



*60 Years*

**IAEA**

*Atoms for Peace and Development*

# **Nuclear Knowledge Management: Challenges and Opportunities**

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**July 2017, Tokyo, Japan**



# Terminology of KM

**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

Wikipedia

## Tacit Knowledge:

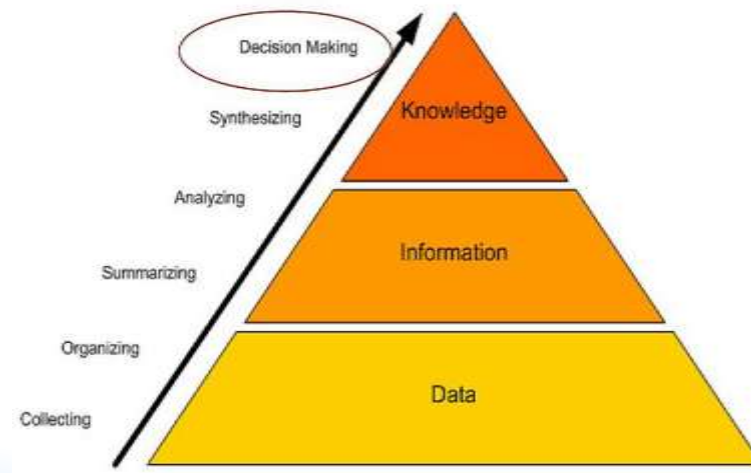
- Subjective, cognitive, technical;
- Experiential learning;
- Hard to document;
- Hard to transfer/teach/learn.

## Explicit:

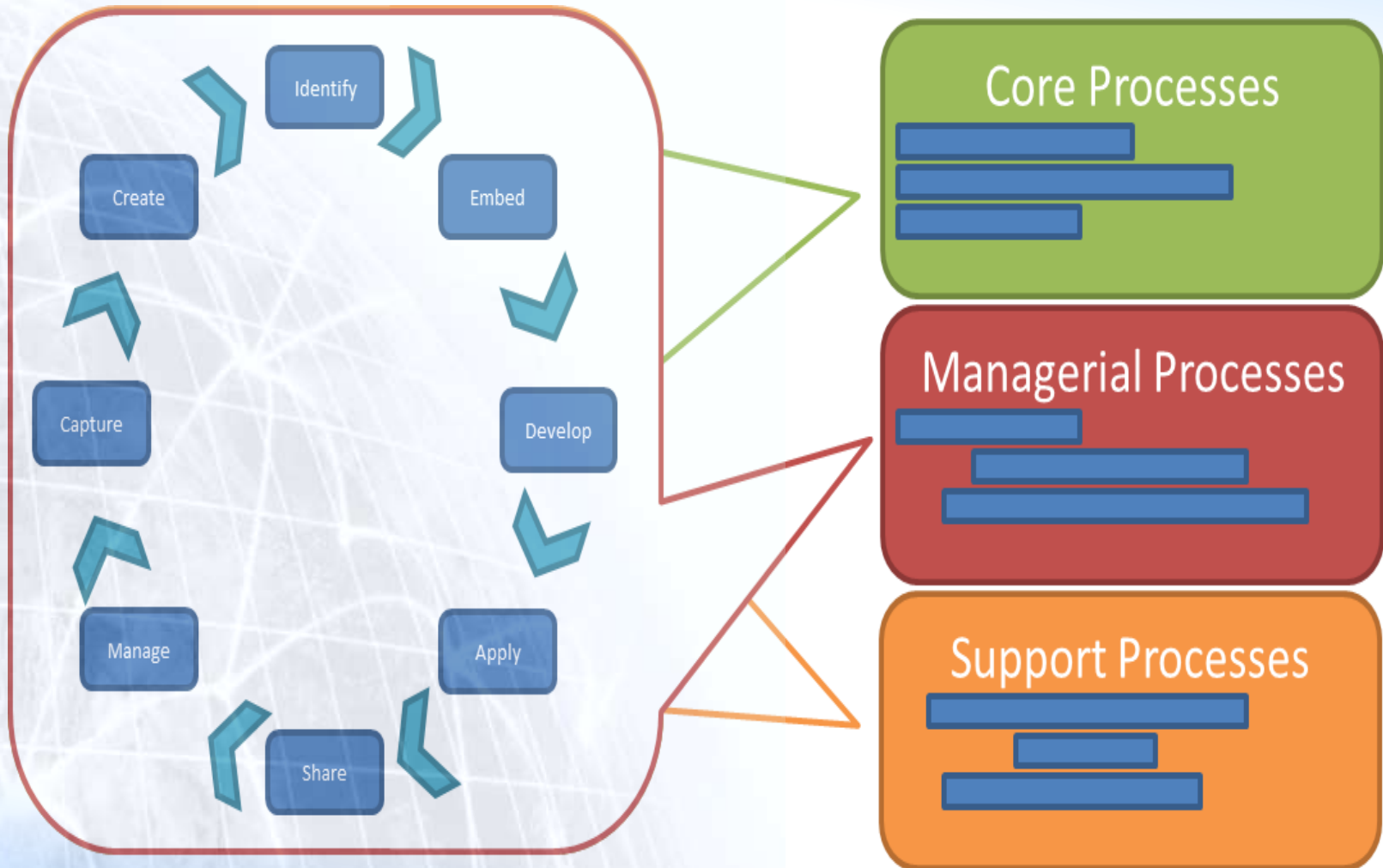
- Objective, rational;
- Easily documented;
- Easily transferred/taught/learned.

## 3R principles

## Data, Information and Knowledge



# KM Cycle



# Terminology of NKM

## **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](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.**

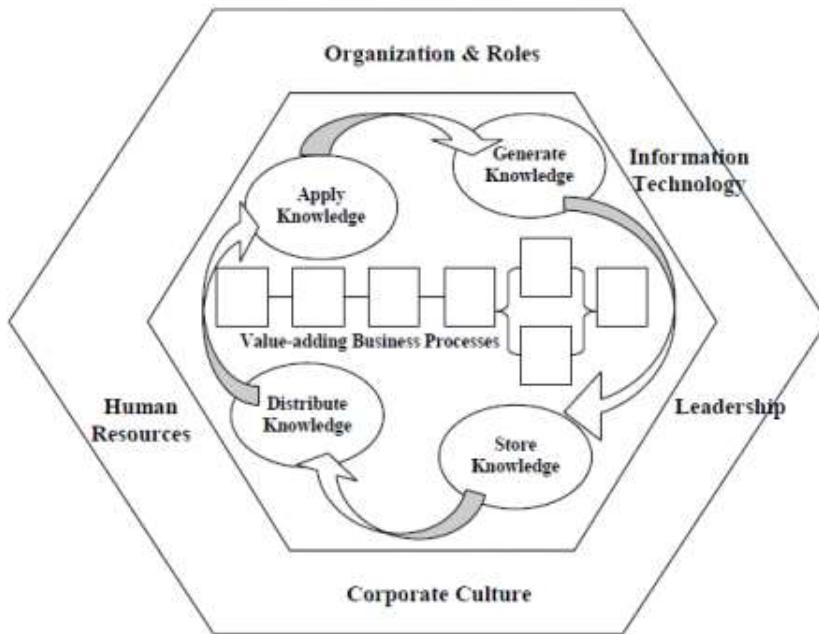




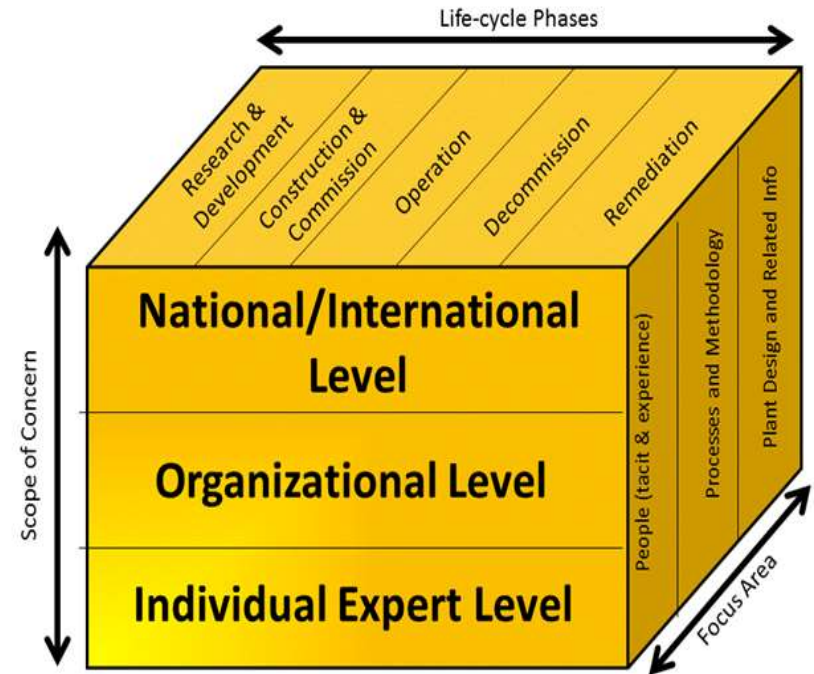
# Strategy of NKM

## 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.**

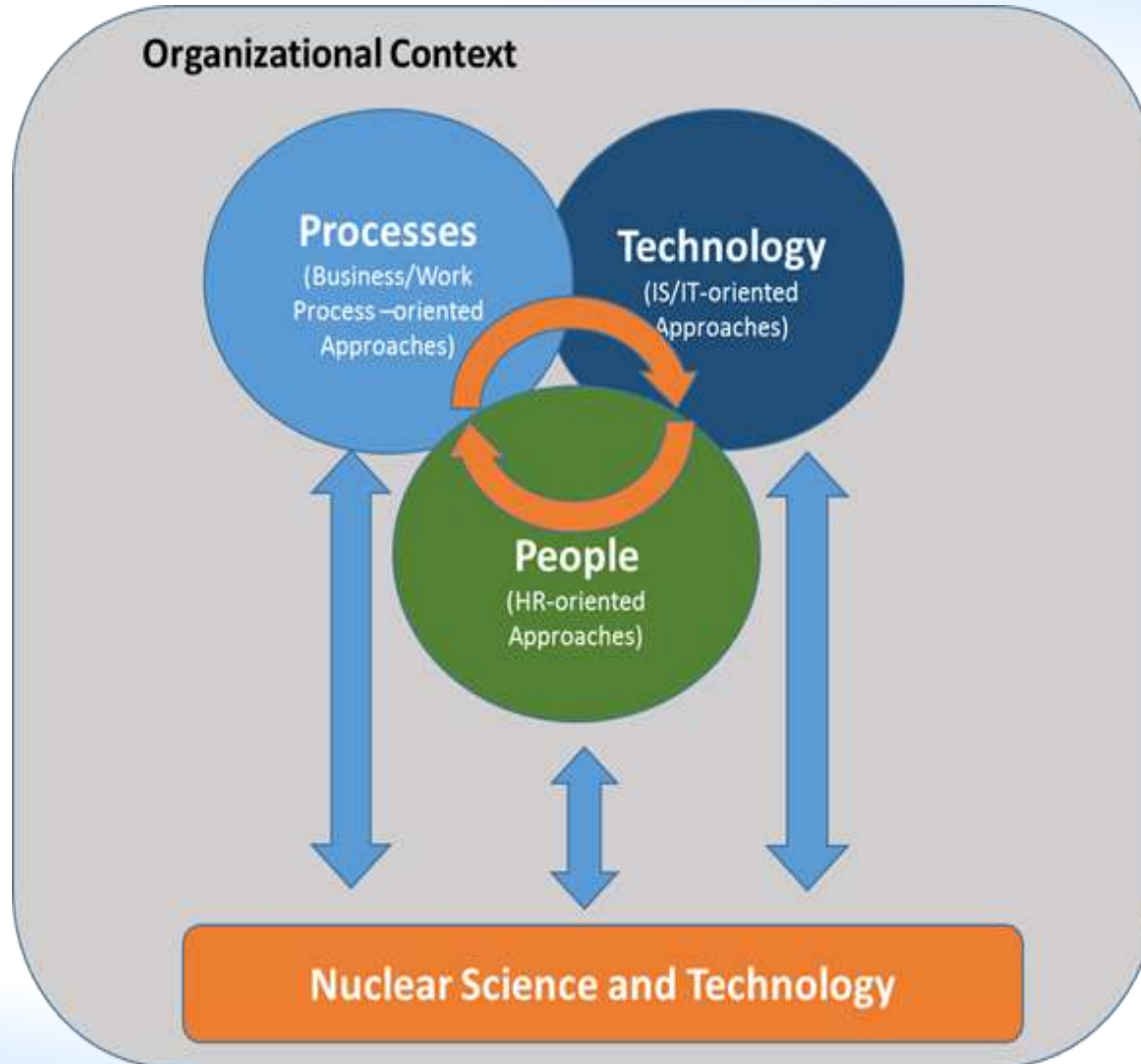


**Fraunhofer Reference Model**

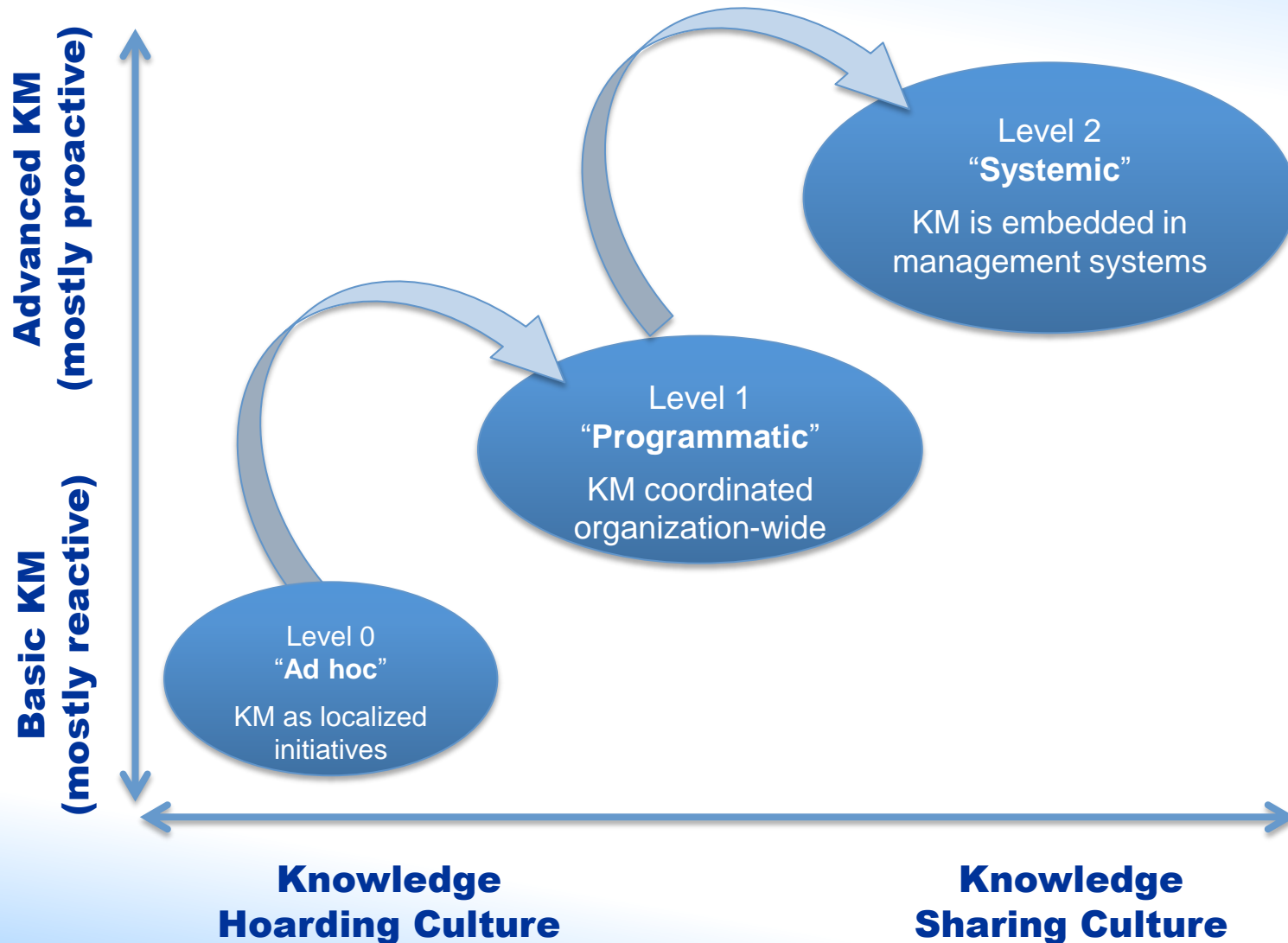


**NKM Cube**

# KM in Nuclear Organizations



# KM Maturity Model



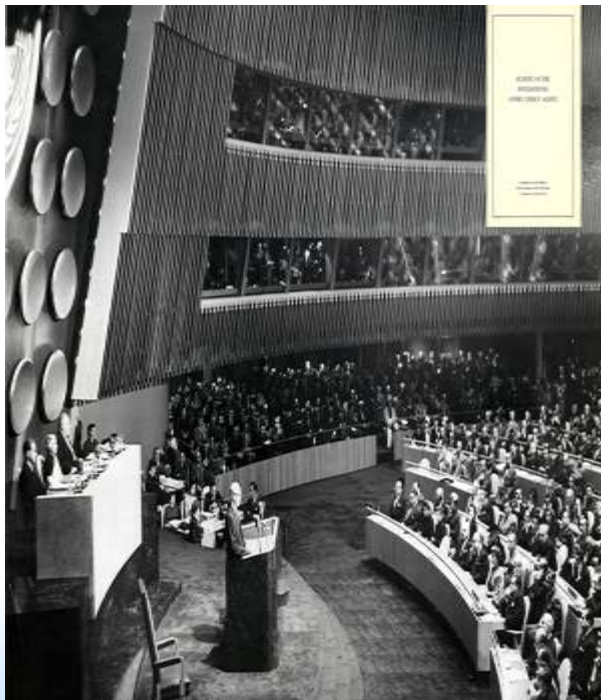


- **Basic Concepts of NKM**
- **IAEA's Statutory Tasks**
- **Trends and Challenges**
- **Forward Looking**



# A Glimpse of IAEA

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



**Headquarters in VIC, 1979-present**

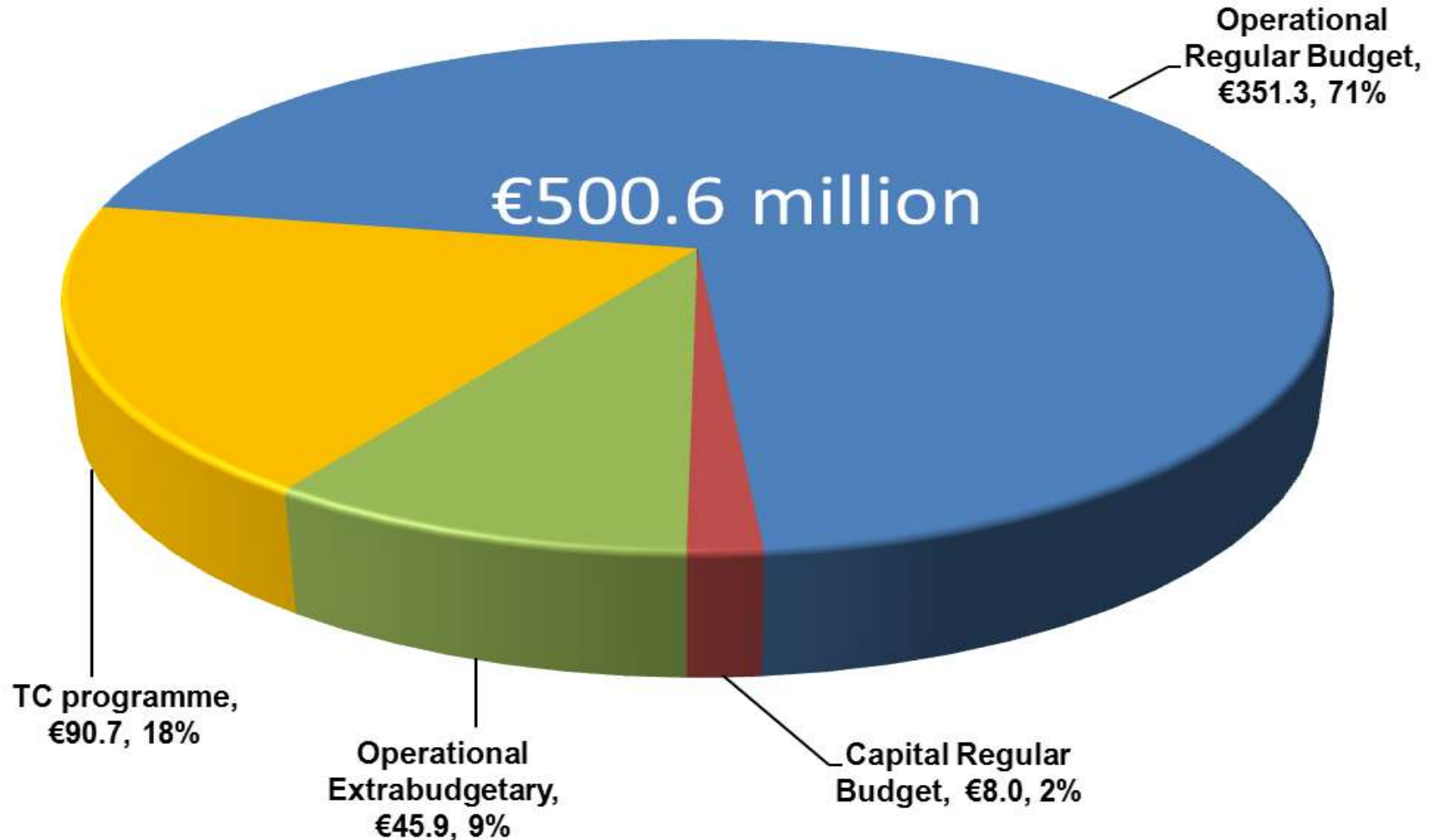
# Mandate

**“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”**



# Budget at Glance

## 2016 Resources at a Glance





# 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**

**DEPARTMENT OF NUCLEAR ENERGY**




Mr Mikhail Chudakov  
Head of the Department  
Deputy Director General

**DIVISION OF NUCLEAR FUEL CYCLE AND WASTE TECHNOLOGY**



Mr C. Xerri  
Director

**DIVISION OF NUCLEAR POWER**



Mr D. Hahn  
Director

**NUCLEAR FUEL CYCLE AND MATERIALS SECTION**



Mr C. Hill  
Section Head

**WASTE TECHNOLOGY SECTION**



Mr I. Gordon  
Section Head

**NUCLEAR POWER TECHNOLOGY DEVELOPMENT SECTION**



Mr S. Monti  
Section Head

**NUCLEAR POWER ENGINEERING SECTION**



Mr P. Vincze  
Section Head

**RESEARCH REACTOR SECTION**



Mr A. Borio Di Tigliole  
Section Head

**NUCLEAR INFRASTRUCTURE DEVELOPMENT SECTION**




Mr M. Kovachev  
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**INPRO SECTION**



Mr J. R. Phillips  
Section Head

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Mr W. Huang  
Director

**NUCLEAR KNOWLEDGE MANAGEMENT SECTION**




Mr J. de Grosbois  
Section Head

**PLANNING AND ECONOMIC STUDIES SECTION**



Mr D. Shropshire  
Section Head

**NUCLEAR INFORMATION SECTION**



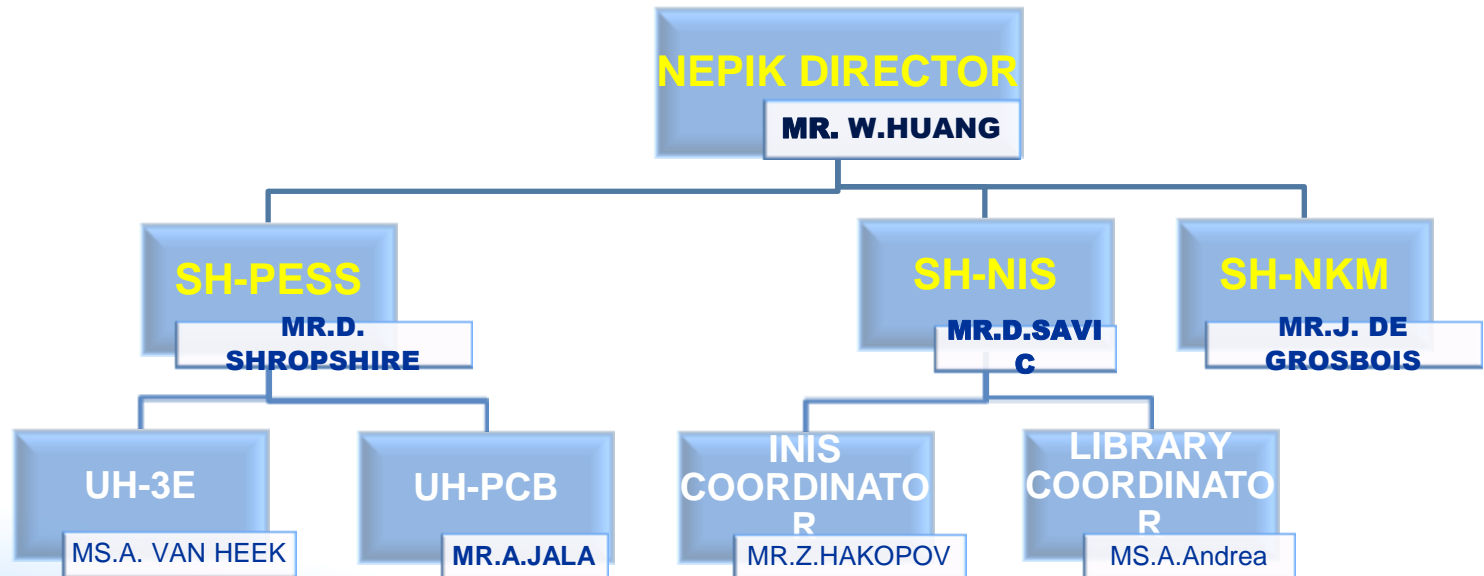
Mr D. Savic  
Section Head

## 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.

# Capacity Building and Knowledge Management-NEPIK

**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**



# NKM Programme

- **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**



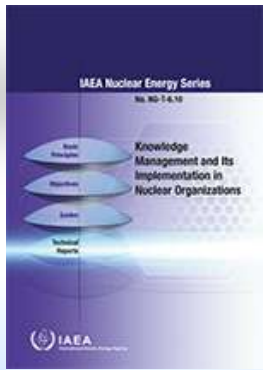
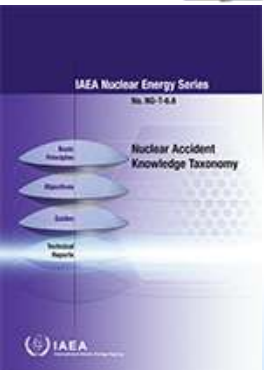
**E-learning**



**Digital Repositories**



**Education**



# Methodologies and Guidance



## 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-TCOP
- ✓ CORONA ACADEMY-TCOP

## 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 & asses**  
**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.

# Technological Product and Services



## 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!**

# Initiatives in Products and Tools

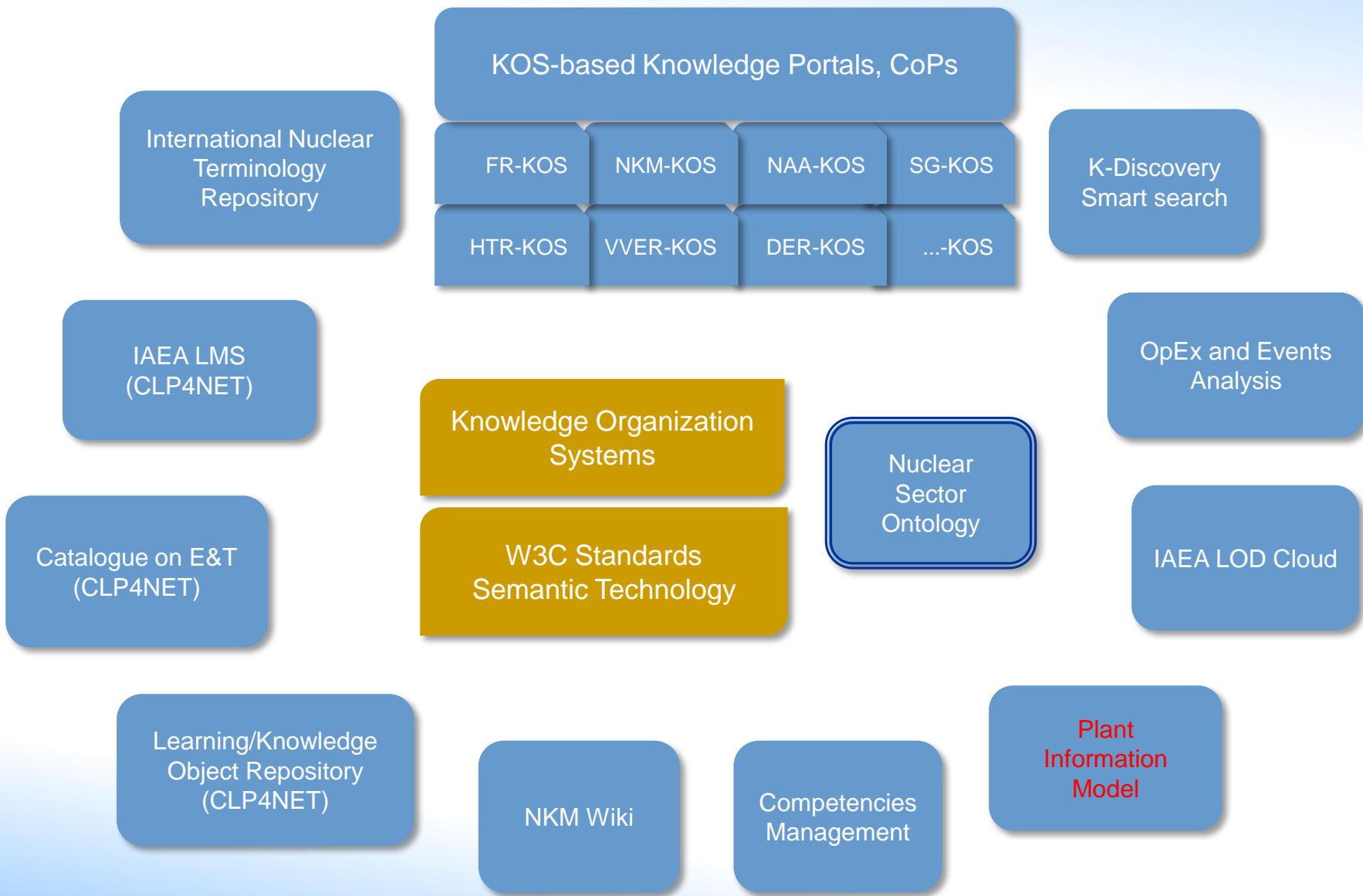
## KNOWLEDGE ORGANIZATION SYSTEMS (KOS) MANAGEMENT TOOLS

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)

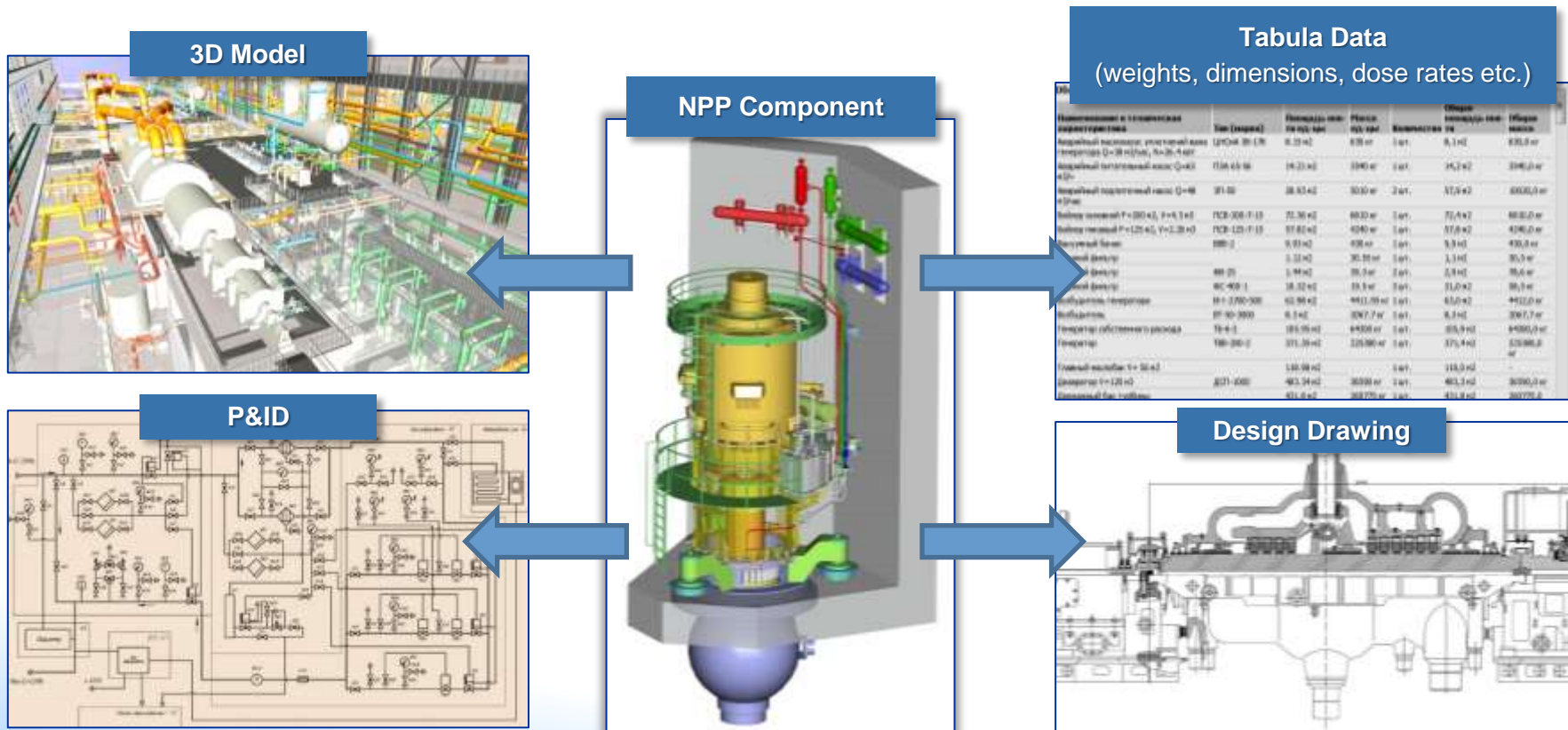
Cyber Learning Platform for Nuclear Education and Training (CLP4NET) is an online platform that allows users to find educational resources easily and contains a learning environment to support instructor-led courses and disseminate e-learning self-study resources to a wider audience. The use of the platform 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



# Plant Information Model 60 Years EA Atoms for Peace and Development

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

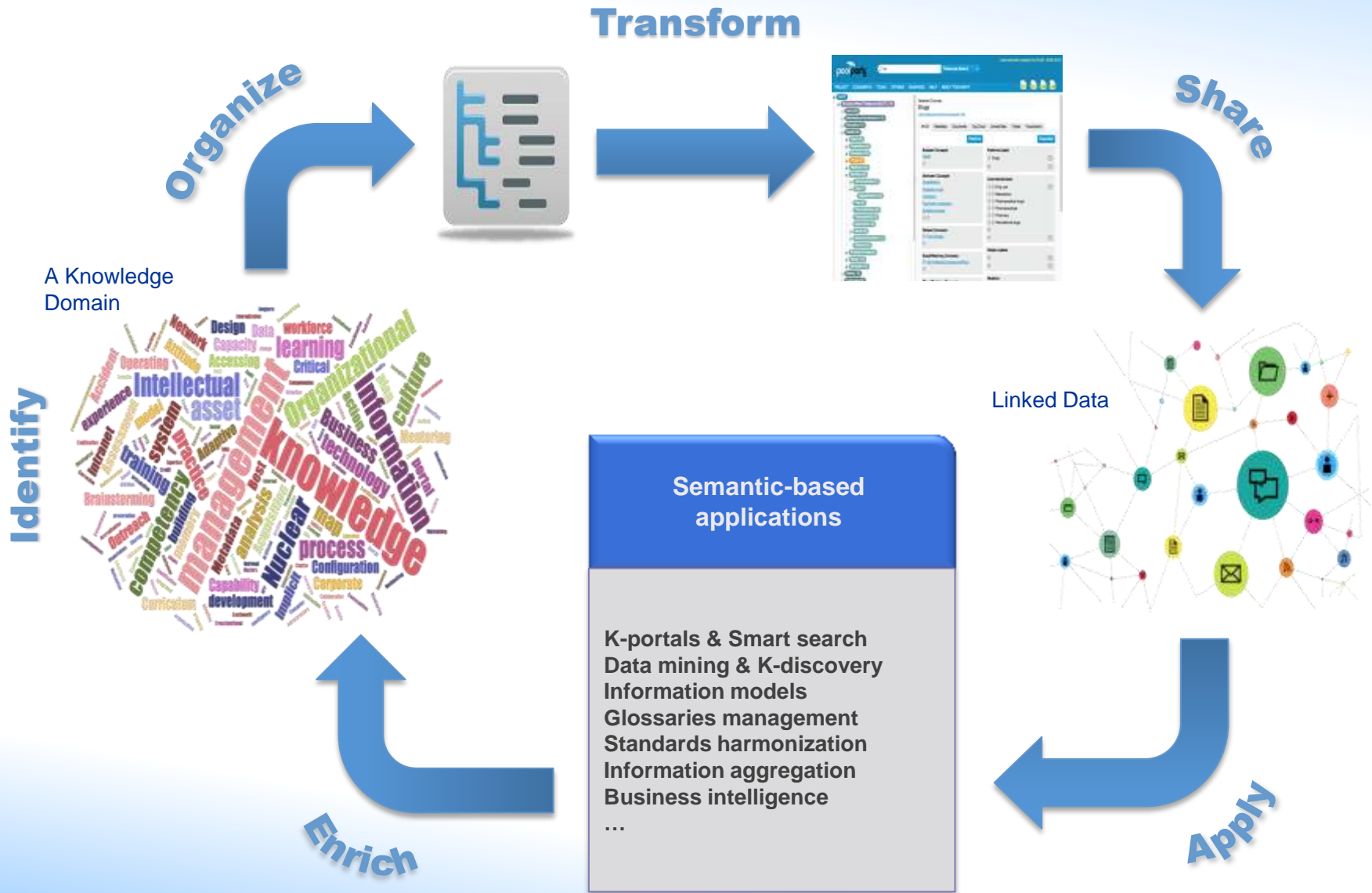


Наименование и краткое описание	Тип (марка)	Площадь поверхности, кв. м	Площадь, кв. м	Объем, куб. м	Комплектация	Объем, куб. м	Площадь, кв. м
Агрегатный насосный узел (АНУ) 30-130	30-130	8,23 кв. м	8,23 кв. м	1 кв. м	3,1 кв. м	130,0 кв. м	130,0 кв. м
Агрегатный насосный узел (АНУ) 40-130	40-130	13,66 кв. м	13,66 кв. м	1 кв. м	15,1 кв. м	390,0 кв. м	390,0 кв. м
Агрегатный насосный узел (АНУ) 40-130	40-130	13,66 кв. м	13,66 кв. м	2 кв. м	17,1 кв. м	400,0 кв. м	400,0 кв. м
Водяной насос (ВН) 30-130, (V=4,1 кв. м)	ВН-30-130	72,36 кв. м	49,0 кв. м	1 кв. м	77,4 кв. м	400,0 кв. м	400,0 кв. м
Водяной насос (ВН) 125-130, (V=1,28 кв. м)	ВН-125-130	57,6 кв. м	49,0 кв. м	1 кв. м	57,6 кв. м	490,0 кв. м	490,0 кв. м
Агрегатный насос	АНУ-2	9,91 кв. м	9,91 кв. м	1 кв. м	9,91 кв. м	40,0 кв. м	40,0 кв. м
Агрегатный насос	АНУ-3	1,12 кв. м	30,15 кв. м	1 кв. м	1,12 кв. м	30,15 кв. м	30,15 кв. м
Агрегатный насос	АНУ-4	1,44 кв. м	30,15 кв. м	1 кв. м	1,44 кв. м	30,15 кв. м	30,15 кв. м
Агрегатный насос	АНУ-5	18,12 кв. м	18,1 кв. м	1 кв. м	18,1 кв. м	30,15 кв. м	30,15 кв. м
Агрегатный насос	АНУ-6	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-7	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-8	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-9	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-10	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-11	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-12	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-13	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-14	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-15	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-16	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-17	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-18	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-19	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м
Агрегатный насос	АНУ-20	62,94 кв. м	41,19 кв. м	1 кв. м	63,0 кв. м	410,0 кв. м	410,0 кв. м

# Concept of PIM



# Utilizing Semantic Technology

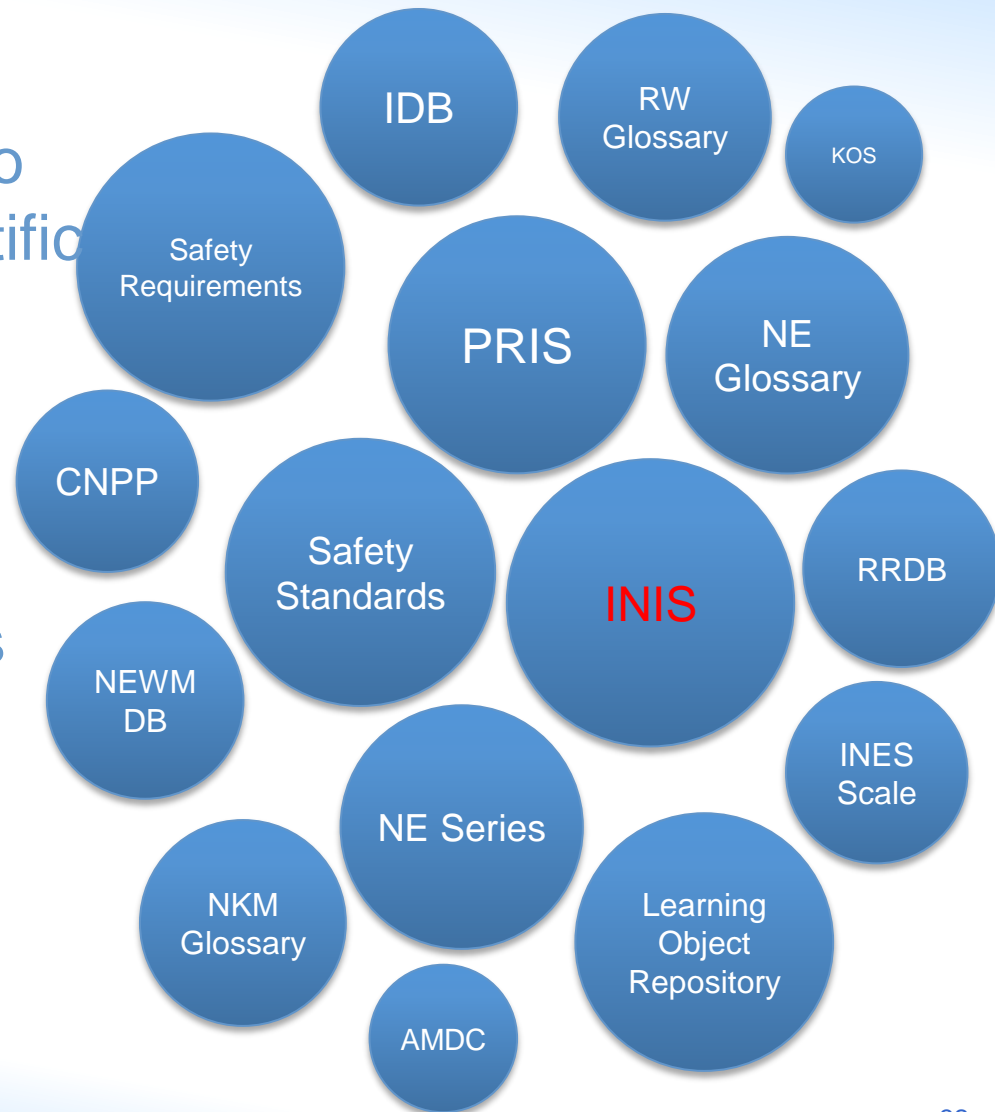


# Linked Open Data Cloud



60 Years  
Atoms for Peace and Development

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

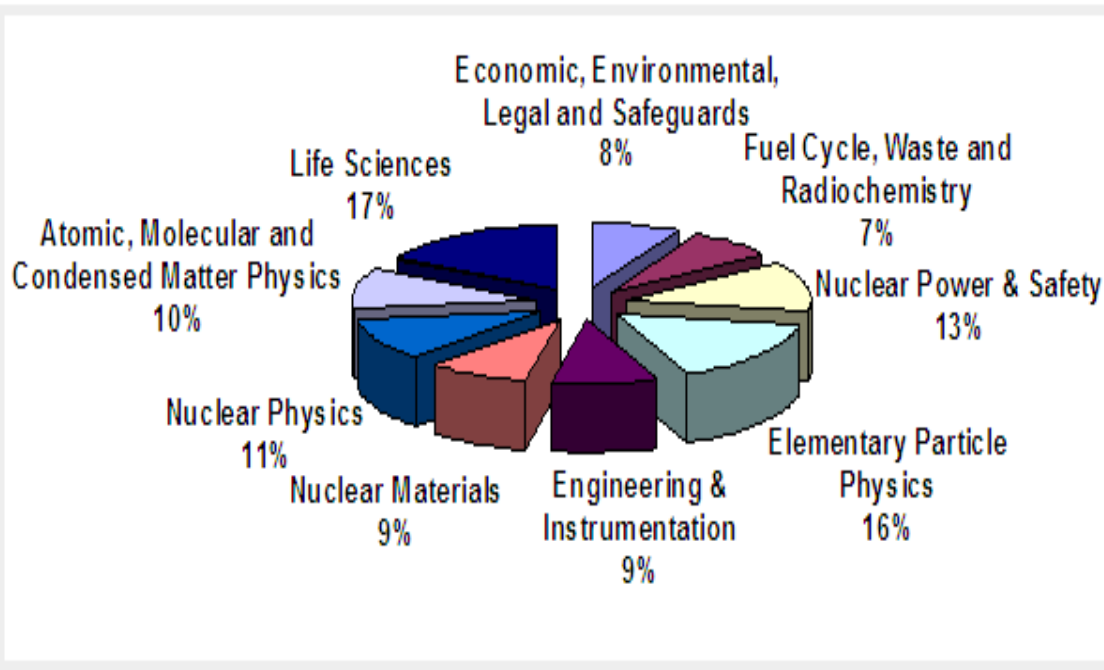




# International Nuclear Information

**INIS, established in 1970, one of the most successful and comprehensive information systems on the peaceful uses of nuclear science and technology.**

## INIS Database



## 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



Communication, Collaboration, Knowledge,

Cyber Learning Platform for Network 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 IAEA's platform is provided as a cost-free service to all of the IAEA and its cooperation partners.

Self-directed Learning Management System    Instructor-led Learning Management System    Integrated Database on Education and Training



Making self-learning materials available online to a wider audience



To support and enhance instructor-led training courses for closed groups of participants



Finding educational resources and opportunities easily, using an advanced search

Click the logos below to visit the websites of Nuclear Education Networks



# 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**
- **IAEA's Statutory Tasks**
- **Trends and Challenges**
- **Forward Looking**

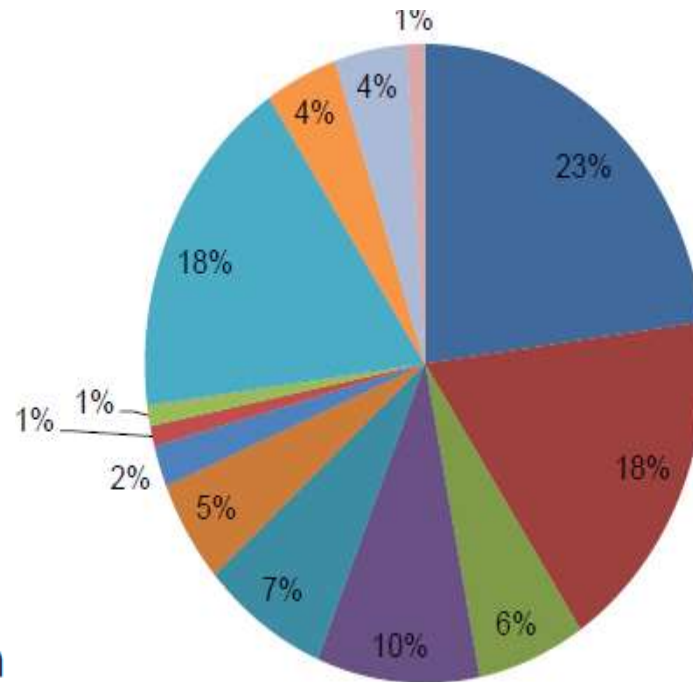


# NKM SURVEY

❖ **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

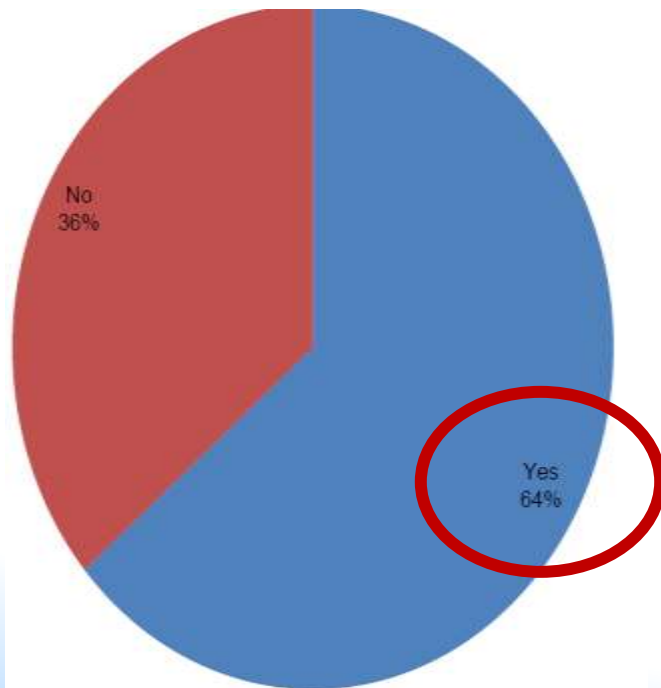


- Decommissioning project organization
- Fuel processing facilities
- Waste management facilities
- Nuclear education and training institution
- Consulting
- International organization
- Other

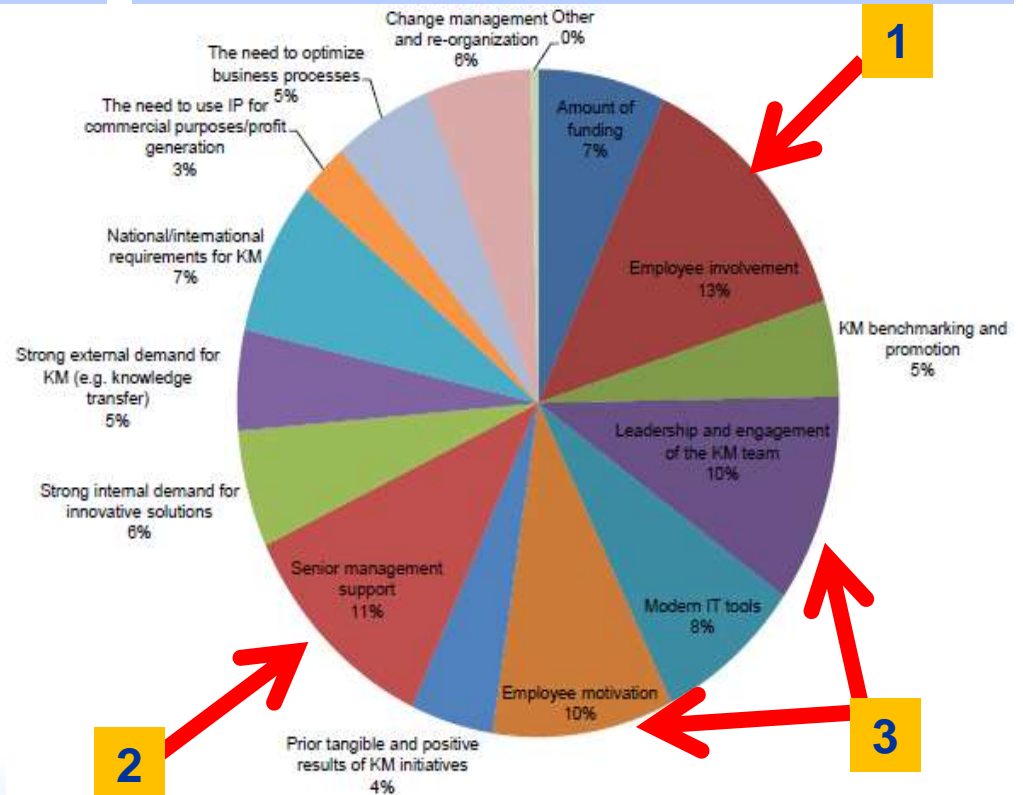
## Implementing organizational knowledge management

### Analysis and orientation

#### Formal definition of KM process in the organization



#### Drivers influencing KM initiatives in the organization

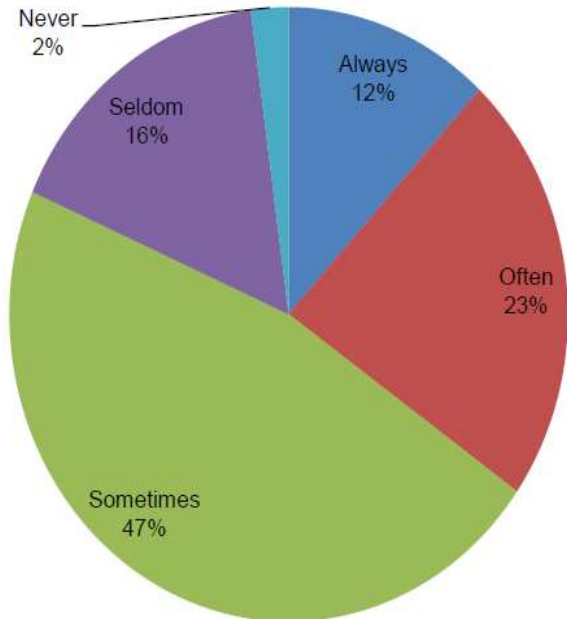
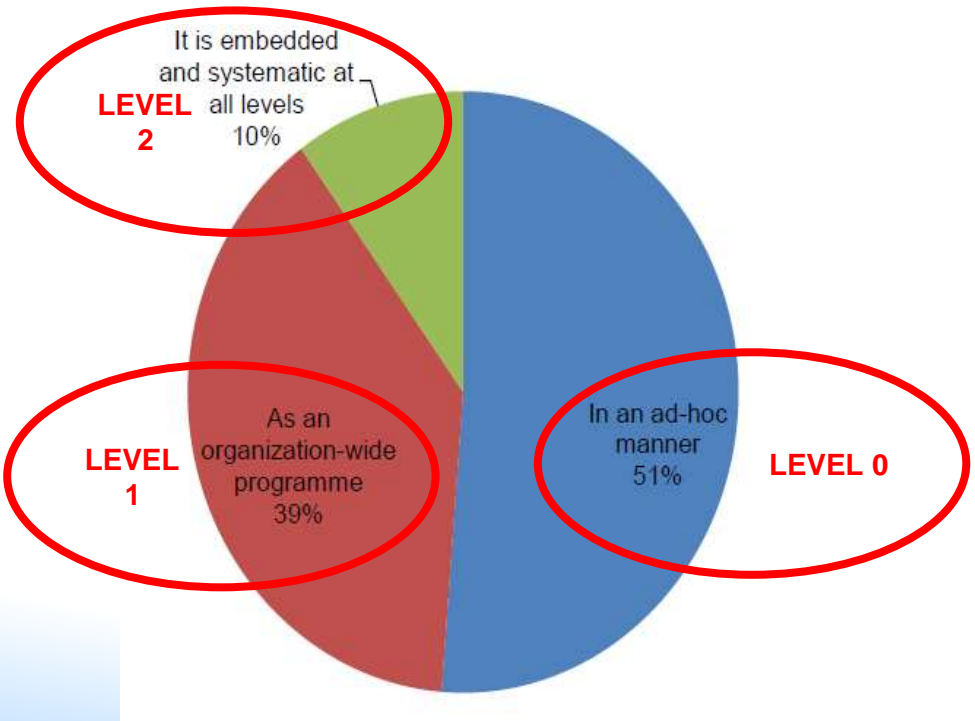


## Implementing organizational knowledge management (cont.)

### KM programme maturity

Degree to which KM programme is implemented in organizations

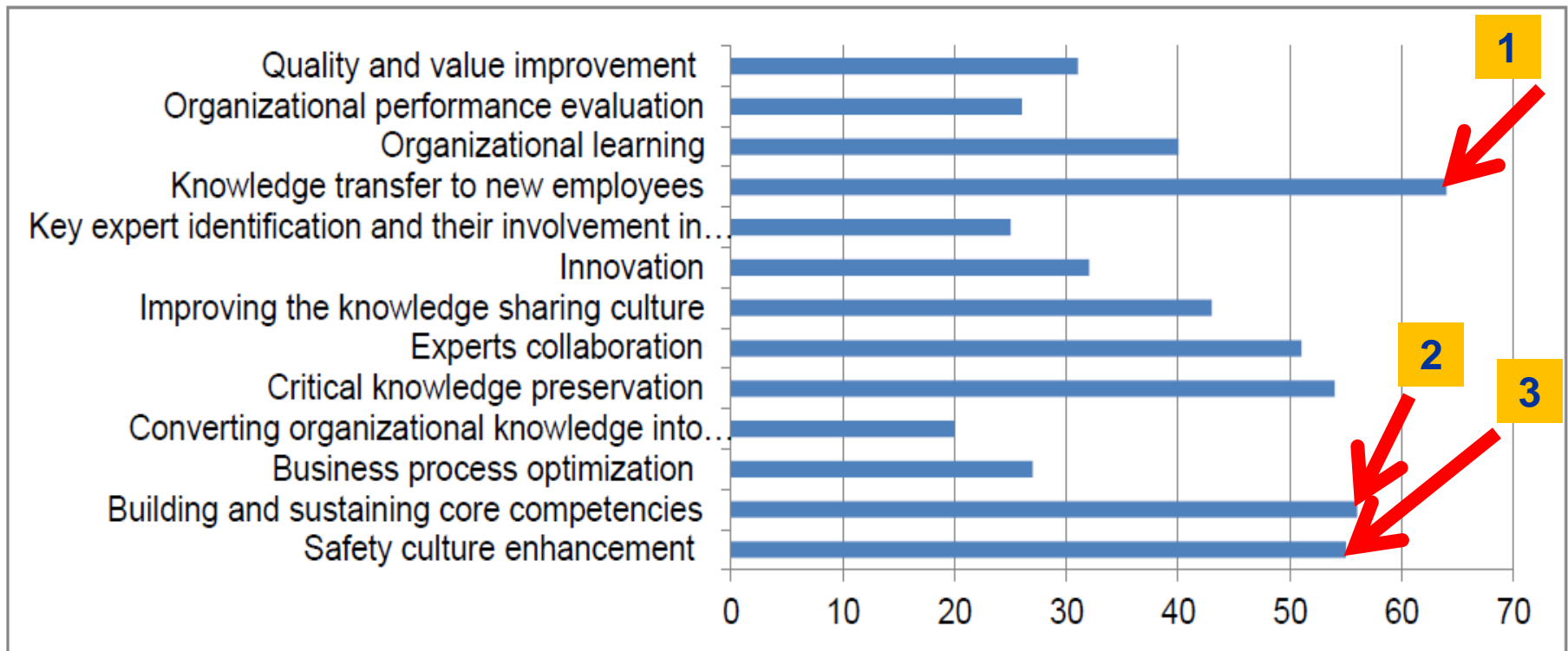
KM responsibilities embedded in the job duties of the staff members



## Implementing organizational knowledge management

### Strategy development

#### Organizational goals supported by the KM programme



# 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.**

**IT supporting KM processes → powerful enabler**



# 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**
- **IAEA's Statutory Tasks**
- **Trends and Challenges**
- **Forward Looking**



# 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.**



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*60 Years*

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*Thank you!*

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