

IAEA ACTIVITIES IN NUCLEAR SAFETY KNOWLEDGE MANAGEMENT

This article presents some considerations on the nuclear safety knowledge management as an integral part of the Capacity Building umbrella concept for nuclear safety. It summarizes the latest efforts by the International Atomic Energy Agency (IAEA) to provide guidance to Member States on how to plan, establish and maintain an effective knowledge management programme in regulatory bodies.

KNOWLEDGE MANAGEMENT AS AN ESSENTIAL CAPACITY BUILDING COMPONENT

Knowledge Management (KM) has been identified by a number of high-level IAEA documents, including IAEA safety standards, strategies, publications and committees as one of the key factors that contribute to safe, secure and efficient operation of nuclear and radiation activities and facilities.

Following the accident, the IAEA convened a Ministerial Conference on Nuclear Safety which led to the development and implementation of the Action Plan on Nuclear Safety (the Action Plan) [1]. Two of the 12 actions of the Action Plan focussed on strengthening and maintaining Capacity Building. A new concept of Capacity Building was developed including four pillars: education and training, human resources development, knowledge management and knowledge networks.

The IAEA defines Capacity Building as a *systematic and integrated approach that includes education and training, human resource development, knowledge management and knowledge networks to develop and continuously improve the governmental, organizational and individual competencies and capabilities necessary for achieving a safe, secure and sustainable nuclear power programme.*

All organisations involved in a nuclear power program (governmental, regulatory, operators, etc.) require a high level of capacity to develop their functions safely. Nuclear knowledge is an essential asset of the organisation: a correct strategy to acquire, improve, disseminate and preserve nuclear knowledge needs to be in place.

Most organisations in the nuclear field recognise the importance of having knowledgeable people working at their organisations, but not all of them have in place a defined approach to manage knowledge with a proper methodology for analysing and structuring that knowledge.

CURRENT WORK ON KM FOR REGULATORS AT THE IAEA

The IAEA is currently developing specific guidance for regulators in the area of knowledge management. The future technical document (TECDOC) on Knowledge Management for Regulatory Bodies and Technical Support Organisations (TSO) will provide practical guidance to Member States on how to plan, establish and maintain an effective knowledge management programme.

The document focuses on the need these organisations have to maintain an appropriate knowledge base to fulfil its mandate and to perform its duties and tasks, as well as to achieve the necessary regulatory independence.

It is necessary to note that nuclear safety knowledge includes not only technical knowledge related to nuclear physics, engineering and similar discipline but that a well-functioning regulators needs also to ensure adequate capacity in other areas such as legal, regulatory and organisational basis, regulatory practices and personal and behavioural competences.

All these regulatory knowledge domains are explained in the IAEA Safety Report n°79 [2] and the related Methodology for the Systematic Assessment of the Regulatory Competence Needs (SARCoN) for Regulatory Bodies of Nuclear Installations" (IAEA-TECDOC-1757) [3] (Figure 1).

The IAEA ongoing efforts in the area of nuclear safety knowledge management are based on experiences from IAEA Member States as well as on the work and discussion of the IAEA Steering Committee on Regulatory Capacity Building and Knowledge Management. This steering committee meets annually under the auspices of the IAEA in order to share experience and advise the IAEA work.



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ESTABLISHING A SYSTEMATIC KM PROCESS AT AN ORGANISATION

One of the main lessons learned in dealing with KM is *the necessity to establish a systematic process in order to manage the knowledge within an organisation*. The ongoing IAEA work proposes a 4 step practical approach based on existing KM methodology (such as the "Methodology for Analysing and Structuring Knowledge" (MASK)) that can be applied to any regulatory body and TSO.

The suggested implementation includes the following steps:

1. Step 1: Strategy development.
2. Step 2: Program Planning.
3. Step 3: Knowledge management activities.
4. Step 4: Effectiveness review and improvement.

A very important consideration is that a good integrated KM Strategy and Plan should be part of the Integrated Management System of the organisation, the KM for any enterprise requires the understanding of the organization and its processes, workflows, people, roles, interfaces, products and quality requirements.

Also, it should always take into account the knowledge interfaces of the organisation with the rest of the national and international stakeholders: In the nuclear sector, no organization operates fully autonomously or without links to other organizations, to governmental policies and institutions and to international frameworks and agreements.

Step 1: Strategy development

This step reflects the realisation by the organisation (in this case, a regulatory body) of the necessity to deal with common problems like loss of knowledge through attrition, experts retirement, etc. and should be specifically addressed at the Management System level. A good starting point for implementing knowledge management in a regulatory body is the establishment of a concise, high level and organisation specific Knowledge Management Strategy.

Any comprehensive KM Strategy should include:

- A clear **management responsibility**, with the figure of a *Chief Knowledge Officer (CKO)*, responsible for establishing the KM strategy, elaborating the KM plan, monitoring and evaluating, and reporting directly to top management.
- Clear and **defined objectives** (a strategic vision of knowledge and focus on the central issue of knowledge: develop a knowledge sharing culture, contribute to the efficiency of knowl-

1. Competences related to the legal, regulatory and organizational basis 1.1 Legal basis 1.2 Regulatory policies and approaches 1.3 Regulations and regulatory guides 1.4 Management system	2. Technical disciplines competences 2.1 Basic science and technology 2.2 Applied science and technology 2.3 Specialized science and technology
3. Competences related to regulatory body's practices 3.1 Review and assessment 3.2 Authorization 3.3 Inspection 3.4 Enforcement 3.5 Development of regulations and guides	4. Personal and behavioural competences 4.1 Analytical thinking and problem solving 4.2 Personal effectiveness and self-management 4.3 Communication 4.4 Team work 4.5 Managerial and leadership competences 4.6 Safety Culture

Figure 1. Four Quadrant Model of competences for regulatory bodies.

edge-based activities, and ensure creativity) and **responsibilities** (The responsibility on KM has to be established to ensure that it is established, implemented, assessed and continually improved).

- Adequate **resource management**, including the appropriate tools, software, etc.
- And a **defined KM process**, integrated with other systems and processes of the organisation: HR processes, Quality processes, IT systems, organisational units, business processes, document management systems, etc.

Step 2: Programme Planning

After the KM Strategy has been defined, the next step is to review existing knowledge, assess this knowledge against the organizational functions (which define which knowledge is required) and identify "critical knowledge", for which specific knowledge management activities are then agreed upon. These steps together form the **Knowledge Management Plan**.

Firstly, this step requires the identification of the main functions of the organisation. In the case of a regulatory body, for example, the main functions would be:

- Review and assessment of information relevant to safety.
- Authorisation of facilities and activities.
- Inspection of facilities and activities.
- Establishment of an enforcement policy.
- Establishment of regulations and guides.

These main functions are built into a **Regulatory Functions Map**, established by the management, according to the mission of the organisation, by choosing the main regulatory functions that must be realised, and

identifying the tasks necessary to accomplish those functions

The following task in building a comprehensive KM plan is to build a *Regulatory Knowledge Domains Map*, which gives a representation of how the knowledge domains in the organisation are structured. A model for such a map can be extracted from the Four Quadrant model shown in Figure 1.

The next step is the **Critical knowledge identification**. This task requires a very subjective process of interviewing key people in the organisation to establish which knowledge shall be considered "critical", based on factor such as the risk of knowledge loss, the vulnerability, what is strategic for the organisation, the difficulty on acquiring the knowledge and its complexity etc. The ultimate objective is to associate a "criticality score" to each knowledge identified in the previous step.

The final proposed task would be the **Alignment and decision for the KM plan**. The alignment part consists of identifying which knowledge domain is required for which regulatory function or associated task.

Once this is done, a decision support document should be created, addressing on each Knowledge Domain:

- The criticality score obtained by the criticality assessment
- The weighting obtained by the alignment with regulatory functions
- The highlights giving the justification of the domain criticality
- Possible options of knowledge actions to reduce the criticality

This is ultimately the goal of the whole plan: provide recommendations to different units of the organisation (management, training area, HR and recruiting, etc.)



Step 3: Knowledge Management Activities

The phase of implementation has to be adapted to the specific necessities of each organisation. The draft IAEA document has tried to put together a set of guidance and existing tools taking into account among others the following aspects:

- Knowledge organisation
- Knowledge codification
- Knowledge sharing
- Knowledge retrieval
- Knowledge creation

Knowledge organisation refers to both types of knowledge available at an organisation: *tangible/ explicit knowledge and intangible/ tacit knowledge*. The regulator, as well as other types of organisations relying in the knowledge of their employees, should establish different ways to channel the technical and business knowledge available, creating new tools if necessary (yellow pages, web resources, knowledge communities, etc.).

Another important step in the implementation is ensuring the right **knowledge codification**: from basic principles, doctrines, guidance, standards to more specific knowledge books.

The next step to make sure of the availability of knowledge is to foster and encourage **knowledge sharing**, which usually happens through the development of communities of knowledge or practice.

The concept of **knowledge retrieval** (or knowledge acquisition) is related to the knowledge that an organisation can try to obtain from external (in some cases internal) sources. Sources include suppliers, competitors, partners/alliances, customers, external knowledge networks etc. Knowledge retrieval is a systematic process of capturing, analysing and exploiting useful information for knowledge generation in an organisation.

Finally, the last aspect of the implementation refers to the ability of the organisation to perform **knowledge creation**, creating new ideas through interactions between explicit and tacit knowledge in individual human minds.

Step 4: Effectiveness Review and Improvement

Periodic review and performance indicators are an effective element of sustainability for nuclear knowledge management programs. Such measures serve to enhance the competency and long-term effectiveness of the regulator, and sets the example for NKM

for the licensee, nationally and industry, internationally, to contribute to the development of national capacity building. For example, periodic audits should be performed to confirm the results of performance indicators and gauge overall program health. These **audits** will need to take a look into clear and quantifiable **Knowledge Management Indicators**.

Other measurement tools are the **NKM Primary Performance Indicators**, which measure the success of the regulator's KM program through direct appraisal of a specific knowledge function or activity.

In other cases, the indicator assigned to many business processes in the organization can be carefully reviewed for knowledge elements to be identified and reviewed for indication as to the success of the regulator's knowledge program. These would be called **General (Secondary) Performance Indicators** and can complement the primary ones.

CONCLUSION

The importance of safety knowledge management has been underlined through several conferences and technical meetings within the IAEA and it is an important aspect recognised within the IAEA safety standards. Nuclear safety knowledge management is also an integral part of capacity building programmes. Several knowledge management processes and methodologies can be tailored to the specific needs of regulators and TSO. The IAEA in co-operation with its Member States are drawing from different national experiences and approaches in order to produce practical guidance for establishing a nuclear safety knowledge management. This IAEA work builds upon well-established safety knowledge models such as the 4 quadrant model [ref 2] and the SARCoN methodology [ref 3] which have been used worldwide. However the guidance under development is not of a prescriptive nature but rather of an overall practical orientation on possible methodologies and ap-

proaches which need to be examined in the context of the particular national framework.

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KEYWORDS

- **Capacity:** Integration of a set of individual competences in order to achieve the strategic goals of the organisation
- **Competence:** Accumulation of experience by putting in practice, individually and efficiently knowledge in an operational activity in order to achieve required objectives. It is the combination of knowledge, skills and attitudes (KSAs) necessary to achieve a task.
- **Critical knowledge:** Critical knowledge is a knowledge domain that is crucial for the organisation and that may be threatened for different reasons. Critical factors for knowledge are about scarcity, gaps, strategic issues, difficulties of acquisition, difficulties to operate etc.
- **Explicit knowledge:** Explicit knowledge is the knowledge that has been articulated or has already been codified in some form such as manuals, procedures, databases, electronic media, etc.
- **Integrated Management System:** A single coherent management system for facilities and activities in which all the component parts of an organization are integrated to enable the organization's objectives to be achieved.
- **Knowledge management:** Knowledge management is an integrated systematic approach to manage knowledge: identifying, sharing, acquiring, and enabling groups of people to create new knowledge collectively to help in achieving their objective. In the case where Knowledge Management concerns one specific organisation, it is referred as Organisational or Corporate Knowledge Management.
- **Tacit knowledge:** Tacit knowledge is the knowledge held in the mind of individuals and is often unspoken and difficult to articulate, share or transfer. It is rooted in practice, experience, intuition, judgement and individual skills. ■

- [1]. INTERNATIONAL ATOMIC ENERGY AGENCY, Action Plan on Nuclear Safety, IAEA, Vienna (2011).
- [2]. INTERNATIONAL ATOMIC ENERGY AGENCY, Managing Regulatory Body Competence, Safety Report Series No. 79, IAEA, Vienna (2013).
- [3]. INTERNATIONAL ATOMIC ENERGY AGENCY, Methodology for the Systematic Assessment of the Regulatory Competence Needs (SARCoN) for Regulatory Bodies of Nuclear Installations, IAEA TECDOC 1757, IAEA, Vienna (2015).