Nuclear Knowledge Management: Challenges and Opportunities

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Basic Concepts of NKM
IAEA’s Statutory Tasks
Trends and Challenges
Forward Looking
Knowledge management (KM) is the process of creating, sharing, using and managing the knowledge information of an organization. It refers to a multidisciplinary approach to achieving organizational objectives by making the best use of knowledge.

Tacit Knowledge:
- Subjective, cognitive, technical;
- Experiential learning;
- Hard to document;
- Hard to transfer/teach/learn.

Explicit:
- Objective, rational;
- Easily documented;
- Easily transferred/taught/learned.

3R principles

Data, Information and Knowledge
KM Cycle

Core Processes

Managerial Processes

Support Processes
Nuclear knowledge management (NKM)
An integrated, systemic approach applied to all stages of the nuclear knowledge cycle. It impacts on human resources, information and communication technology, process and document management systems. Thus, corporate and national strategies relating to nuclear safety can be significantly influenced by the ability to manage knowledge both now and in the future. Managing knowledge is an essential enabler of any nuclear power programme.

IAEA

http://iaea-nkm.cloudapp.net/wiki/index.php/Knowledge_management

KM is ubiquitous in all walks of business life, including nuclear sector. But NKM has its own special attributes
Attribute of NKM

- Complexity
- Long Life/Inter-generational;
- Intellectual Property;
- Safety/Security/Safeguards;
- Regulatory involvement;
- Internationality.
Objectives of NKM

A set of business goals in a nuclear organization that can be facilitated by knowledge management

- Improve safety, security and non-proliferation;
- Achieve gain and benefit in performance;
- Inform risk management and decision making;
- Ensure maximized NKM flow over the long term;
- Communicate with public transparently;
- Help continuous improvement.
Policy of NKM

A principle or protocol to guide decisions and achieve rational outcomes with respect to knowledge management for organizations

- Statement of intent;
- Strategic-based;
- Guideline for daily activities;
- Focus on Key components and process.
Strategy of NKM

A high-level plan to achieve organizational goals with a knowledge management system

- Strategic KM principles;
- The organizational imperative and focus for KM
- A KM vision for the organization;
- Critical knowledge areas;
- Stakeholders;
- A KM Framework
- Information management;
- Changing management;
- Business case;
- Recommended pilots.
NKM Reference Models

Fraunhofer Reference Model

NKM Cube
KM in Nuclear Organizations
KM Maturity Model

Knowledge Hoarding Culture

Level 0
“Ad hoc”
KM as localized initiatives

Level 1
“Programmatic”
KM coordinated organization-wide

Level 2
“Systemic”
KM is embedded in management systems

Knowledge Sharing Culture

Basic KM
(mostly reactive)

Advanced KM
(mostly proactive)
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A Glimpse of IAEA

Inter-governmental Organization within UN system, established in 1957 by “Atom For Peace”

Headquarters in VIC, 1979-present
“The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose”
2016 Resources at a Glance

- **Operational Regular Budget, €351.3, 71%**
- **Capital Regular Budget, €8.0, 2%**
- **Operational Extrabudgetary, €45.9, 9%**
- **TC programme, €90.7, 18%**

Total: €500.6 million
IAEA Administration

DDG MT MP-5
DDG NA MP-2
DDG NS MP-3
DDG TC MP-6
DDG SG MP-4
DDG NE MP-1
**Major Programme 1**

- Provides scientific and technical support to Member States through the provision of services, guidance and advice; facilitating discussion; and dissemination of data, information, and knowledge;

- Designs and delivers training and helps interested Member States to build capacity and to develop infrastructure necessary for managing a nuclear programme.
Effective and comprehensive engagement with various relevant stakeholder in energy planning, nuclear information and nuclear management in a coordinated and integrated manner to ensure a timely result-based response to Member States’ needs and overall IAEA objectives.
Formally established in 2001;

Increased awareness and understanding of risks and challenges of KM in nuclear sector;

Development and dissemination of good KM practices in all Member States;

Facilitate nuclear knowledge flow to developing countries and newcomers;

3 programmatic areas:

- Methodologies and guidance for NKM;
- Education, training and networking;
- Technological product and services in NKM.
NKM Service

Networks

NEM and NKM Schools

KM Asist visits

Digital Repositories

E-learning

Education
Objective
Provide MSs with relevant guidance and methodologies for KM and deliver services to help in the implementation of KM programme.

Documents and Guidance
- Design Knowledge Management;
- Knowledge Management across Nuclear Facility Life-cycle;
- Knowledge Loss Risk Management and Tools to Retain Tacit Knowledge;
- Knowledge Preservation of Nuclear Accidents;
- Support of IAEA Capacity Building initiative, including KM for New-builds and Newcomers;
- KM for Decommissioning and Environmental Remediation.

Services
- Knowledge Management Assist Visits and Expert Missions
- Communities of Practice on NKM Wiki
Implementing KM in Nuclear Organizations

**KM for Nuclear Organizations**
- KM Guidance for Nuclear Organizations
- KM perspective for Outsourcing activities at NF
- Publication on KM in Decommissioning and Environmental Remediation
- Mapping organizational competency
- KM for Waste Management facilities
- KM for Regulatory TSO (NS)
- KM Audit and KPI (IP)
- Process-oriented KM (Process improvement)
- KM roadmap for NO (Project template)
- Green Frontiers Initiative

**Design Knowledge Management across nuclear facility life-cycle**
- Application of DKM
- Plant Information Modelling (PIM)
- DKM programme for New-build projects (Handover)
- Design Requirements Management

**IAEA Capacity Building**
- SALTO (SVS-26, area F)
- OSART (TBD)
- TC
- CKM
- EC Collaboration (CORONA2, MESKAL)
- IEC IAEA (scenarios)
- ISO (TC260 Draft 30401 on KM standard development)

**Content Management**
- WIKI
- Case Study-Catalogue
- KM assessment tools
- KM basic e-modules (CLP4NET)
- Education and training resource repository
- International Terminology Repository
- Nuclear Accident Repository

**KMAV Services**
**T-COPs** (KM Technical Community of Practice)
- KM-TCOP (Surveying on KM implementation )
- CLP4NET-T COP
- CORONA ACADEMY-T COP

**Methodology** (Annex, IAEA NKM website)
Education, Training and Networking

Objective

To facilitate education, training and networking in nuclear science and technology

- Deliver and assist in delivering educational programmes, e.g.
  - Nuclear Energy Management Schools and;
  - Nuclear Knowledge Management Schools;
  - INMA - International Nuclear Management Academy;
    IAEA-facilitated masters programme in Nuclear Technology Management;
- Foster Networking (ANENT, LANENT, AFRA-NEST, STAR-NET)
- Provide assistance, guidance and peer reviewing, e.g.
  - ECAP - Education Capability Assessment and Planning providing framework and guidance to plan & assess sustainable national educational programmes in nuclear science & technology.
Initiatives on nuclear education and networking

Nuclear Knowledge Management School
The Nuclear Knowledge Management School is a certificate course aiming to provide specialized education and training on development and implementation of KM programs in nuclear science and technology organizations.

INMA
International Nuclear Management Academy is a framework facilitated by the IAEA in collaboration with nuclear engineering and business faculties at universities and with nuclear employers around the world. Its goal is to support participating universities in the implementation of high quality master's level management programmes for the nuclear sector, tailored to its specific needs and challenges.

University Assist visits and Peer Review Assessments (UPPRA)
Specific tool developed. General assessment on University’s KM, or specific assessment on programs and new tracks (NG-T-6.4)

Nuclear Energy Management School
(international and regionals, 4 this year)
Two weeks programme, targeted at junior to mid-career professionals working in nuclear organizations who show some managerial interest and leadership potential, providing general knowledge to better understand the organizational and international context of the nuclear energy sector and prepare them to work at a higher level in their organizations.

ECAP
The Education Capability Assessment and Planning Framework provides a process for countries to establish sustainable nuclear education through strategic stakeholder engagement, coordinating resources and planning and assessing the potential of higher education’s contribution to the promotion and development of nuclear science and technology to meet development priorities.
Objective
To provide tools for NKM through the application of state of the art information and computer technology

Technology Solutions
- Knowledge organization systems (KOS);
- Ontologies and taxonomies;
- Portals;
- Repositories;
- Glossaries;
- The Cyber Learning Platform for Nuclear (Network) Education and Training - CLP4NET;
  - Agency-wide standard and single e-Learning platform
  - Over 18,000 registered users!
KNOWLEDGE ORGANIZATION SYSTEMS (KOS) MANAGEMENT TOOLS

The rapidly increasing amount of information in every knowledge domain poses challenges to the retrieval, integration, and reuse of information relevant to a specific context. To cope with this situation, methods of knowledge modelling and representation play an increasingly important role. Knowledge organization systems (KOS’s), a term summarizing knowledge structures such as controlled vocabularies, taxonomies, thesauri and ontologies, provide the basis for describing (possibly quite complex) knowledge domains.

CYBER LEARNING PLATFORM FOR NUCLEAR EDUCATION AND TRAINING (CLP4NET)

Cyber Learning Platform for Nuclear Education and Training (CLP4NET) is an online platform that allows users to find educational resources easily and contains a learning environment to support instructor-led courses and disseminate e-learning self-study resources to a wider audience. The use of the platform is provided as a cost-free service to all of the IAEA and its cooperation partners. CLP4NET aims to facilitate sustainable education mainly in the nuclear sector by empowering web-based development and dissemination of e-learning resources and courses, in a way that is cost-effective, scalable and easy to use.
Products, Tools and Solutions

KOS-based Knowledge Portals, CoPs
- FR-KOS
- NKM-KOS
- NAA-KOS
- SG-KOS
- HTR-KOS
- VVER-KOS
- DER-KOS
- ...-KOS

Knowledge Organization Systems

W3C Standards
Semantic Technology

International Nuclear Terminology Repository

IAEA LMS (CLP4NET)

Catalogue on E&T (CLP4NET)

Learning/Knowledge Object Repository (CLP4NET)

IAEA LOD Cloud

OpEx and Events Analysis

Plant Information Model

Nuclear Sector Ontology

Competencies Management

NKM Wiki
A Plant Information Model (PIM) is an organized set of interlinked facility information, relationships, rules and knowledge frameworks forming a representation of the plant throughout its lifecycle.
Utilizing Semantic Technology

Transform

Organize

Share

Identify

Enrich

Semantic-based applications

K-portals & Smart search
Data mining & K-discovery
Information models
Glossaries management
Standards harmonization
Information aggregation
Business intelligence
...

A Knowledge Domain

Linked Data
Use semantic technologies to foster the exchange of scientific and technical information by publishing open IAEA information resources and databases as Linked Data on the Web and setting links between data items from different data sources.
INIS, established in 1970, one of the most successful and comprehensive information systems on the peaceful uses of nuclear science and technology.

**INIS Database**

- Economic, Environmental, Legal and Safeguards: 8%
- Life Sciences: 17%
- Atomic, Molecular and Condensed Matter Physics: 10%
- Nuclear Physics: 11%
- Nuclear Materials: 9%
- Engineering & Instrumentation: 9%
- Elementary Particle Physics: 16%
- Fuel Cycle, Waste and Radiochemistry: 7%
- Nuclear Power & Safety: 13%

**Facts at Glance**

- 154 members – 130 MS & 24 int. organizations
- Over 4 million bibliographic records & half a million full-texts
- 136,221 records added to the INIS repository in 2015
- 50,000 searches and 3,000 downloads per month
- 1.5 million unique searches and over 2 million document downloads
Cyber Learning Platform for Network Education and Training (CLP4NET)

Utilizing e-learning technologies and methods to make nuclear knowledge more broadly available in a modern, effective and efficient manner

http://clp4net.iaea.org
- Basic Concepts of NKM
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- Forward Looking
129 survey participants, experts from 46 Member States

Company/Organization type

- Government organisation
- Regulatory authority
- Operating organization
- Utilities/NPPs
- R&D organization and EPC
- Technical support organization
- Suppliers and services organization
- Decommissioning project organization
- Fuel processing facilities
- Waste management facilities
- Nuclear education and training institution
- Consulting
- International organization
- Other
Implementing organizational knowledge management

Analysis and orientation

Formal definition of KM process in the organization

Drivers influencing KM initiatives in the organization

1. Change management and re-organization 6%
2. Employee motivation 10%
3. Leadership and engagement of the KM team 10%
   - Amount of funding 7%
   - KM benchmarking and promotion 6%
   - Modern IT tools 8%
   - Modern IT tools 8%
   - Prior tangible and positive results of KM initiatives 4%
   - Employee involvement 13%
   - Senior management support 11%
   - National/international requirements for KM 7%
   - The need to use IP for commercial purposes/profit generation 3%
   - The need to optimize business processes 6%
   - Strong external demand for KM (e.g., knowledge transfer) 5%
   - Strong internal demand for innovative solutions 6%

No: 36%
Yes: 64%
Implementing organizational knowledge management (cont.)

**KM programme maturity**

Degree to which KM programme is implemented in organizations

- **LEVEL 2**: It is embedded and systematic at all levels (10%)
- **LEVEL 1**: As an organization-wide programme (39%)
- **LEVEL 0**: In an ad-hoc manner (51%)

KM responsibilities embedded in the job duties of the staff members

- Never (2%)
- Seldom (16%)
- Always (12%)
- Often (23%)
- Sometimes (47%)
Implementing organizational knowledge management

Strategy development

Organizational goals supported by the KM programme

- Quality and value improvement
- Organizational performance evaluation
- Organizational learning
- Knowledge transfer to new employees
- Key expert identification and their involvement in...
- Innovation
- Improving the knowledge sharing culture
- Experts collaboration
- Critical knowledge preservation
- Converting organizational knowledge into...
- Business process optimization
- Building and sustaining core competencies
- Safety culture enhancement
NKM Trends

- Awareness and use of KM by various stakeholders has generally increased, but it varies significantly;

- Information and computer technology (ICT) is evolving at tremendous speed:
  - Online collaboration;
  - Semantic technology;
  - Modelling and artificial intelligence;
  - Plant Information Management system;

- Individual components of K-processes remain:
  - “Communicative measures”;
  - “Capability clusters” such as networking, Community of Practice;
  - Synergies in learning processes.
Challenges

Common challenges facing by organizations

- Strengthened safety requirements in nuclear sector after Fukushima vs insufficient guidance of NKM in nuclear community;
- Wide recognition of notion of NKM vs few actions taken;
- Aging workforce vs difficulties in attracting new talent;
- Intellectual property rights vs knowledge sharing culture.

The notion of NKM well-established in developed countries but might not always at a satisfactory level, while gap concerning the awareness of principles and benefits of KM in developing countries identified.
- Basic Concepts of NKM
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International Conference on NKM

- Nov.7-11, 2016;
- Some 500 participants including high-profile guests & dignitaries
- Aiming at improved awareness of the importance of NK;
- Exchanging experiences and lesson learnt
- Addressing challenges and forward looking.
Key Observations

- Looming losses from staff retirement and attrition leading to disconnect between science and practice;
- Shared underlying issues, challenges and requirements emerged indicating common practices and approaches;
- Issues always at the top of the industry agenda such as assuring relevant skills and expertise, securing critical knowledge, and effecting sustainable inter-generational transfer;
- Theoretical knowledge to be complemented with practical science and technology skills, and technical expertise to be integrated with socio-economic considerations and managerial skills;
- Nuclear knowledge to be managed more pro-actively throughout the full life-cycle of facilities, to be pursued across organizational borders and barriers, and as part of the integrated management system.
Key Outcome

A wider recognition that Knowledge Management is core to every type of nuclear programme, and has an important role in safety and safety culture.
Conclusion

- The concept of NKM widely recognized, implementation of NKM varying significantly;
- Sound NKM practice and feedback being accumulated, sharing mechanism needed to be improved;
- Issues and Challenges observed and needed to be addressed efficiently and effectively with adaptive IT solutions for knowledge transfer for younger generation;
- Some NKM methodologies, mechanism and service in place, more work needed to be done;
- With the 3rd Conference on NKM serving as an important momentum, IAEA is committed to collaborating with MS to meet growing needs in NKM to ensure peaceful uses of nuclear power in safety, secured and sustainable manner.
Thank you!

Visit IAEA NKM at http://www.iaea.org/nkm