



**IAEA**

International Atomic Energy Agency

*Atoms for Peace*

Refreshers course presentation  
Yanko Yanev. IAEA NKM Program

# MANAGING NUCLEAR KNOWLEDGE



# Topics

- **Knowledge and Management**
- **Why “Knowledge Management” in the Nuclear field?**
- **Knowledge retention in the nuclear industry**
- **Managing the Risk of Knowledge Loss**
- **Nuclear Knowledge Management and the IAEA activities**
- **Conclusion**



# A Definition of Knowledge

*Its not easy*



*Many have tried....*

Raphael's *School of Athens* and the Wisdom of the Ancients



Knowledge is the mother of all virtue; all vice proceeds from ignorance

Knowledge is power

Learning is a treasure which accompanies its owner everywhere

Knowledge is experience everything else is information



# Scientific knowledge

- It is the property of communities..
- It is not merely an individual experience..
- It is exchangeable and contributes to the knowledge of the community.





Knowledge from this perspective is what our human civilization has accumulated over time to understand the world and act effectively in it

# MANAGEMENT...

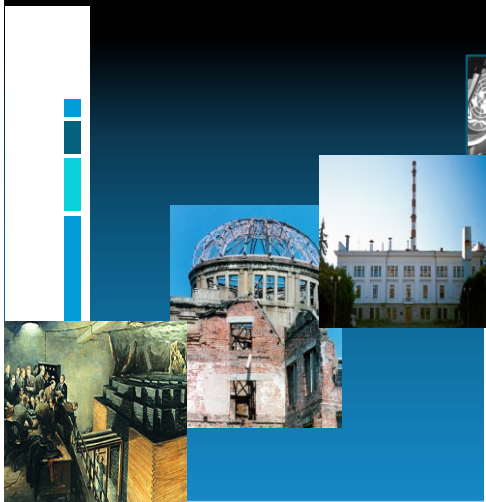
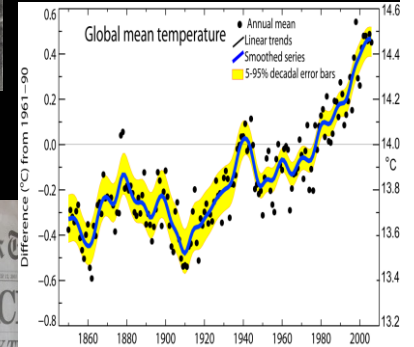
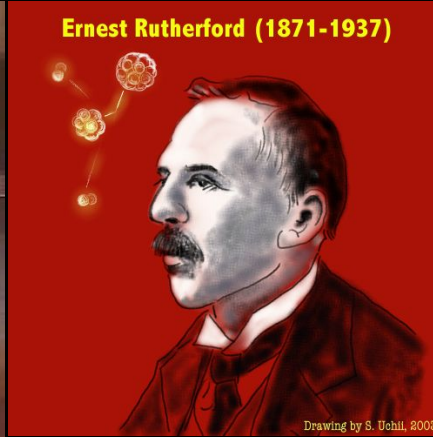
*Manu agere*

*To lead*

*It is all about leadership*



# Nuclear knowledge – a remarkable achievement



1955

1965

1975

NKM Program 2008/9

1995

2005





# Nuclear knowledge

- Involves virtually every area of physical sciences and engineering
- Requires a complex infrastructure
- Must be based on firm technical understanding to manage safety, economics, & innovation
- Takes many years to build up the knowledge base

# Nuclear knowledge is an asset

## Asset Classes:

### Physical Capital

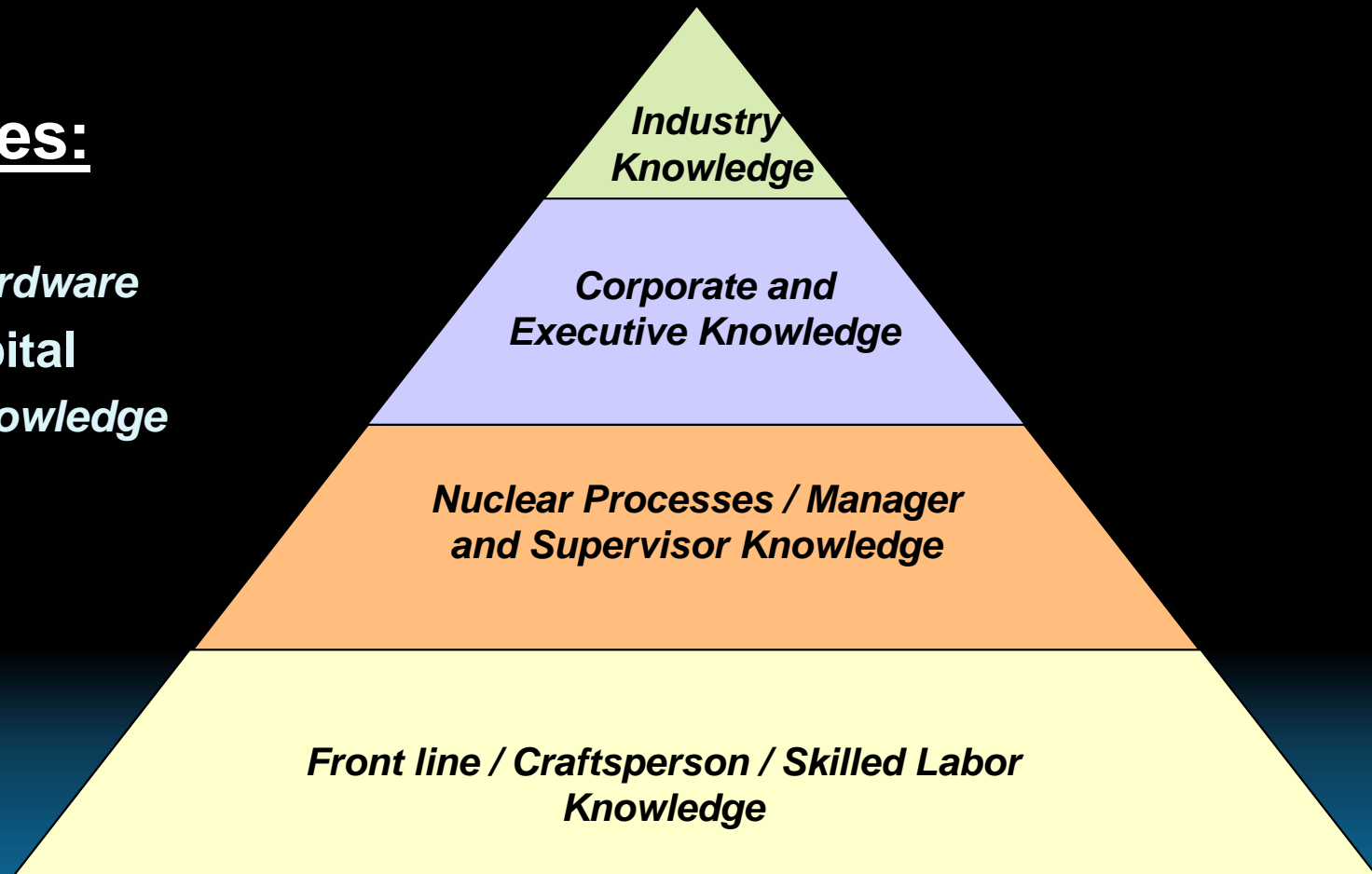
- *Equipment/Hardware*

### Technology Capital

- *IT/Process Knowledge*

### Human Capital

- *People*



A resource which was created by absorbing other resources,  
Has its **own cost** .Has to be **managed** in an efficient and effective  
manner to help to reach *organizational or national goals*.



# Who owns Nuclear knowledge?

- Governments, including regulators;
- Designers, vendors, utilities, operators, suppliers, consultants, and support organizations;
- Training and academic institutions;
- Research and Development (R&D) organizations;
- The Public and Non Governmental Organizations (NGOs); and
- International organizations.



# Nuclear Knowledge is globally imbalanced..

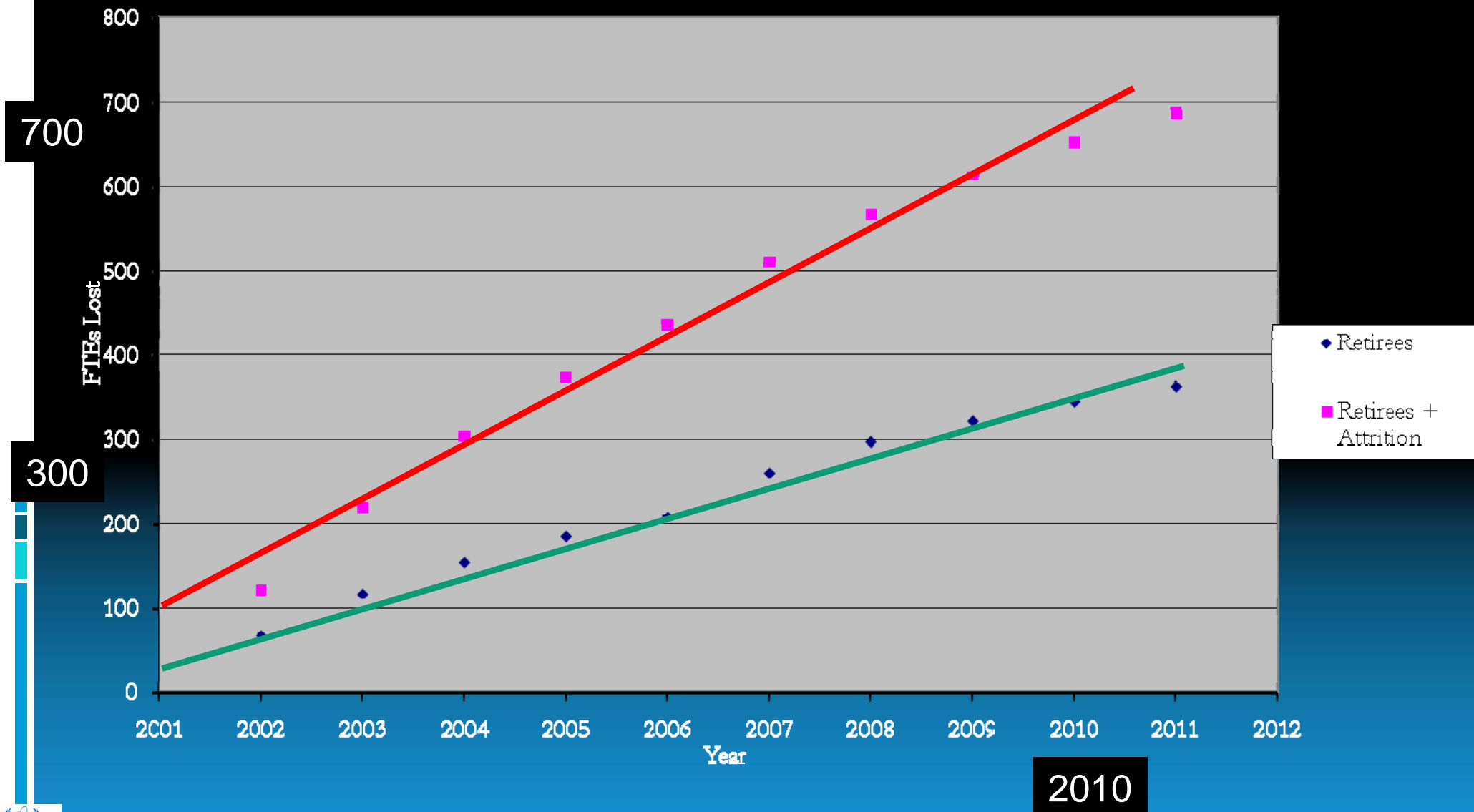
## Affected by:

- A combination of governmental budgeting inconsistencies,
- The demographic gaps in the professional workforce,
- The resurging increase in nuclear technology applications worldwide and
- The lack of awareness of the importance of systematically managing nuclear knowledge in the past.



# The DOE Nuclear Workforce

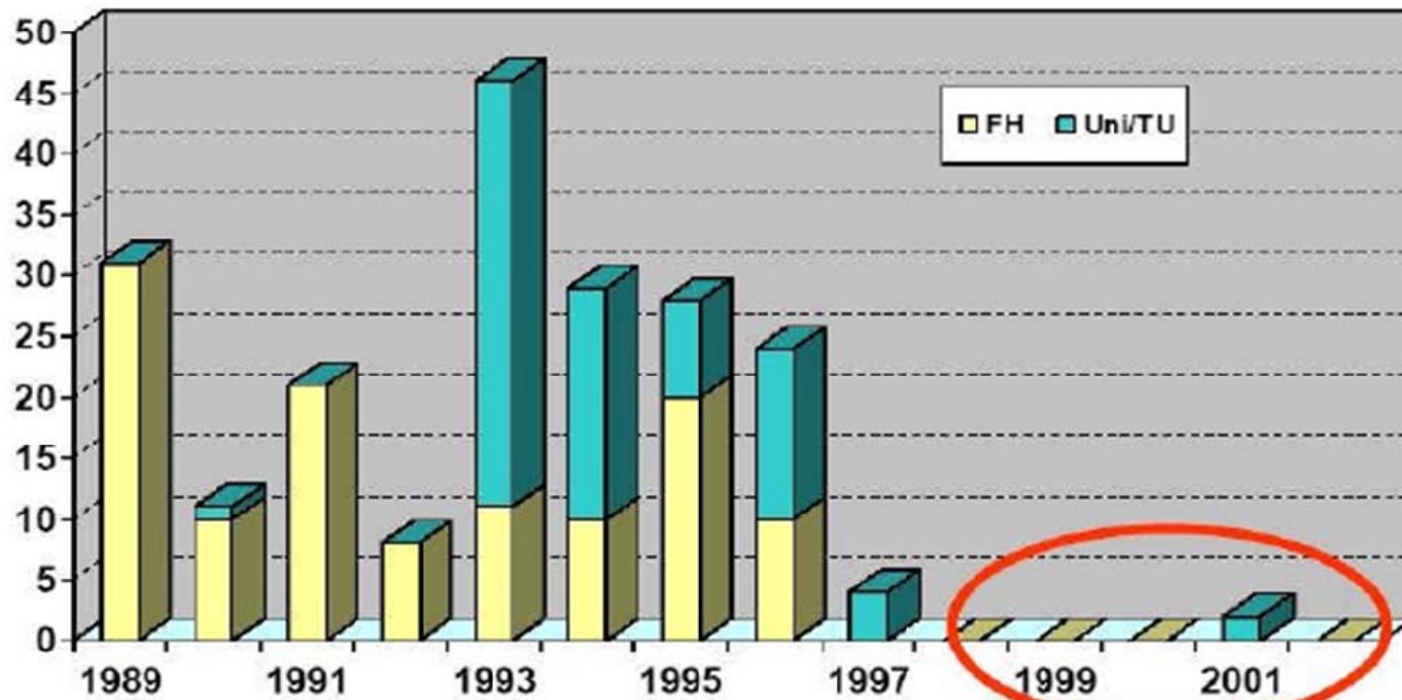
## PNNL: Loss of Nuclear Workforce (2002-2010)





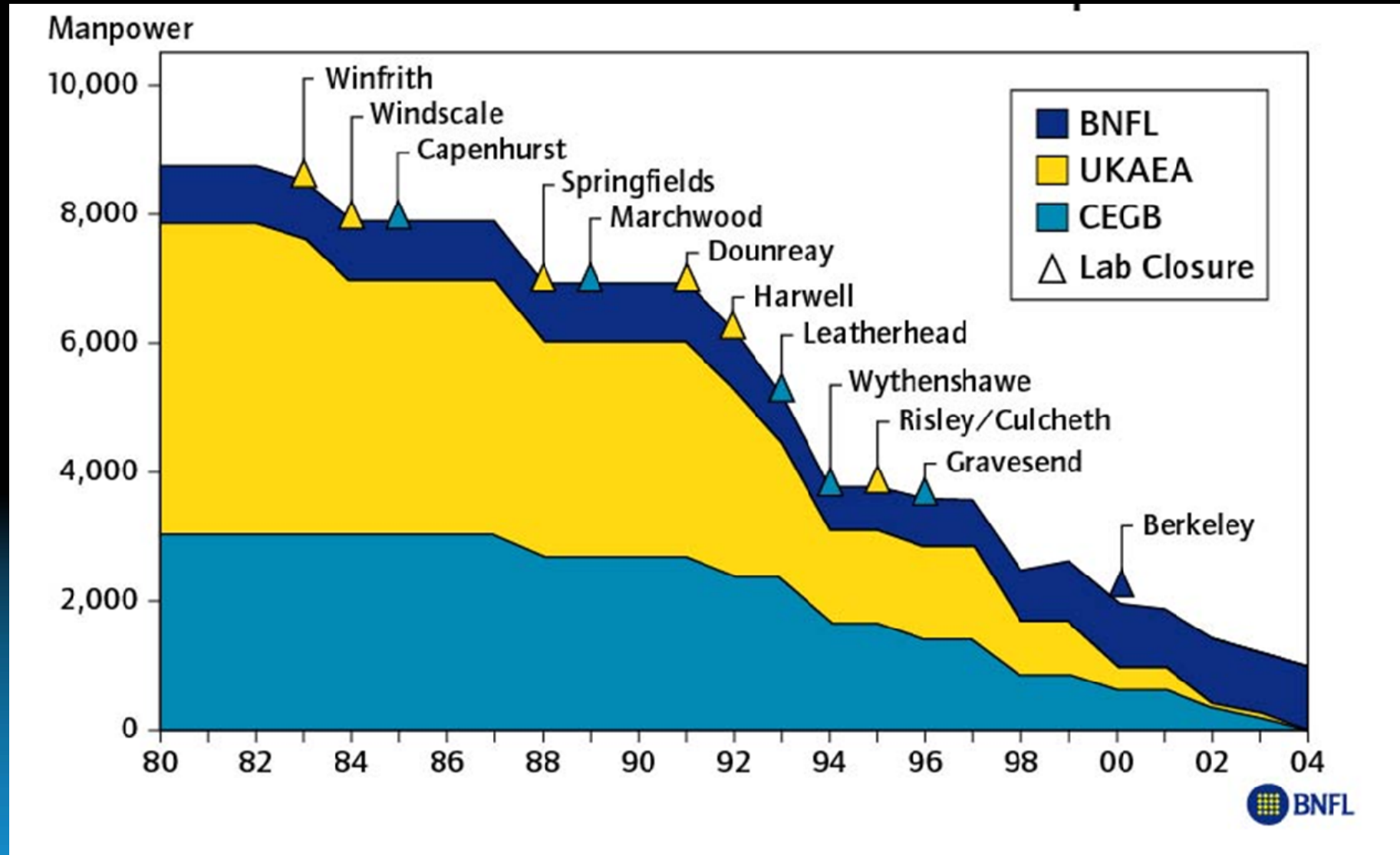
# The next German nuclear generation?

## Diplomas in the Fields of Nuclear





# UK Nuclear Research Potential





# Nuclear Renaissance - a Global Reality

- Continuing evolutionary advance in reactor technology
- Multinational research to produce quantum leaps in technology
- Unprecedented levels of efficiency & capacity utilisation in key countries
- A robust and accumulating record of operational safety, backed by a pervasive global nuclear safety culture
- Political progress in implementing the scientifically sound concept of waste disposal using deep geological repositories
- The truest barometer: expansive growth plans for nuclear power in major nations in both the developed and developing worlds





- **Rising expectations correspond to a rising demand for nuclear knowledge and workforce.**
- **“People are likely to be the worst bottleneck”**



# The loss of nuclear experience

- *The bubble of experience that is retiring has been around for at least five years.*
- *There's an arrogance hearing big companies saying:, "We're a great company. We can hire anybody we want. We can fix the problem just by hiring people." (viz. AREVA, Westinghouse, others)*
- *But there's little thought about what you lose by just hiring new people. Now our hand has been forced by our growth desires. The experience is going and we may not be able to support the growth of nuclear power.*





# Impacts of knowledge loss

- Loss in efficiency
- Degradation in safety performance
- Loss of capacity to innovate
- More costly errors
- Growth strategy threatened





# The delay in Olkiluoto3 ?

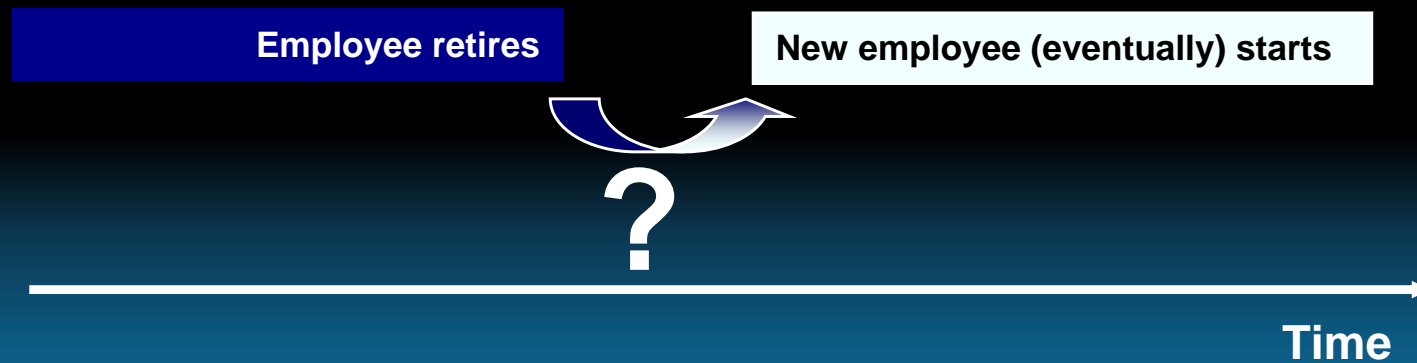


- AREVA admitted that one of the reasons for the delay is the deficiency in managing skills and knowledge in coordinating such big projects.
- The same applies for the Finish contractors.

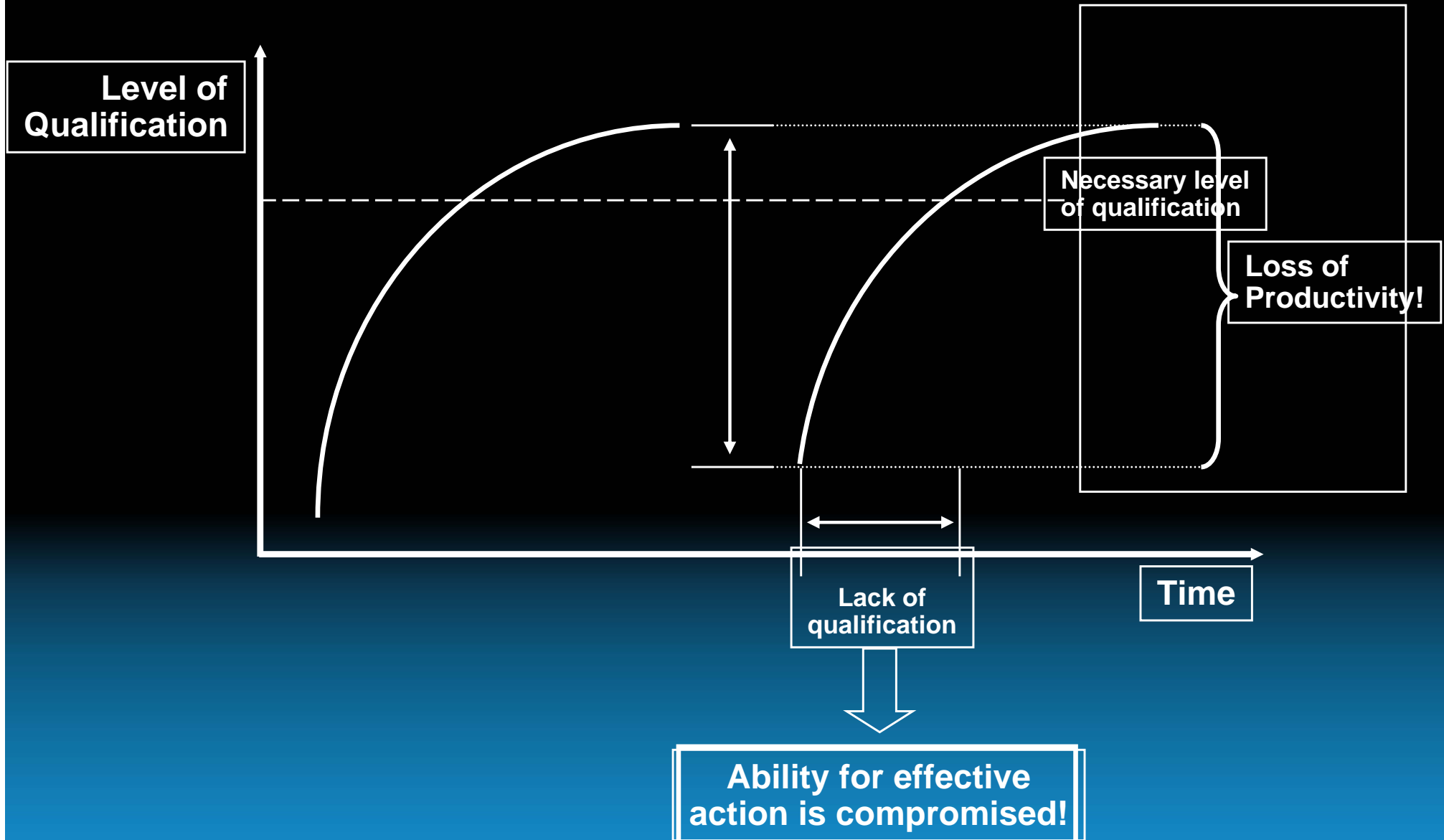


# Attrition-related loss of knowledge:

## Loss due to insufficient knowledge transfer

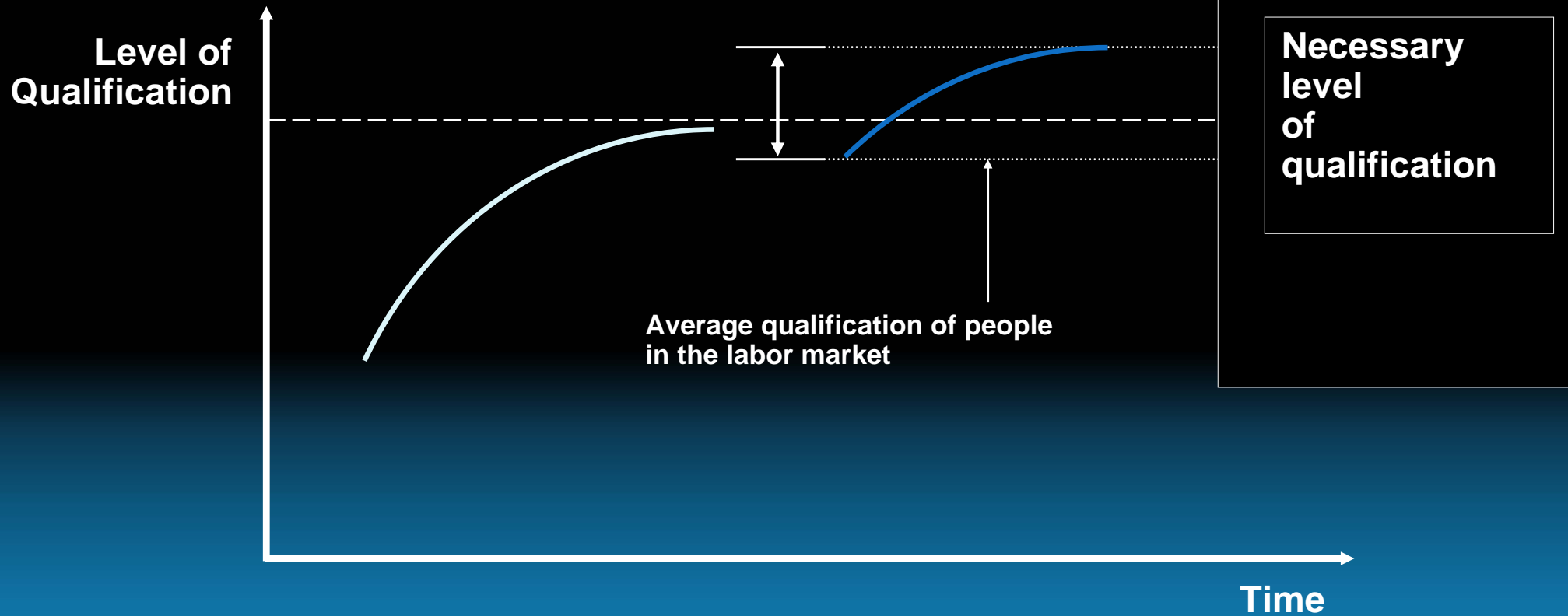


# Attrition-related loss of knowledge:





# Knowledge Loss: When is it **NOT** a problem?





# Challenges to Knowledge Preservation





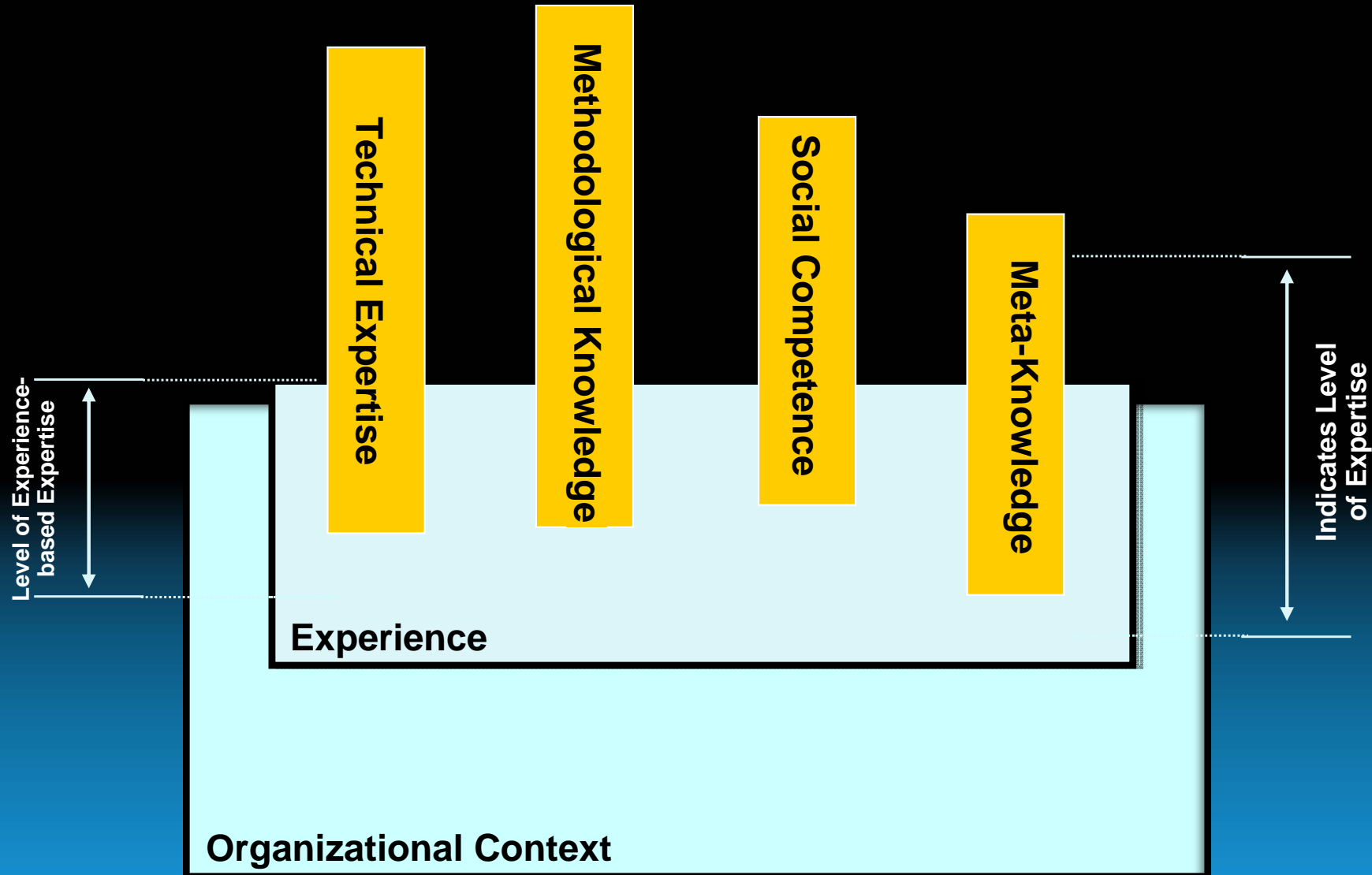


# What to preserve?

- **The most important:**
  - **technical expertise**
  - **methodological knowledge**
  - **social competence (getting along with others)**
  - **meta-knowledge (knowing where)**
  - **past experience.**



# Knowledge is Rooted in the Organizational Context.





# Knowledge Continuum

**Explicit Knowledge**

**Tacit Knowledge**



**Complete  
Articulability:**

**Limited  
Articulability:**

**Strategy → Capture**

**Strategy → Connectivity,  
People as Knowledge Repositories**

**CODIFICATION**

**PERSONALIZATION**



# Basic knowledge preservation strategies

**Documentation**

**Exit-Interview**

**De-Briefing**

**CODIFICATION**

**Internal**

**Representation  
(Redundancy)**

**Tandem  
(Mentoring)**

**KPS  
Teams**

**Communities  
of Practice**

**External**

**External  
Experts**

**PERSONALIZATION**



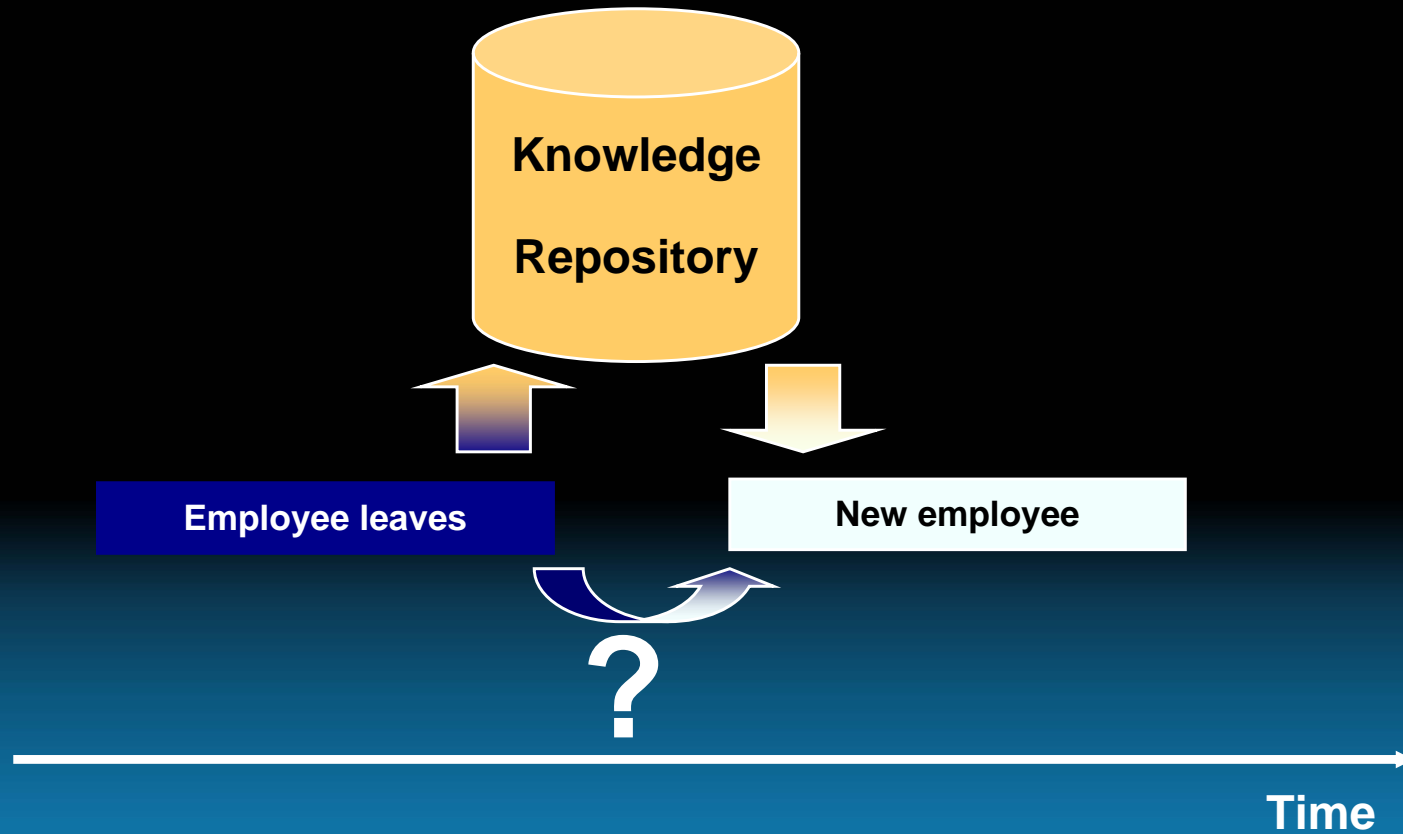


# Means of Knowledge Preservation



# Codification

## Creating a «Knowledge Repository»





# Personalization

(«The **T**-shaped individuals»)

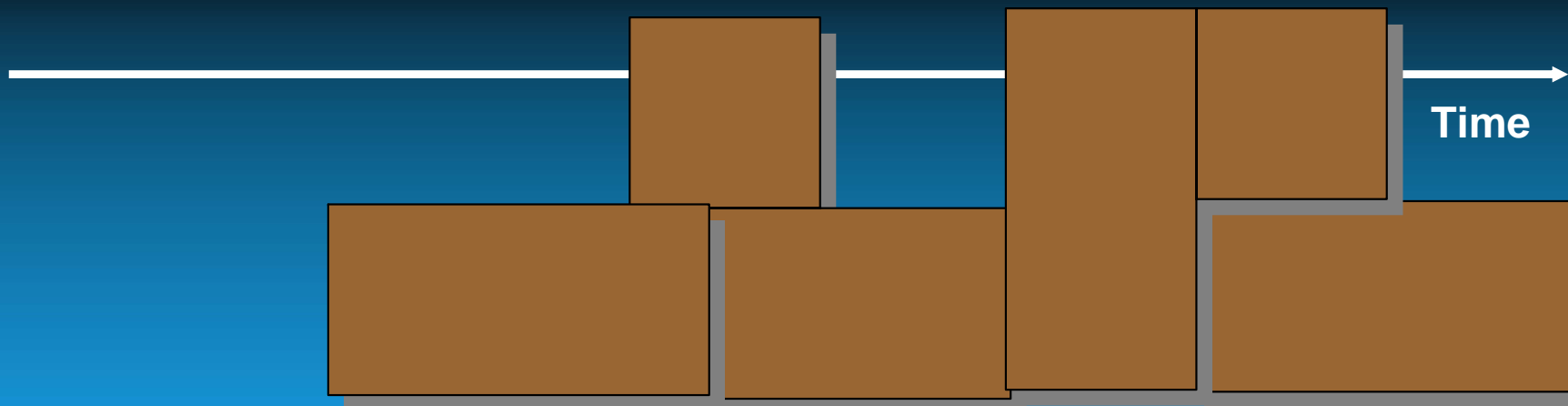
T-shaped individual(s)



Employees retire



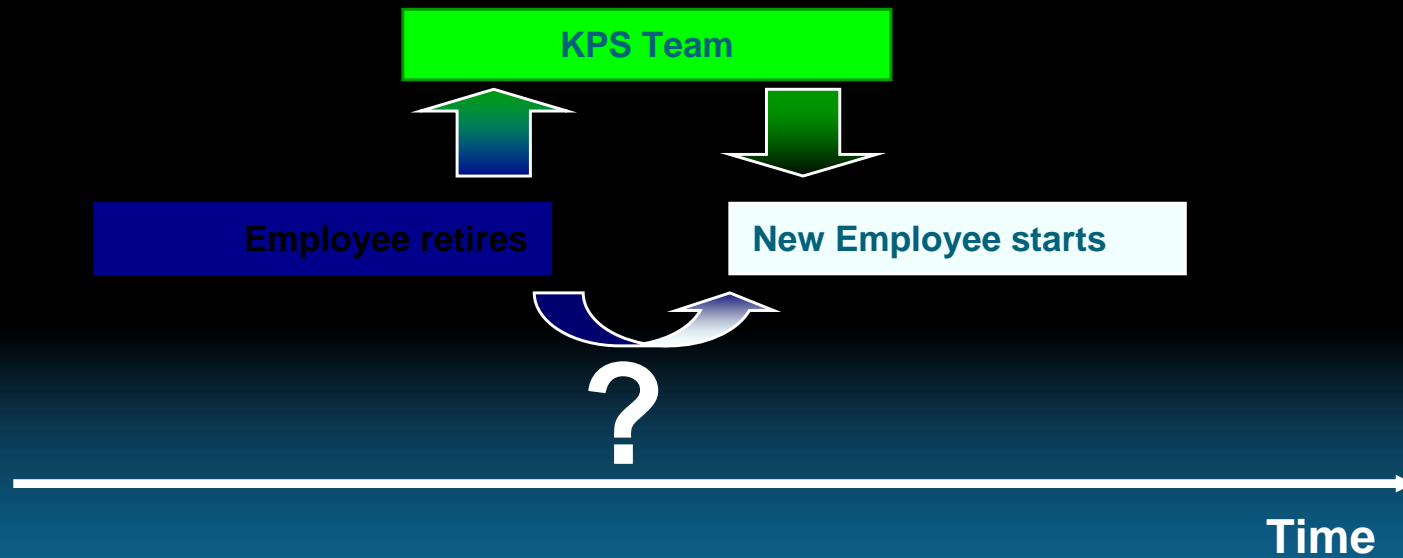
New employees start





# KPS (torage) Teams

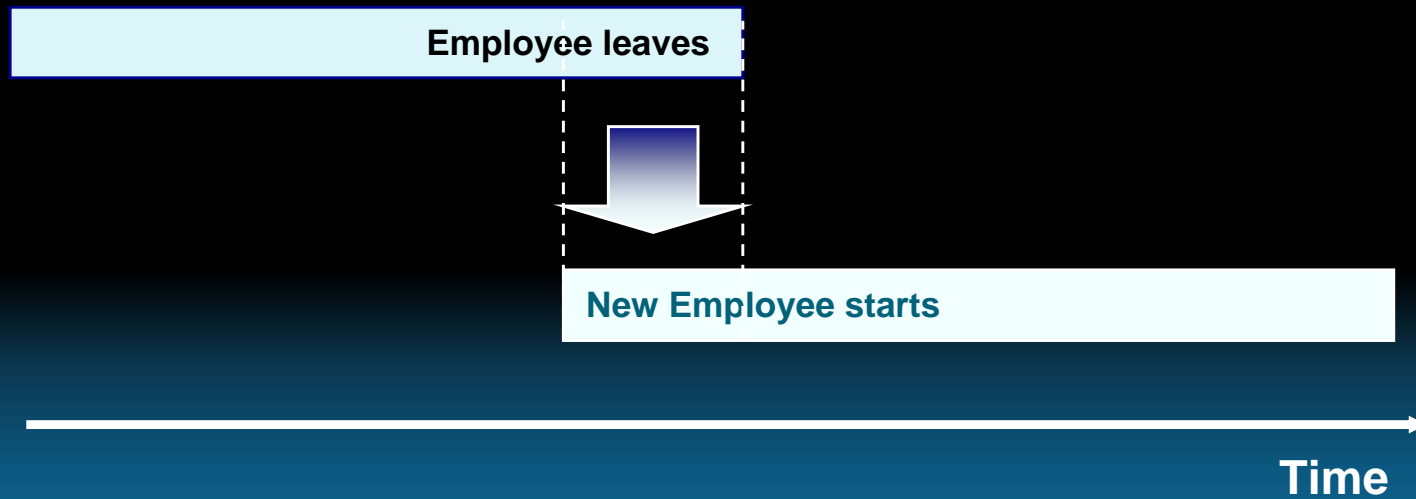
Members of the organization with explicit task of storing and transferring knowledge







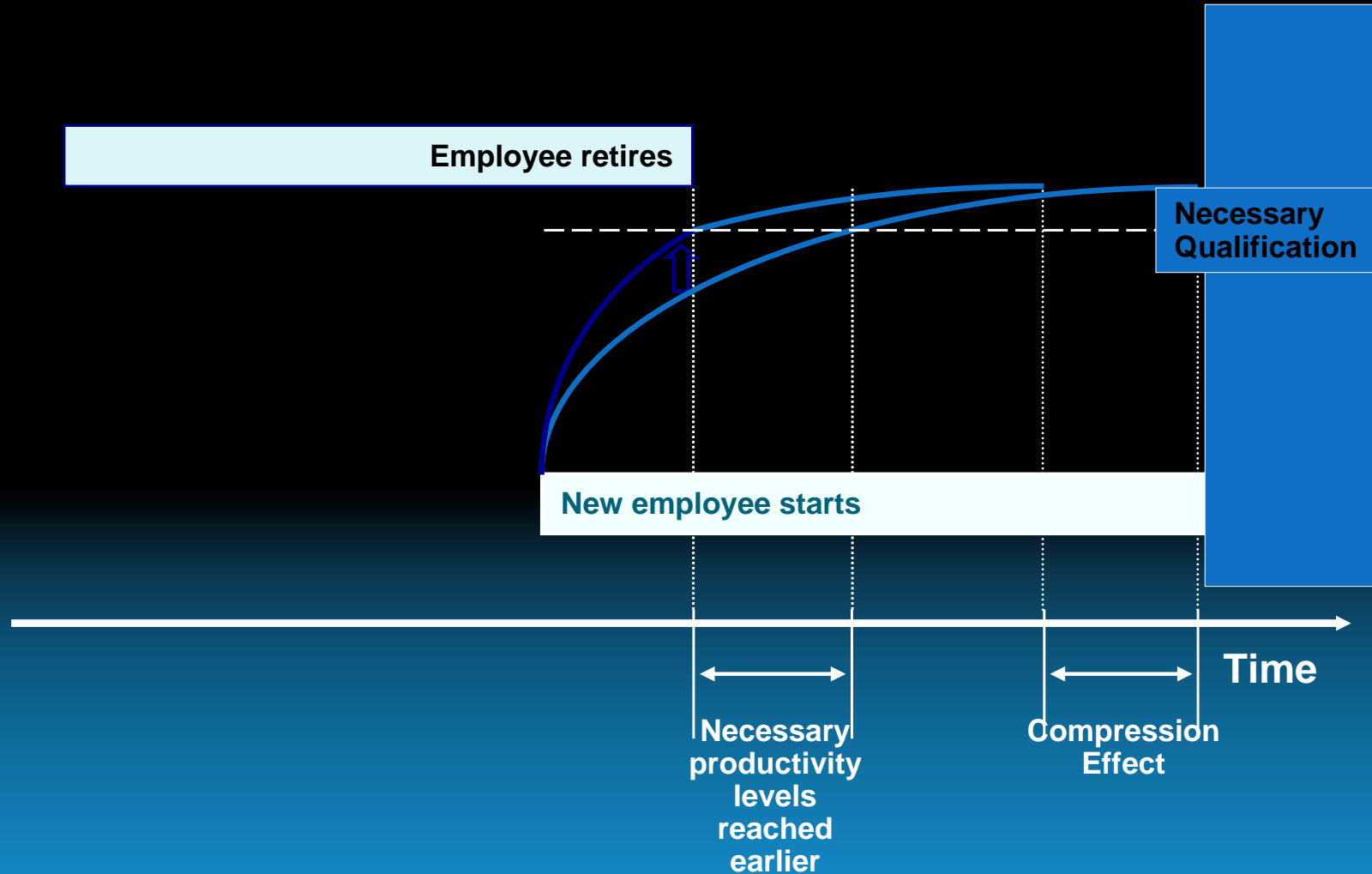
# Mentoring (Tandem)





# Mentoring

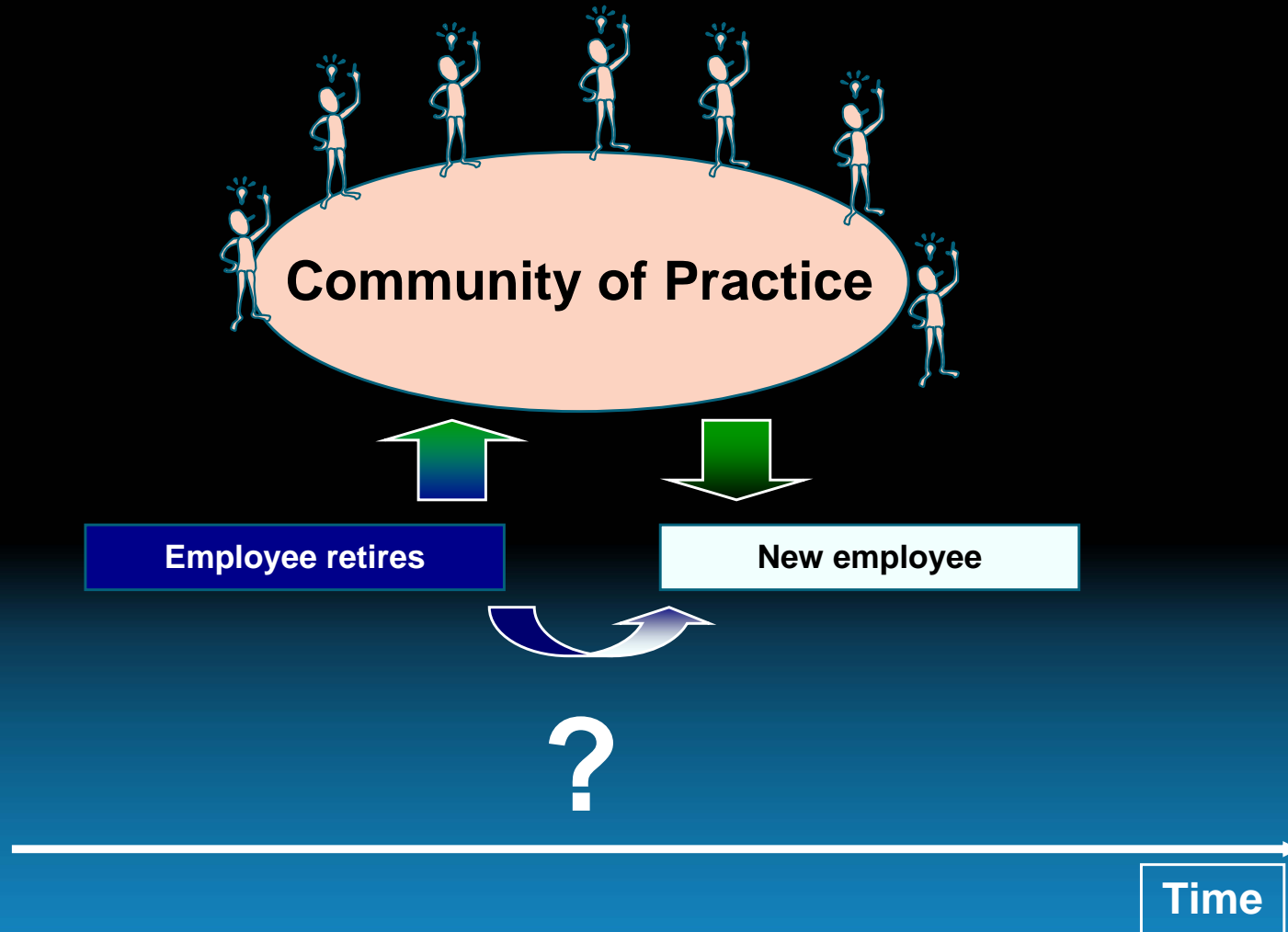
## Compression of Learning Curve





# Community of Practice

Pe





# How much is the profit from KM?

## Dimension

- „There are ~ 250.000 Siemens employees with PCs that are considered as knowledge workers worldwide. They work 230 days a year. If every employee could save only ½ hour (25 €) in daily knowledge work (for instance information retrieval) through better corporation and knowledge sharing Siemens would save about 1.5 billion € a year“ (Vieser, Siemens AG).



# **NUCLEAR KNOWLEDGE MANAGEMENT AND THE IAEA**



# NKM and the IAEA

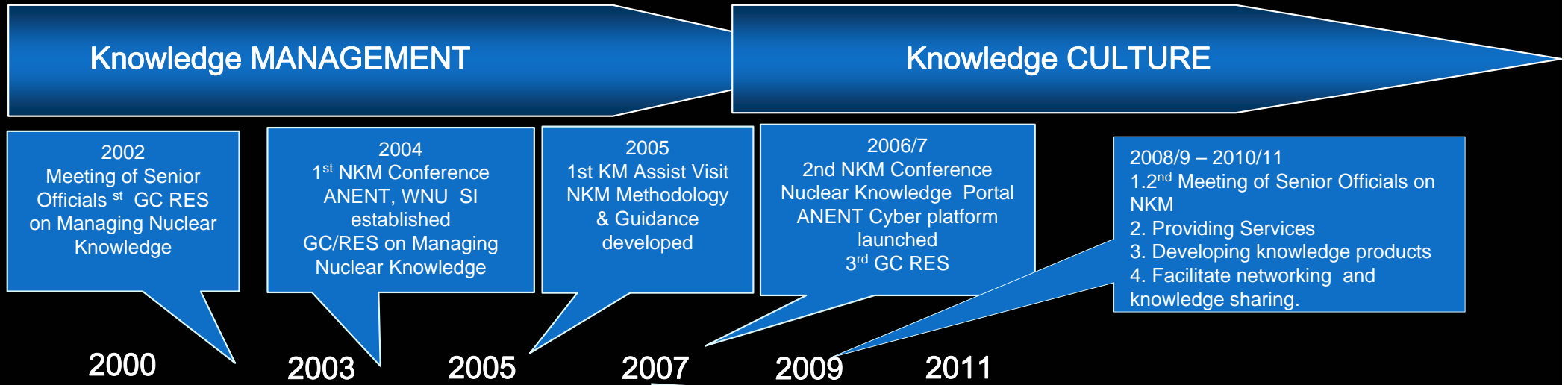
- The Agency is perceived as a resource of information, best practices and expert advice (consultant). Also as an international benchmark for industry and/or regulators
- NKM program provides best practices, services and relevant “knowledge products” to Member states.
- Networking of education and training in nuclear science and technology continues as many countries are interested.
- Training in knowledge management is a key area of activity.
- Analysis and assessment of organizational nuclear knowledge management competence ( **Assist Visits** ) is a unique service provided by the Agency.



# IAEA Knowledge Management Objectives

- To increase awareness in Member States,
- To provide methodology and guidance,
- To support nuclear education and training,
- To implement special projects, provide services and support to nuclear knowledge management initiatives.

# NKM Programme Evolution







# Agency NKM Program Strategy

## Phase 1

1. Develop Methodology and Guidance
2. Facilitate educational networks.
3. Develop pilot projects

## Phase 2

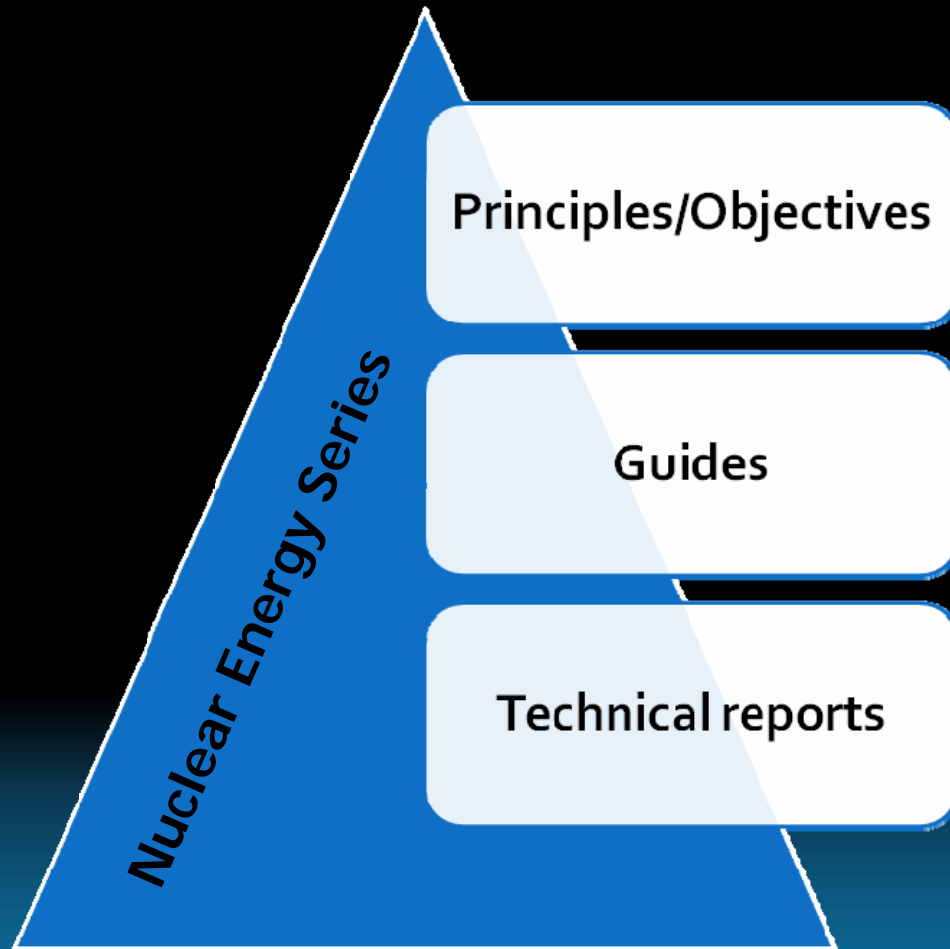
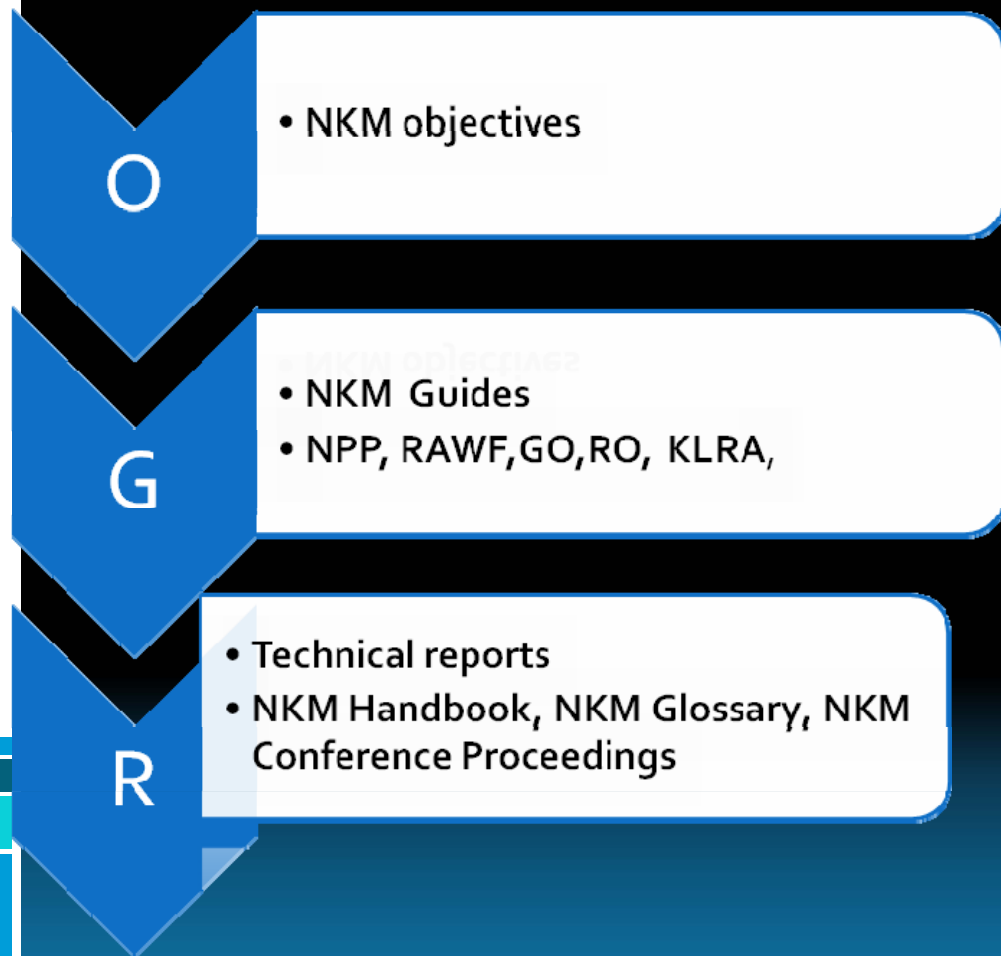
1. Transfer NKM to Member States through workshops, schools, assist visits and TC projects
2. Develop and Implement Cyber Educational Platform
3. Develop Knowledge products

## Phase 3

1. Integrate NKM in Management Systems
2. Promote Nuclear Knowledge Culture in “New start” countries.
3. Integrate educational networks



# NKM Methodology and Guidance



# The ANENT project

## INFORMATION RESOURCES

### *Comprehensive, supporting materials*

Integrates all the Agency's resources

- INIS
- Library
- Training materials
- Nuclear Safety Series
- Nuclear Energy docs.
- National reports
- Others

## CYBER PLATFORM FOR EDUCATION

### *The Cyber Learning Platform*

Provides distance learning courses, Advanced degrees,

Cyber educational materials, etc.

## NUCLEAR DISCIPLINES

### *Programs and Curricula*

Cooperation with: ENEN, EC, UNENE, NTEC, MEPhI, Other Institutes in Member States, Industry

Provision of Educators, Mentors, and Tutors

A bit more complicated

**AGENCY NETWORK FOR EDUCATION IN NUCLEAR TECHNOLOGY**

# Supporting WNU partnership

- A. Strengthening University Curricula
- B. Developing Future Leaders
- C. Ensuring Security in Global Nuclear Energy Systems
- D. Training to Enhance Industry Operations
- E. Sharing Advances in Nuclear Science
- F. Improving Secondary School Introductions to Nuclear Technology

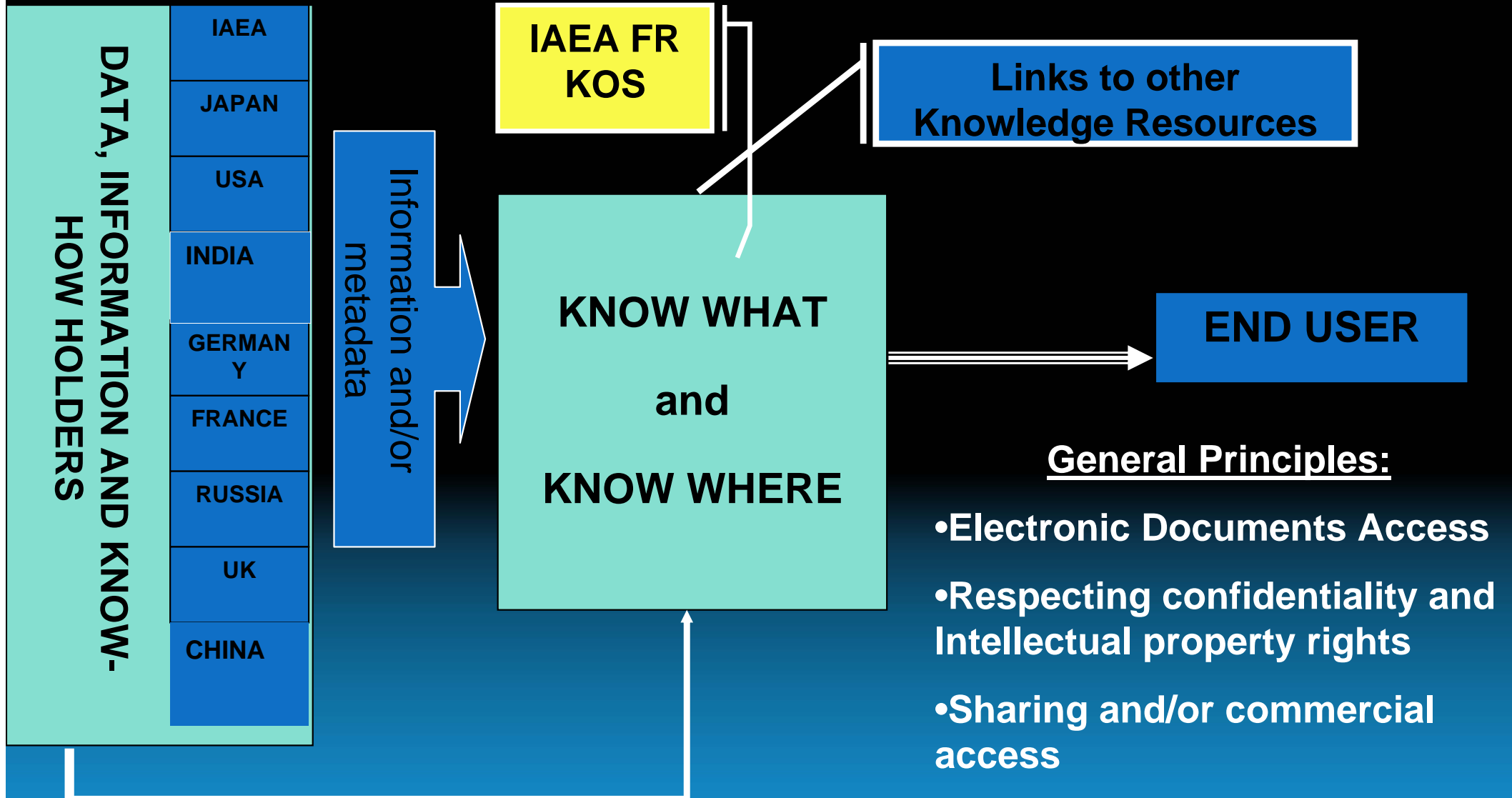


# Implementing NKM Assist Visits

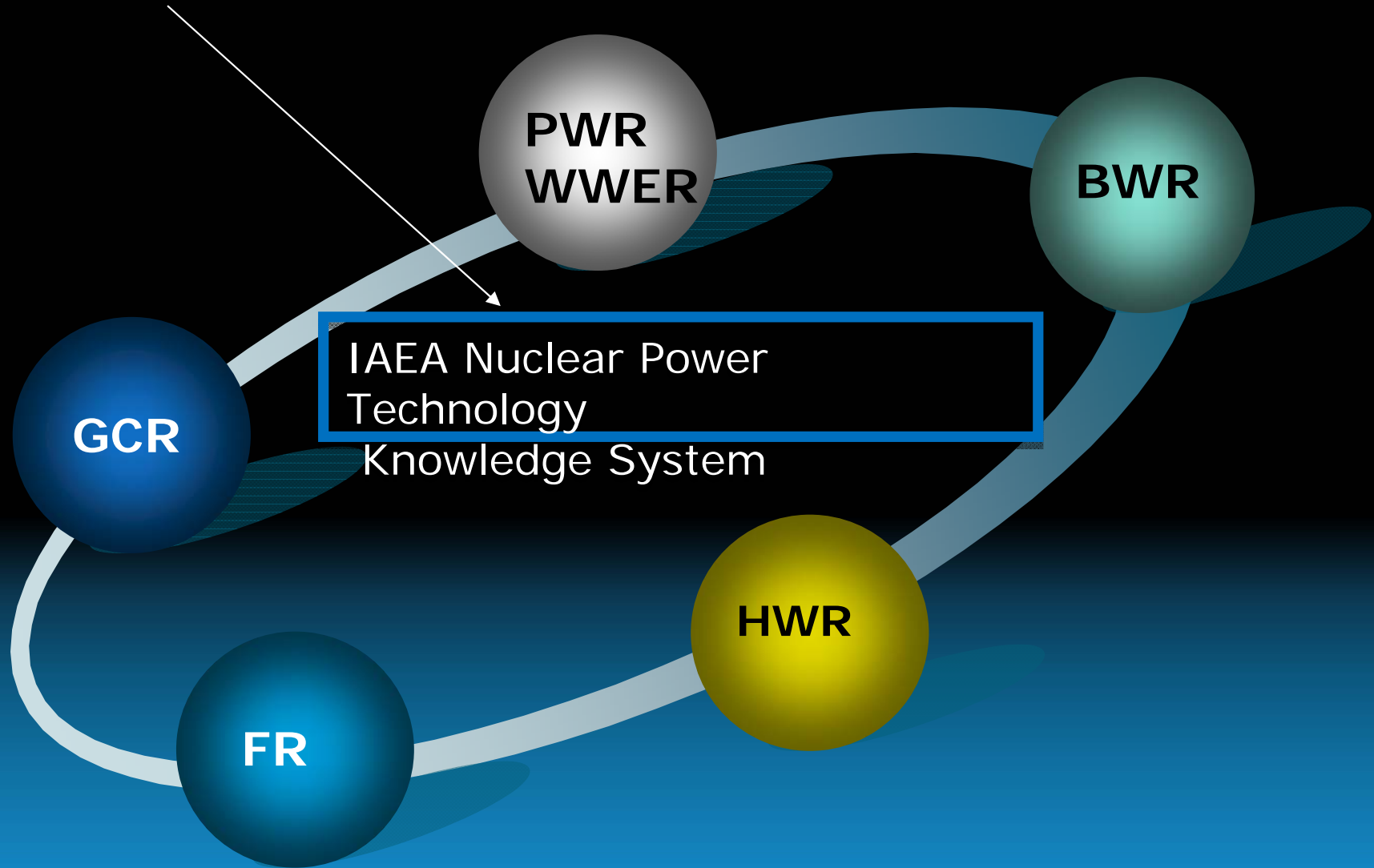


- ❖ Evaluation of organizational NKM elements,
- ❖ Analysis of organizational needs for NKM,
- ❖ Support in developing a Strategy for NKM,
- ❖ Assistance in methods and tools for NKM,
- ❖ Risk assessment of knowledge loss.

# Fast Reactors Knowledge Organization System

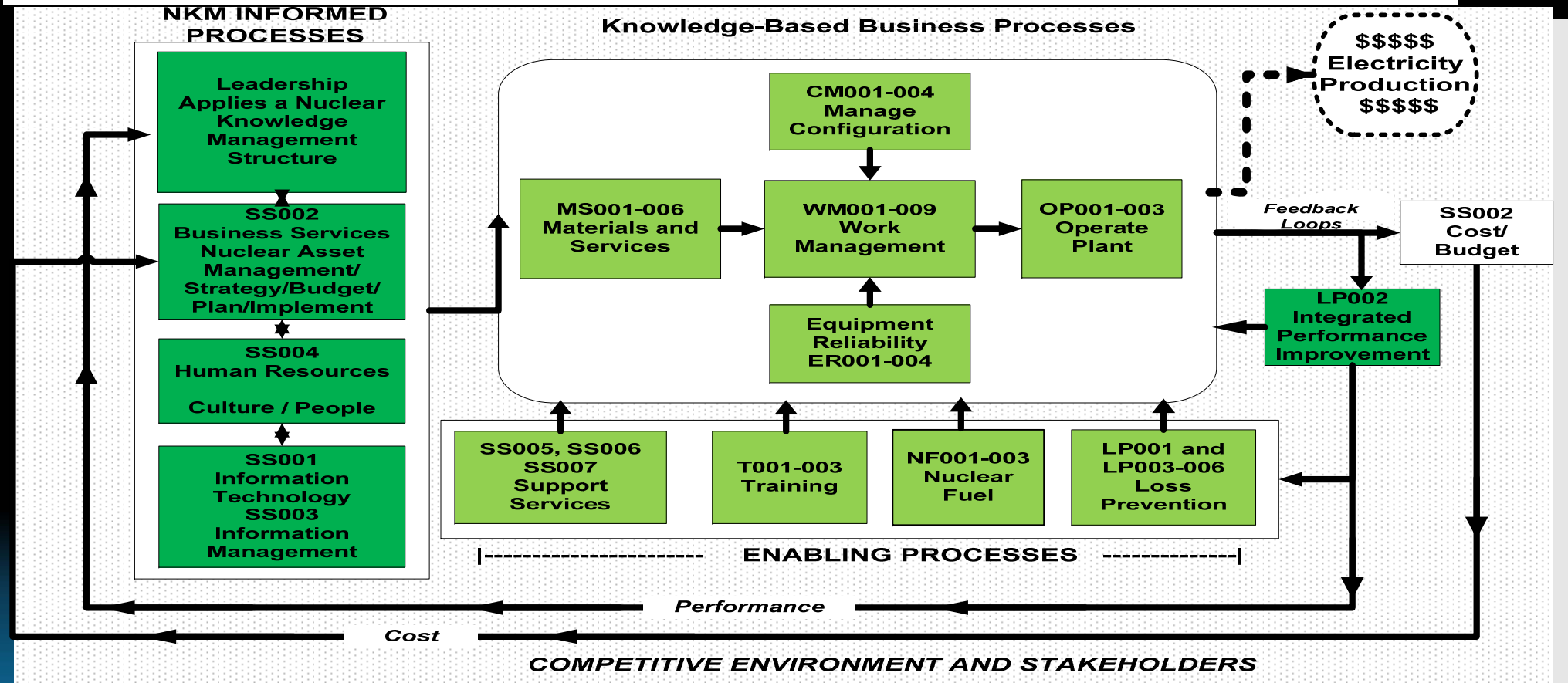


# Future Opportunities



# NKM and NPP Performance

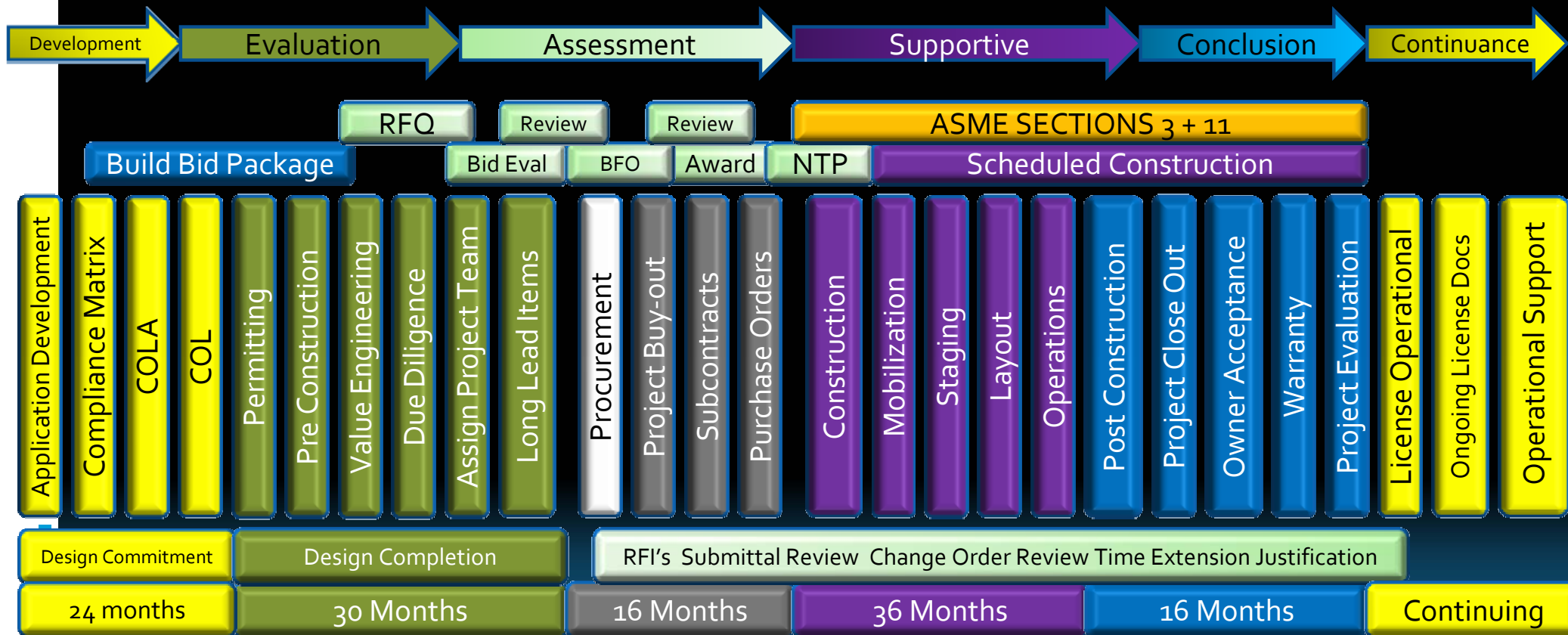
## How NKM Affects the SNPM





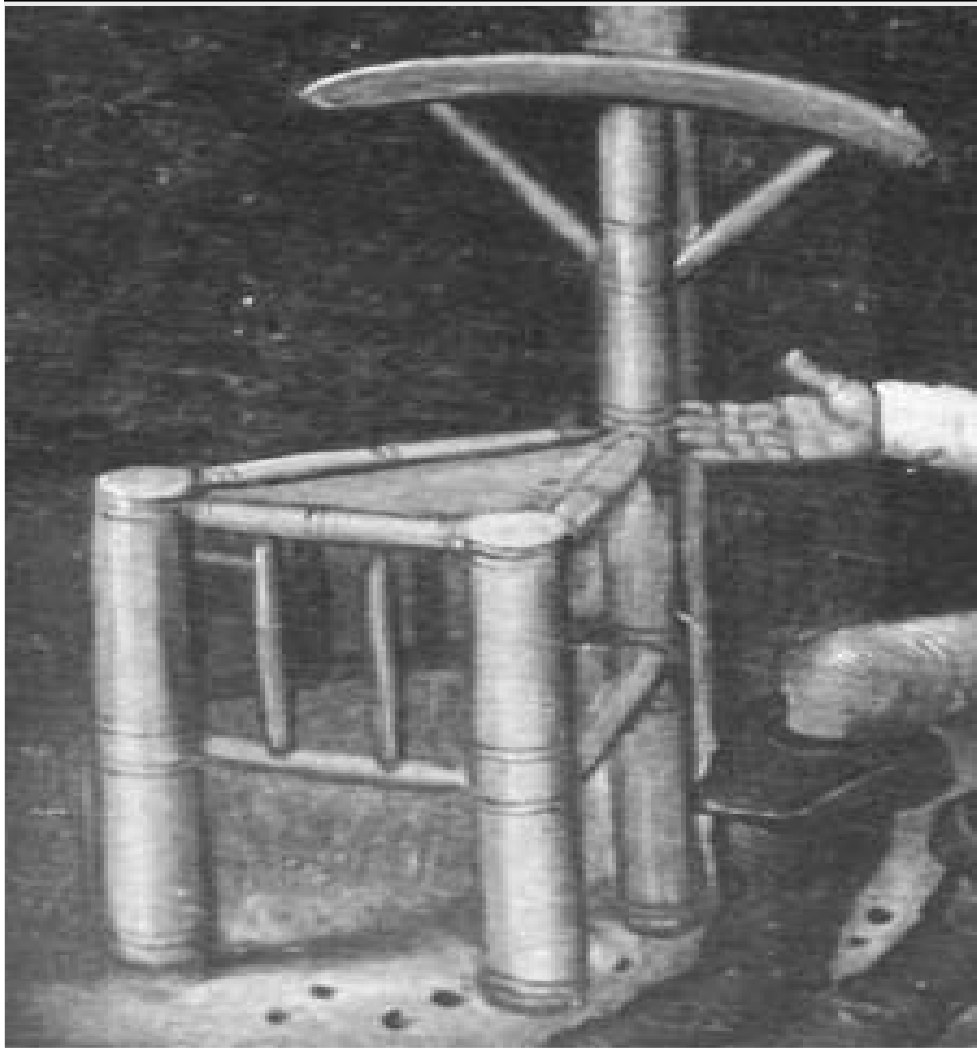


# Future Opportunities



## Construction Oversight Knowledge Management Tool for new build NPPs

# The three legs of the chair...and Nuclear Energy



Pieter Breughel the Younger

- 1. Society must be convinced in the benefit of nuclear energy.**
- 2. Nuclear Technology should be used responsibly.**
- 3. Nuclear Knowledge must be sustained and further developed.**

# It is our responsibility!

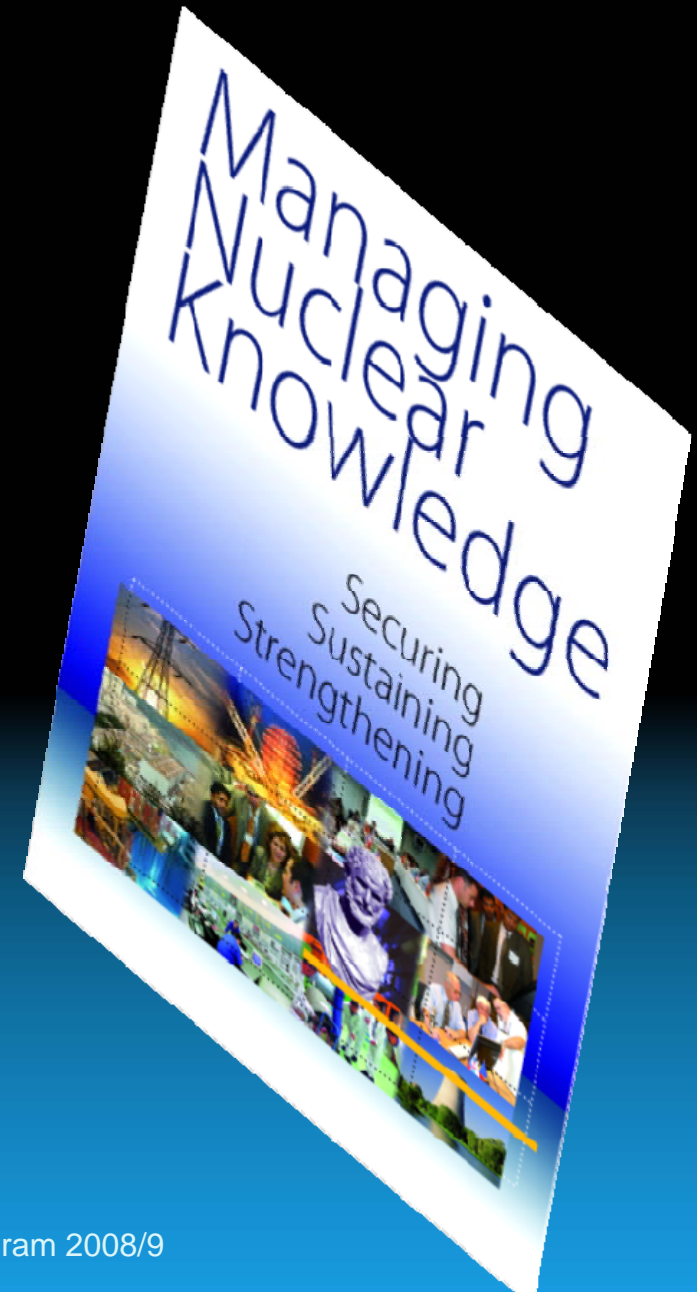


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## Concluding remarks...

- 'Nuclear knowledge management ... has to be sustained. ... **Complacency is the enemy of any robust knowledge system.** We have to be forever diligent to sustain the nuclear knowledge systems we put into place.
- Nothing ever works on its own. It always has to be managed.'





**“The wicked leader is he who the people despise.**

**The good leader is he who the people revere.**

**The great leader is he who the people say, ‘We did it ourselves.’”**

**Lao Tsu, Chinese philosopher**



- Presentation provided by

Nuclear Knowledge Management (NKM) Unit,  
INIS&NKM Section,  
Department of Nuclear Energy,  
International Atomic Energy Agency

<http://www.iaea.org/NuclearKnowledge/>

***THANK YOU VERY MUCH!***