to the additional burden the systems bring, in competition with other important managerial activities. One reason for the resistance was also connected to the somewhat unsatisfactory user interfaces of the used systems. It was believed that when the systems give a true support for managerial tasks, they will achieve their intended use.

4.3 A balance between individuals and the organisation

Managers are responsible for the work their subordinates do, i.e. that they are competent and that they carry out work according to specifications. This implies that the managers should ensure that their subordinates have required competency and skills. In addition it is however also clear that everyone in the organisation has a responsibility to maintain and develop own competencies. Many of the respondents felt that there over the years has been a slight transfer from the organisation to the individuals in the responsibility for a continued competency development. They also saw the performance appraisals as an important forum for interaction in which company and individual goals can be matched. To achieve a positive outcome in these discussions, it is evident that managers should have a very good view of company goals, strategies and core competencies.

The possibility for two career paths was touched on in the discussions. One path would be oriented towards a specialist training and the other towards managerial training. A managerial training would be more oriented to becoming a generalist. The thinking behind the two career path system is well known at both companies. FKA has tried the system, but presently it is not in use. At TVO the system is in use and it is seen as providing certain advantages. Some respondents pointed to the need for identification possible managers early and giving them a systematic training.

4.4 The balance between producing and buying

Core competency is usually associated with competency that a company should have within its own organisation. The decision to produce or buy is always a matter of strategic considerations and there may be different reasons for producing or buying some services. In some cases

it may for example be beneficial to produce services that are standard and can be found on the market, if it for different reasons is more cost effective to produce them oneself. In other cases even specialised services that may be crucial for the success of a company, may be better to be bought, for example when the load on these services is small and it therefore is a danger that this competency will wither away over time.

The respondents agreed to a large extent on these general principles and some of them pointed to the difficulty especially for specialists to maintain their competency without a continuous interaction with other specialists in their own field. Respondents also noted that when a crucial competency is bought on the market, there should be a reasonable confidence that this competency can be obtained at least on a medium term into the future. Respondents agreed on that a discussion of core competencies can help in making the strategies clearer in what to produce and what to buy.

4.5 Adapting to changes in the operating environment

One important part in the work connected to core competencies is to reflect changes in the operational environment of the plant. This will need an active monitoring of partners, competitors, vendors, contractors and other stakeholders. In collecting this information it is useful not only to consider the present situation of the stakeholders, but also to have some feeling of their strategies and development plans. This environmental monitoring is a task of each manager within his or her span of responsibilities. To make the environmental monitoring efficient it is often useful to co-ordinate these activities internally. When larger changes occur in the operational environment, they may warrant specialised projects for information collection and analysis.

The respondents agreed on that this environmental monitoring is important and gave examples of changes to which they have to act. Especially in Sweden new regulatory requirements were seen as one area warranting special efforts. Another important area that was mentioned was information technology and especially new instrumentation and control systems. Many respondents thought that changes in the educational systems were important to follow to have an understanding of the education and the expectations of persons entering their professional careers. Finally several respondents noted that changes in the operating environment at the same time represent both threats and opportunities.

4.6 Recruitment and training programmes

Recruitment and training programmes represent one important part of human resource management. Both FKA and TVO have their own personalised programmes for taking care of newcomers in the companies. Some respondent noted that the need for this was learned the hard way some years ago. Presently both FKA and TVO are engaged in managing a larger renewal of the personnel, which is due to an upcoming wave of retirements. Both companies have identified the need to transfer tacit knowledge from the old generation to the newcomers. Mentorship programmes were mentioned as one concrete solution and some of the respondents noted that new control room staff would need at least a three year period of overlapping work. At the same time it is also important to give newcomers responsibilities to enable them to grow within the organisation.

FKA has been running trainee programmes for many years with good experience. When the interviews were made a programme at FKA was undertaken with the objective to recruit people to their second or third job. This has been started with the expectation that such people

would be more stable than people, who are entering their first job. At TVO the new plant project has created a large enthusiasm and many new people have been and will be recruited. One of the respondents stressed the need to find persons, who are interested in technical issues and want to work out things for themselves. Today it is quite common to use psychological tests in the recruitment process.

Earlier, FKA experienced some problems with a bureaucratic recruiting process, but now an agreement to streamline the procedure has been reached with the unions. Both at FKA and TVO there was a large satisfaction with the on site training simulator, that in addition to the training of control room operators, have been used to give courses also for other professions at the plants. Both FKA and TVO maintain contacts to universities and colleges to get the benefit of contacts both to a recruitment base and to a research community. The recruitment of females has been increasing slowly over the years at both FKA and TVO. In Finland and Sweden there is a growing concern that a decreasing number of students are selecting a technical or natural science direction in their studies.

4.7 Management training

The training of managers was brought up by many respondents. There was a large agreement that the pressure on managers has been growing over the years and that persons entering a management career within nuclear power would need more systematic training today than what was the typical practise before. This would in addition to a broad technical training also include training in leadership, communication and safety culture. FKA introduced in the year 2004 a large programme, which is aiming at giving all managers and supervisors in the company specialised training to support the creation of common values, an understanding of company mission and efficient working practices.

In the discussion of management training some respondents noted that technical excellence is not always a good predictor of leadership excellence. The management career is however often seen as the only path of career success in a company. There have been discussions of possibilities to institute so called dual careers ladders in which one ladder would lead to management positions and the other to specialist positions.

4.8 Regulatory concerns

Both in Finland and Sweden the changes in the nuclear industry have caused regulatory concerns. The concerns have in both countries been similar and issues such as retirements, outsourcing, loss of vendor competency, etc., have initiated discussions between the regulator and the utilities. In Sweden a new rule of notifying the regulatory body on large organisational changes has been in force since the year 1998. This rule has been interpreted to enforce notifications and regulatory approval when activities connected to safety are outsourced. In Finland the similar requirement is that the administrative rules of a nuclear power plant should be submitted for approval to the regulator, but on this level neither the organisational structure nor the organisational affiliations are defined explicitly.

5 INTEGRATING CORE COMPETENCY INTO STRATEGIES AND PLANS

This chapter gives a reflection of views by the respondents on ways to include the concept of core competencies in strategies and plans. All respondents were very unison in their views that core competencies should be seen as an instrument in the support of strategic planning.

This chapter also gives an account of some of the broader mechanisms of change in the society, which may warrant further attention.

5.1 Core competency as a strategic tool

The concept of core competency supports sense-making in the organisation. It is closely connected to the mission of the company and it becomes an important part in the development of plans for the future. Nuclear power plants are today forced to take a long-term strategic outlook to be able to initiate actions on important issues that are governed by very long time constants. An early identification of important issues supports their sustainable resolution in time. This proactivity is even more important in a period of rapid change, because it takes time for people to adapt to new conditions and thinking.

Combining a top-down view in considering core competencies in a strategic context with a bottom-up view from performance appraisals and competency surveys helps in ensuring that plans are laid on a solid ground. In the process of strategic planning core competencies can support reconsiderations of mission, strategic goals, necessary capabilities, etc. as one component in a tool-box, which is used to ask relevant questions regarding the management of activities. Allowing the strategic planning process to support communication and dialogue in the organisation it is easier to arrive at a common view on the activities. The concept of core competency should therefore be seen as a living instrument, which can support a reasonable consensus on what the important issues are and which direction the organisation is going.

5.2 Components of competitiveness

Many companies consider competent and motivated personnel as their most important asset. This is even truer in the nuclear industry, because a continued operation relies on skilled and competent personnel in operating and maintaining the plants. The deregulation has placed a higher pressure to be cost effective, which has introduced the need to find more efficient ways to work. This also means that an earlier conception of the operation of the plants in a holding phase following after an erection phase implied a too passive orientation to various needs for change. Competitiveness implies innovation and a search for efficient work practices. This conceptualisation gives a different stress on areas of competency that will be needed in the future.

The new situation involves the need for achieving more with fewer resources. One solution in the conventional business world has been co-operation through networks in which new business chains and virtual companies are created. The nuclear industry has traditionally been in the forefront in networking both nationally and internationally, but new demands are likely to introduce new needs. If this path is taken it will again place new requirements on future competencies.

Customer orientation has been one of the catchwords in the conventional industry. The nuclear power plants do not have customers in a conventional sense, but have instead important stakeholders. In creating a position on the market and in the society it is important that the interests of these stakeholders are properly reflected. In a prioritisation between issues, which have an influence on competitiveness, senior managers should through their attention and personal examples, give the personnel signals on priorities to be set.

5.3 Motivating the personnel

One important task for managers at each level in the organisation is to create motivation. Motivation has many precursors, but one important component is to be able to find the work meaningful, important and challenging. Several of the respondents stressed the need for creating an atmosphere of enthusiasm in teams and expressed as their view that this may need new innovative thinking. At TVO there has already for many years been an outspoken strategy that all the time have something ongoing that can be seen by the personnel as a professional challenge.

Delegation and empowerment have been used as means to increase motivation. The creation of ownership especially within maintenance is another issue in which both FKA and TVO have invested efforts. In the technical support one important challenge is to avoid the stamp of bureaucracy and rigidity and instead create an atmosphere of flexibility and innovation. Large modernisation projects have shown to have a stirring effect on motivation.

5.4 Adapting to changes in education

Both in Finland and Sweden there are ongoing changes in the educational systems. One change is the gradually increasing share of the age cohort that is selecting an educational path towards higher college and university studies. This change has led to a situation, where the profession of technicians almost has disappeared. This development may have large influences on future recruitment for positions within operations. A similar disappearance of skilled craftsmen may have an even larger influence on positions within maintenance departments.

It would be important for the nuclear power plants to be able to utilise the higher educational level in the age cohort, because otherwise a high turnover in the personnel can be expected. The only way to combat such a development is innovation and restructuring of work in a development of new professional roles. For example it would be important to create suitable interfaces and co-operation over the traditional borders of operation, maintenance and technical support.

5.5 Training for specific professions

In the discussions many respondents saw maintenance as one area important for a further development. Where the training of control room people has been systematised already for many years, there have been relatively few activities to support the training of maintenance people. At FKA the first steps towards use of specialised simulators for the training of maintenance skills have been taken, but among the respondents there was a large agreement that more actions are needed. In the future it can be expected that maintenance people will need more engineering skills in working with preventive and condition based maintenance. This means for example that they should be able to analyse maintenance information statistically to detect trends and identify mechanisms of deterioration. In addition they should have a rather good understanding of the facilities and their design basis.

Another profession of large importance is internal inspectors and reviewers. They have to be generalists in a true sense of the word and they should have a very good understanding for how safety is constructed into systems, work practices and instructions. Present practices assume independence between designers and reviewers, which obviously has to be ensured also in the future. An efficient utilisation of knowledge and skills would however suggest that their skills could be used at least in early stages in the design of plant modifications or new instruc-

tions, to avoid large investments in work that may take wrong directions. To facilitate such arrangements, it may be necessary to rethink the structure of inspections, audits, assessments and reviews to ensure a proper loading on people at the same time as people are given a realistic possibility to do work they are supposed to do.

5.6 Co-operation within the nuclear field

Vendors and contractors serve as natural partners for co-operation with the nuclear power plants. The annual refuelling outages can for example involve hundreds of companies and over thousand persons. Both FKA and TVO have a tradition of getting the same people back year after year with a mutual benefit of straightforward and easy definition and supervision of work. FKA and TVO have adopted as a strategy to create long term contract, which give them and their contractors a mutual benefit in the planning and execution of work. The vendors and contractors used are often engaged in development projects to come up with new technical solutions and to make work practices more efficient.

Both FKA and TVO have several contacts to other nuclear power plants, which aim at a sharing of operational experience. Co-operation exists to create common views on certain areas, such as for example norms and practises to be used within specific fields. Before the deregulation even bartering flourished in some areas, but today for example the access to common spare parts is based on contracts between the parties. Co-operation also takes place within the quality audits that are performed at vendor and contractor companies. A more informal exchange of information takes place at various fora, where people meet and exchange the latest gossip in the field.

Finally one important co-operation takes part through the international organisations such as WANO, IAEA and OECD/NEA. Both FKA and TVO have been supportive for the international co-operation by participating in peer reviews and the work of various working groups.

5.7 Contacts to education and research

Both FKA and TVO have long traditions of contacts to educational and research organisations. One part of the work has involved funding of thesis work on an MSc level. Respondents from FKA and TVO mentioned positive experience from interactions between their own specialists and academia in supervising MSc and other similar projects. This arrangement has the benefit that topical issues can be resolved at the same time as the capabilities of young engineers can be assessed. It is relatively common that persons, who have done their thesis work at the plant will continue their careers within nuclear power industry. Both FKA and TVO participate in various national and international R&D programmes that are connected to the nuclear industry.

5.8 Networking

The nuclear power plants utilise many different possibilities for networking within and outside the nuclear field. This networking usually takes place on an individual level, where the amount and quality of voluntary work, determines the status of a person within the network. On a national level networking often takes place through various professional societies and national research programmes that serve as fora for an information exchange. On an international level visits, conferences, working groups, projects, peer reviews, etc., often lay the basis for personal contacts later on. These networks can be important in rapidly getting outside

views on acute technical problems. The difficulty however, is that contacts to networks may be difficult to maintain if the pressure of the daily work becomes too high.

6 SOME REFLECTIONS

This chapter presents some reflections that have been spurred by the collected material from the interviews. It is the hope that these reflections can be beneficial in deepening some of the earlier issues that have been discussed in the report.

6.1 The need for defining concepts

Core competency seems to get its own specific interpretation, which is varying slightly from person to person. One could ask if it is necessary to define the concept more precisely, or if it is acceptable to have slightly different interpretations within the organisation. On one hand it seems to be important that concepts used in the strategic planning have a reasonable common understanding on what is meant. On the other hand the slight differences in interpretations seem to stimulate fruitful discussions.

Sometimes already the formulation of new concepts can stimulate discussions on their meaning and interpretation, which in turn can generate new insights. Concepts combined with discussions can be seen as a special kind of tool for creating a shared understanding within the organisation. The definition of the concepts should correspond with the usual understanding people have and not necessarily with what consultants think it should be. Safety culture is another similar concept, which may have its largest benefit in stimulating a discussion of how safety is constructed.

6.2 A graded approach

There is a need to make gradations between issues and the efforts that are spent for their resolution. The efforts should be adapted to the importance of the issue on safety or efficiency, because resources are always limited. This principle is, when applied for safety, sometimes referred to as a risk informed approach. One may also say that this principle implies that one should look for errors and failures, which are likely to be made, where they are likely to be found or where their consequences can be dire.

A graded approach can be applied to inspections and reviews, where the challenge is to set a limit for what can be considered good enough. In inspections and reviews it is not possible to look in detail on everything, which implies that some basis has to be taken as granted. A psychological effect of a thorough review is also that it may tend to make earlier work sloppier, because it is believed that the review will catch remaining problems. A definition of practices for inspections and review should rely on a balance between the need for confidence in earlier work and the need for an independent check that no errors are hidden in proposed constructions, analysis, instructions, reports, etc. In the practical procedures for inspections and reviews it may be necessary to stress that they are not an indication of a lack of confidence in work done and that they do not take responsibility away from doing a correct design in the first place.

Another issue where a graded approach is needed is to ensure that organisational slack and flexibility is available in various functions. Slack and flexibility are necessary in order to cope with uncertainties and to ensure that a suitable preparedness is maintained. On the other hand too much idle resources carry unnecessary costs.

6.3 Management innovations

The nuclear industry is forced to use proven practices, but this should not be interpreted to mean that innovation and change are impossible. Sometimes in a change process it may be necessary to go through a series of intermediate changes to make a turn around from practices that have become obsolete. On the other hand it is equally important to understand that not all management innovations may be applicable to the special conditions that prevail in the nuclear industry.

Process orientation of work is one management innovation that correctly handled can help in streamlining work and removing unnecessary hindrances for a smooth flow of errands through the organisation. Expectations on the process orientation seem however to have been larger than what actually has been achieved. One of the problems in applying a process orientation of work activities seems to be involved with an uncertainty in deciding on how the concepts should influence organisational structure.

Management innovations have made work practices more efficient, but they have also increased work load on managers at all levels in the organisations. If this development continues, it may bring problems in the future. Some respondent thought that the organisations should give better support to their managers through guidance in finding efficient working practices. One of the problems in this connection seems to be that ambitions sometimes are set to unrealistically high levels as compared with available resources. If such a situation is allowed to continue, the danger is that important work is not completed at all or is carried out with an unsatisfactory quality.

6.4 Knowledge management

The relationships between core competency and knowledge management are obvious. In a theoretical discussion of knowledge management it is usual to make a separation between explicit and tacit knowledge. Many respondents actually gave a reference to the need to collect, record and share tacit knowledge of the persons, who were involved in the start up of the present units.

Within knowledge management it is usual to talk about a learning spiral, which different authors have defined somewhat differently. One of the well known models talks about phases of an externalisation of tacit knowledge to make it explicit and usable by others.⁷ Then the knowledge could be combined in new ways to generate more efficient practices. These practices are further internalised within the organisation. Finally, when the practices are widely spread, they are interpreted and reformulated to become new tacit knowledge and the process could start over again.

The difference between knowledge and information management is that information has to be placed into context to become knowledge. This contextualisation has sometimes shown to be difficult. In an assessment of stored documentation at the nuclear power plants, a common observation is that reasons for certain design solutions often have been poorly documented. This means that it sometimes is difficult to find the connections between requirements and selected solutions. Information technology has been used to archive information and the new systems have shown their benefit in finding relevant things, but the categorisation of the information still to a large extent relies on human work.

⁷ Nonaka, I., Takeuchi, H. (1995). *The knowledge creating company*, Oxford University Press.

Knowledge management has been identified as a key strategic issue for knowledge intensive companies. In such companies managers communicate and demonstrate their continuing support for competency development and such companies typically adopt a global approach to competency. In knowledge management it is necessary also to consider forgetting. People have a tendency to forget and important issues should therefore be brought up at regular intervals. Sometimes again active organisational forgetting may be necessary to get rid of outdated practices. In knowledge management it is often advantageous to make a difference between facts and the principles that are used for reasoning about facts.

6.5 Outsourcing of work

Outsourcing of work has been applied broadly within the whole industry as a mean to find higher work efficiency. One part of this increased efficiency is achieved by allowing a concentration of attention on core competencies and another part through additional opportunities for innovation, when a service provider becomes exposed to a larger set of customers. In a discussion of what to outsource, core competencies have a central role. An assumption in an outsourcing process is that the competencies can be bought within a reasonable time frame into the future and that outsourcing can bring in tangible gains.

Before deciding on entering an outsourcing process an evident need is to know the price of own work. It is important to note that outsourcing does not automatically become less expensive than doing things oneself. There are many benefits of maintaining competency in the own organisation, such as better control, a higher efficiency and a smaller uncertainty. If a company to which the activities are outsourced will be very dependent on the parent company, outsourcing may not be the most efficient solution.

In the nuclear industry, the restructuring of the vendor market has actually brought forward a discussion of future needs for insourcing some activities back from vendors to the nuclear power plants. For the nuclear power plant it is evident that operations and safety management cannot be outsourced. An account of outsourcing in the nuclear industry has been given in a recent report.⁸

6.6 Leadership

All respondents agreed that leadership skills are one important part in the management of nuclear facilities. From the interviews there was however not very much guidance given on what such leadership skills should involve. One comment was that a leader always should be the paragon for her or his team, but this does not necessarily imply that s/he is able to master all tasks that are given to the team. A second comment was that leadership requires commitment and dedication together with persistence in ensuring that important messages are understood and reacted on. A third comment was that leaders have to believe in their messages, because otherwise they will most likely not be reacted on.

Leadership involves the creation of ownership among the personnel. For ownership to be developed and maintained it is important that there are clear areas of authority and responsibility within the organisation. Delegation of authority and responsibility can foster the development of ownership. Pride in the work of the own team or organisational unit can also have a positive influence on the feeling of ownership. Closeness to strategic decision making can fur-

⁸ Jari Kettunen, Teemu Reiman (2004). Toimintojen ulkoistaminen ja alihankkijoiden käyttö ydinvoima-teollisuudessa, (Outsourcing of functions and the use of contractors in the nuclear industry, in Finnish), VTT Research Notes 2228. Also available at <http://www.vtt.fi/inf/pdf/tiedotteet/2004/T2228.pdf>.

thermore help in understanding the logic of the business and enhance a feeling of participation.

Several respondents agreed on the need for visibility of the leaders in the organisations. Some respondent noted that being a manager is a profession in itself. The most important task of a manager is to decide and act, whereas the organisation should provide the underlying basis for decisions. It is also important that the organisation is loyal to decisions and that decisions can be changed only at the level, where they originally were made. Both at FKA and TVO there was an agreement that leadership training is one area that has to be prioritised in the future.

6.7 Societal changes

There are many societal changes that warrant thinking and action at the nuclear power plants. Additional cost pressure has for example brought for example the concepts of lean organisations and business re-engineering. It is however important to put such solutions into context before they are applied. To be functional such organisational innovations have to be based on more efficient work practices, because otherwise decreased margins may carry additional costs. Efficient work practices have to be based on actual improvements through the use of new methods and tools or on decreased administration through empowerment and initiative. Sometimes administrative burdens seem to have increased, which may be a reflection of a managerial need to be in control.

In the working life there is an ongoing change according to which it is expected that people will take more initiatives, be more active, work more independently, search for information themselves, etc. Today many persons are enthusiastic about these trends, whereas others feel large uncertainty with the new situation. It is apparent that the organisation should be able to adapt to such differences in views. Good results in future are likely to be obtained more through commitment and ownership than through command and supervision.

The nuclear is and has to be controlled by strict rules in many activities, but the rules should not be allowed to enter areas where they are not necessary. Whenever possible there should be room for flexibility and innovation. At the nuclear power plant good engineers will be needed also in the future and they are often attracted by the challenge in the work. It is likely that the nuclear power plants have to rely more on distance work, because already now there is not that much attractions near to the nuclear power plants. If the nuclear power plants have a possibility to offer work for two persons, this may provide an edge in the competition for good people. Finally, the future may also see more international recruiting.

6.8 Regulation concerning competency

One bearing principle in the regulatory oversight is that the licensee has the undivided responsibility for the facilities. This principle can be interpreted to imply that the regulatory body defines requirements that are set on the operation, but does not take stand on the means used for reaching these ends. This separation may be difficult to achieve, because certain requirements assume a specific set of solutions for which requirements can be given. Regulatory requirements will mostly include some prescriptions on the means by which the performance based requirements are supposed to be reached.

Regulatory requirement concerning competency can in Finland be found in the so called YVL-guides⁹ issued by STUK and in Sweden in the regulation¹⁰ issued by SKI. There have been discussions in both Finland and Sweden on the need for systematic follow up of available and necessary competency at the plants. The systems that are applied at FKA and TVO have largely been considered sufficient. Similarly the discussions on activities that may be outsourced have been concluded to a mutual satisfaction.

6.9 Towards the future

The plants had when they were built a projected life-time of 40 years. Operations so far have given clear indications that some 20 years more of operation would be possible. In such a perspective it is clear that maintaining the necessary competency at the nuclear power plants is an important task to achieve. The remaining lifetime may actually be long enough for a person, who is hired today to be likely to approach his/her retirement age before the plants are shut down and decommissioned. In this long term perspective there are many issues, which may not be urgent today, but which are important to follow up at in a longer time perspective.

One of these issues is connected to a dissolving of the present relatively stringent division between professions. On a medium term the division between mechanical, electrical and I&C maintenance may be somewhat diluted and maintenance activities would then rely more on multi-skilled teams. In a long term the present division into operations and maintenance may be diluted in a similar way, where a larger group of people may be accredited to take up tasks in the main control room of the plants.

It will be important for the nuclear power plants to maintain their competitive edge in being able to attract good people. This may need strategic efforts in identifying target groups and in restructuring jobs. It will also imply a proactive approach to safety with the objective to stay out of the headlines and media attention. It will include efficient management of projects, both small and large, which aim at ensuring a good production capability. Networking within and outside the nuclear industry will be an important part of the actions for the future. The application of new technology can be one part in reaching a better efficiency in work practices. Finally leadership and safety culture will be important components in bending political attitudes towards more favourable directions regarding nuclear power.

7 CONCLUSIONS

Proficient and knowledgeable people are an asset of any organisation. The challenge is to define what skills and knowledge are needed and to ensure that these people are available on a continuing basis. A discussion of core competencies can help in this process. Core competencies are not very much different at different nuclear power plants and a broader exchange of views may be helpful in this regard.

The study clearly illustrates the importance of identifying core competencies. This activity should be one part of the strategic planning process. Core competency is a dynamic concept that should be placed into context of the environment and that should be updated as a part of the strategy process. It is relatively easy to define the technical parts of the competency, but

⁹ STUK (1992). Functions important to nuclear power plant safety, and training and qualification of personnel, YVL-1.7. Available at <http://www.stuk.fi/saannosto/YVL1-7e.html>.

¹⁰ SKI (2000). The Swedish Nuclear Power Inspectorate's Regulations concerning the Competence of Operations Personnel at Reactor Facilities, SKIFS 2000:1. Available at <http://www.ski.se/>.

more difficult to define the human and the organisational parts. Today there seems to be a far larger understanding than some decades ago that also these components are important for both safety and efficiency.

In defining core competency it is important that the nuclear power plants themselves engage in this process, because only they have a good enough understanding of their actual needs. The study reveals that these discussions at FKA and TVO are well under way. In the discussion there were many issues related to the concept of core competency that was touched on and that have been reported above.

It is evident that flexibility and innovation are important virtues in meeting the challenges in maintaining a high competency within the nuclear industry. However, it is equally evident that these requirements have to be met in a structured way, because in the nuclear industry development by trial and error is not possible. A similar balance has to be found between traditions and renewal, where it is important not to stifle change, but neither to jump on newfangled whims.

Human resource management is one area where long time constants set important restrictions on what can be achieved. A thorough thinking at the nuclear power plants on how to prepare for future demands on competency is needed to approach this issue. In conclusion, core competency can be seen as an important instrument facilitating the strategic planning process, it can direct discussions to essential issues and in the discussions create a better awareness of company values, mission and goals.

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APPENDIX 1. QUESTIONS ASKED DURING THE INTERVIEWS

1. Describe your understanding of the concept "core competency"?
2. In discussing core competency at a nuclear power plant, what should be included and what can be excluded?
3. Researchers have suggested a division between physical, intellectual and cultural assets when core competencies are identified. How do you think this division fits in?
4. Another way to sort up the concept of core competency is to speak about resources, assets, abilities and competencies that are scarce, difficult to imitate or more generally difficult to substitute. How would you approach your core competencies using this model?
5. A more practical way to discuss core competencies at a nuclear power plant is perhaps to speak about operation, maintenance and technical support as general categories. If this division is used, what do you think is critical and important?
6. How would you involve competencies within the fields of economy, administration and leadership in a discussion of core competencies?
7. In Sweden there has been a discussion between the regulatory body and the nuclear utilities on the definition of the concept of nuclear activities (kärnteknisk verksamhet). This concept is used in the nuclear legislation in Sweden and the regulatory view is that nuclear activities should not be outsourced. How do the concepts of nuclear activities and core competency relate to each other? What is your view on the Swedish regulatory position?
8. In maintaining core competencies one may separate between individuals and the organisation. It is clear that organisational competency builds on its individuals and that the responsibility for maintaining a specific competency will be individual. Still the organisation has to take the burden of building systems to make it possible for the individuals to take this responsibility. What is your view on the division of the burden between the organisation and the individuals? Should there be instructions for this activity and how detailed should they be?
9. One contemporary disturbance is connected to the age distribution of the personnel and forthcoming retirements at the nuclear power plants? How should this disturbance be taken care of? Are there systematic procedures to define the competency required in different jobs? How could competency be transferred from an older to a younger generation?
10. Core competency relies on some stability, where it is possible to buy certain services. This means that there has to be a monitoring the operational environment and to integrate this information into strategic plans. How should this be carried out to be systematic?

APPENDIX 2. ONE EXAMPLE SET OF CORE COMPETENCIES

One approach in the definition of core competencies could be to start from a strategic view and define core competencies through critical success factors. Using this view one list of core competencies could emerge through the following issues:

1. Knowledge and competencies that are needed for operating and maintaining the nuclear power plant.
2. Knowledge and competencies that are connected to the own plant, its structure and its behaviour in transients and accidents.
3. Knowledge and competencies in nuclear technology in general that includes nuclear science and technology in areas that are not directly connected to a specific plant.
4. Knowledge and competencies that are connected to laws and regulations in the nuclear field.
5. Knowledge and competencies that are connected to behaviour and handling of nuclear fuel and waste.
6. Knowledge, competencies and skills that are connected to the management of intellectual resources and including the management of people and organisations.
7. Knowledge and competencies that are connected to the management of knowledge and practices.
8. Knowledge and competencies that are connected to finances and money.
9. Knowledge and competencies that are connected to the management of projects.
10. Knowledge and competencies connected to the management of contacts and relationships to the society.