Knowledge for the future – Time eats information

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Long-term technologies

The need to pass knowledge on to future generations is not unique to radioactive waste management. Think, for instance, of chemical waste, space debris, the location of land mines, or the genetic code of manipulated organisms, etc. (Kornwachs and Berndes, 1999). In all these cases we have to handle the impacts and effects of technologies over the long term. The time frame of these effects surmounts the lifetime of one generation and more. In order to enable future generations to handle this precarious legacy we need to hand on suitable information. However, this is not enough; we have to facilitate the understanding of the very meaning of this information, too (Kornwachs, 2008; Sebeok, 1984, 1990). This can be referred to as a "wicked problem", since the legacy of the nuclear age is distributed all over the world and huge amounts of wastes have been accumulated. There is not yet any solution available which could reduce the half-life of nuclear waste on a large industrial scale (Acatech, 2014).

Time eats information

Information is constantly decaying, e.g. due to copy processes and the limited lifetime of information carriers such as paper, chemical, electronic and nano-storage technologies. For time frames greater than 1 000 years none of the present technologies seems to be long lasting enough or effective by itself. It can be shown that no presently known information and communication technology (ICT) can preserve written or electronically stored information over 4 000 years, say (Kornwachs and Berndes, 1999). The preservation effort would have to include the reception, deciphering, and the semantically correct understanding. The decay of information entails the decay of knowledge. This leads to a decrease of possibilities to act. However, we and future generations need this knowledge (including the basics of physics and relevant technology) in order to be able to take action in the future. This task is still unresolved, both for nuclear waste management and for other issues (Jensen, 1993; NEA, 1995; Kornwachs and Berndes, 1996; Hotzel et al., 2014).

Stable organisations

One can only try to pass knowledge on to future generations via institutions. However, an organisational solution via institutions will not be effective, unless we know what kind of knowledge will be important in the future. Thus, selection processes need to be managed. To do so in an effective way, there are three preconditions:

- We have to transfer not only the scientific and technological information, but we also have to ensure that it might be understood in an adequate way.
- We have to collect the information about nuclear waste sites with the help of stable institutions, which are responsible for the appropriate availability of the data.

- The option "bury it and forget it" does not seem to be a reasonable one. All sites should be kept in a reversible mode. If new scientific or technologic findings will become available, one should have the possibility to manage the waste problem under new points of view. Hence, any information handed on should include the reversibility of the relevant technology.

Information is not yet knowledge

To gain knowledge, it is necessary to understand information as a message in a given context; hence context information (language, culture, technology) must be passed on, too.[1] This is not a technical problem of databases. It remains the question how we can organise public education in technology. Information can be transformed into knowledge, when it has been understood (reception, reading, interpretation etc.). This transformation process needs time. Hence, the availability of information is a necessary but not sufficient condition to gain knowledge. Written papers, databases, web pages, and even books, are not enough, because we do need certain pre-knowledge to understand them. Additionally, we need practice and implicit knowledge to understand the information about the nuclear waste legacy. All this must be kept vivid and well trained (Acatech, 2011). This task cannot be substituted by an automated technology but by already existing institutions like universities, academies or libraries with political support by international organisations like the OECD or the United Nations.

The possibility to act in a responsible way

Finally, we need to clarify the ethical foundation of any obligation to future individuals, whom we would force to deal with our technological heritage. We have also to hand on the strong conviction that the dissemination of information about the nuclear waste for each subsequent generation is essential in order to enable knowledge (Ott, 2014; Kornwachs, 2010). There is a simple ethical reason for that: We should not lead future generations into dilemmatic situations in which they cannot act in a responsible way anymore. The least we can do is to keep them informed effectively (Human Interference Task, 1984). The next generation will have the same task, and so on and so on. This can be considered as a kind of induction. Nevertheless, this will be only a necessary condition for them to keep the possibilities open to act in a responsible way today and in far future years.[2] But it is a way to propagate responsibility.

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1. The definition of knowledge is often confused with the term of information. Here, information is defined as something what can be understood. Knowledge is the result of understanding information and of integrating it into already existing knowledge. See Kornwachs (2010).
2. The principle according to which this requirement has been formulated, is: "Act always in a way such that the conditions for the possibility of responsible actions are preserved for all concerned". See also Kornwachs (2000).

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