NEA
NUCLEAR ENERGY AGENCY

NEA Policy Brief

November 2019

More information at: www.oecd-nea.org/nest

Knowledge management in the context of an ageing workforce

- As the current nuclear workforce ages, concerns are arising over skills requirements and transferring knowledge to the new generation of experts and staff. A key issue is the loss of tacit knowledge accumulated by those who have long experience in the nuclear industry.
- The best way to transfer knowledge to young people is to expose them to challenges through working on new projects, creating a continuity in the knowledge path.
- The management of critical knowledge concerns all sectors of the nuclear organisations (suppliers, utilities, regulators and all levels of the nuclear workforce).
- There exists a need to maintain a critical mass of nuclear activities at the national level to retain knowledge without discontinuity.

What's the issue?

Knowledge is a vital asset without which no organisation can operate safely or economically. The nuclear sector has reached maturity; it is staffed by experts and employees who have been working in the field for decades. As a growing number of high-level nuclear experts in NEA member countries retire, replacing the experience and expertise lost is a growing concern. This problem is compounded by the dwindling number of recent graduates in the field in many countries, and declining investments in nuclear R&D between 1974 (74% of total energy R&D investment) and 2017 (19%) (IEA, n.d.). The result is a potential knowledge and competence loss if organisations do not put in place the appropriate programmes and measures to preserve, manage and transfer knowledge to the next generation.

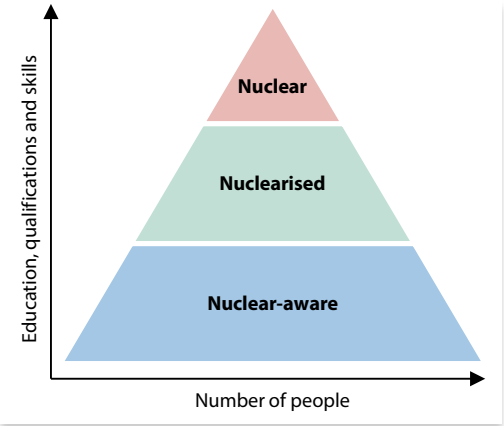
Preventing future skills shortages and gaps means ensuring a sustainable continuum of nuclear knowledge and expertise. The holders of innovative knowledge and expertise developed these by confronting challenges and having breakthroughs. There exists a need to develop competences and preserve knowledge through new challenges for the developing workforce. Each organisation must become a sustainable knowledge organisation, by establishing programmes to develop a trained and skilled workforce. The NEA Nuclear Education, Skills and Technology (NEST) framework was established to help member countries address these workforce needs.

Why is this important?

Nuclear education and skills development are fundamental to building a healthy and knowledgeable workforce. Many NEA member countries are reporting their concern that a growing proportion of the high-level nuclear experts are retiring, while the number of recent graduates in the field who are able to replace them is decreasing. Another issue lies in harvesting tacit knowledge that cannot be easily codified and stored, because it is based on personal experiences. A large share of this knowledge is held by experts nearing retirement. Thus, the knowledge accumulated by this highly qualified workforce could be lost, making nuclear activities more difficult and more expensive, and raising questions about the ability of nuclear organisations to conduct nuclear operations safely in the coming years.

The competencies required by the nuclear workforce have sometimes been described through a pyramid, where the nuclear workforce is classified based on its level of education and skills.

Figure 1. **Pyramid of competencies and skills for the nuclear industry workforce**



Source: NEA, 2000.

At the top level of the pyramid shown in Figure 1 is the most highly qualified workforce, which has accumulated unique experiences and knowledge that cannot be stored in books or procedures. Managing this knowledge involves not only training and educating the new workforce, but also reconsidering the existing knowledge-management transfer strategies.

The **middle and bottom levels of the pyramid** in most countries benefit from on-site training. The issue here is how to harmonise qualification processes, and facilitate workforce mobility across sectors and countries to enhance and diffuse knowledge.

In countries with developed nuclear programmes, industries and nuclear operators drive the development of the nuclear sector and are able to tackle the gaps in some specialist areas, such as safety and operations. Countries who are embarking in a nuclear energy programme, on the other hand, lack the expertise to establish and run nuclear operations. These difficulties are compounded by a scale effect: manufacturing capabilities need a critical mass of activities to meet the requested level of quality and performance. Hence, countries with limited nuclear programmes will face more difficulties in recruiting and retaining experts, compared to countries with very large programmes.

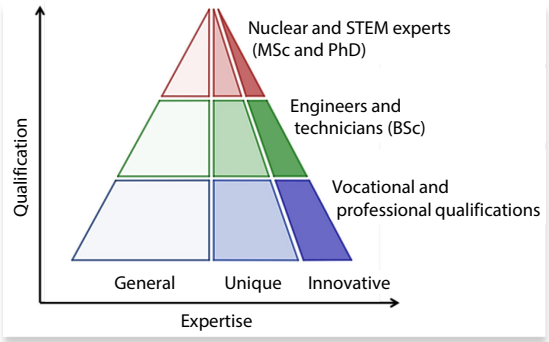
In countries where industry has established a talent pipeline through relationships with universities and enhanced on-site learning, it is necessary to optimise workforce efficiency rather than train the workforce, possibly by harmonising the qualification process and facilitating workforce mobility across countries and sectors.

How can the NEA help?

The NEA contributes significantly and continuously to preserving and transferring explicit knowledge in fields such as nuclear science, radioactive waste management and radiological protection. NEA activities conducted by working parties and expert groups provide considerable value in gathering the knowledge, data and experience accumulated by NEA member countries, and transforming them into explicit and transferrable knowledge.

The NEA has been developing the NEST framework to advance the expertise, skills and human capacities that member countries feel are necessary. It does so by exposing early-career researchers to challenging projects and real-world problems through hands-on training. This will not only promote the transfer of knowledge from the older generation of nuclear experts, but will also support the enhancement of a knowledgeable and skilled workforce who could become the next generation of nuclear leaders and experts.

Figure 2. **Nuclear workforce pyramid by qualifications and expertise**



What should policy makers do?

The policy actions to be undertaken at the national level depend on the needs and requirements of different countries and stakeholders, based on the local context and national policies.

Factors to be considered at the **national level** include the level of development of the nuclear sector in the country (embarking, advanced or phasing out); the country's increasing or decreasing nuclear use; and the size of the country's nuclear energy capacity. In countries with a large nuclear programme, the needs encompass all the levels of the skills pyramid. In countries with a small or vanishing nuclear programme, there exists a need to keep workforce competencies alive to address challenges such as reactor operation, decommissioning of facilities, waste management, and staying at the forefront of research and innovation.

Factors to be considered at the **organisational level** include the lack of graduates; the lack of skills; workforce retirement; the need to preserve and transfer knowledge to individuals; and the need to enhance knowledge flow within and among organisations.

To identify the people most affected by the loss of knowledge and suggest appropriate mitigation measures, the workforce needs to be categorised not only in terms of qualifications (Figure 1), but also in terms of their expertise (Figure 2). Thus, policy makers need to reconsider the skills pyramid, not only along horizontal lines, but also considering expertise along vertical lines: general; unique; innovative.

General tasks and procedures (left column) are explicit; the knowledge required to perform them is acquired through education and training. No specific issue has been identified in this context, apart from a better use of human resources.

Unique competencies and expertise (middle column) are obtained through education and experience; they are tacit and difficult to transfer. With declining activities in the nuclear sector in many OECD countries, developing and preserving this knowledge may entail sharing expertise and promoting workforce mobility towards countries that are still developing their nuclear activities.

Innovative knowledge (right column) permeates all levels of the pyramid, and is acquired by experiencing and solving challenges. The innovative workforce can solve complex problems, create new knowledge and develop new products.

The main challenge in knowledge management is harvesting tacit knowledge based on the personal experience of those at all levels of the skills pyramid. The innovation cycle in the nuclear sector is 20-30 years. There exists a real and pressing need to preserve the knowledge of those who participated in nuclear development – the keepers of nuclear knowledge who currently support governments, corporations and regulators.

Further reading

IEA (n.d.), Energy Technology RD&D, www.iea.org/statistics/rdd (database).

NEA (2012), *Nuclear Education and Training: From Concern to Capability*, OECD Publishing, Paris.

NEA (2000), *Nuclear Education and Training: Cause for Concern?*, OECD Publishing, Paris.