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The metascientific foundations of nuclear knowledge management

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Abstract

It is noted that achievements by metascience are insufficiently used in the development of the theory of knowledge management including nuclear knowledge. The phenomenon of theory deserves paying special attention because knowledge means the theories mastered by people. There is no such knowledge about subjects and objects, processes or phenomena that would not be the representation of theories. That is why the main provisions of metascience are first disclosed by the author in the present paper and following this they are applied for characterization of 15 important problematic issues of the nuclear knowledge management theory.

Management of intratheoretical concepts, i.e. the principles, laws and variables, is implemented using four methods, namely, deduction, experiment, induction and correction of the original underlying principles. Management of theories is implemented by the use of three methods: problematization, innovation and interpretation. Multiplication of theory management cycles results in the generation of series of interpretative theories. Subject matter of each separate theory is exposed in the composition of the series from the viewpoint of the most well developed concept. Conclusion is made that series of interpretative theories constitute the basic element (unit) of knowledge.

Significant place is occupied in the characterization of outstanding problems of nuclear knowledge management by the correlation between the articulated and practical, as well as between tacit and explicit knowledge. Mechanism is examined for implementation of the discourse leading to the development of the group knowledge. Characteristic is given of the status of competence, skills and hands-on experience of carriers of nuclear knowledge. Approaches to the preservation and development of theories are discussed.

Keywords: Knowledge management; Methods of nuclear knowledge management; Metascience; Series of interpretative theories; Competences.

Introduction

Since 2002 management of nuclear knowledge or, which essentially means the same, administration of nuclear knowledge became one of the priority directions of activities by the International Atomic Energy Agency (IAEA) [1]. Different aspects of the above concept are examined in the series of monograph studies dedicated to the nuclear knowledge management concept (*nuclear knowledge management,* NKM) listed on the IAEA site [2–6] and, in particular, those the methodological aspects of which are of interest for us in the first place [5]. NKM glossary developed within the IAEA framework is opened with the following definition: "Knowledge Management itself is defined as an integrated, systematic approach to identifying, managing and sharing an organisation's knowledge, and enabling persons to create new knowledge collectively and thereby help achieve the objectives of that organisation. Knowledge Management helps an organization to gain insight and understanding from its own experience. Specific activities in knowledge management help the organization to better acquire, store and utilize knowledge" [6, p. 1]. This definition is forestalled with warning that all definitions used in the glossary refer to knowledge management. It is, however, noted that "The following definitions of terms apply specifically to the field of Knowledge Management. It should be noted that identical terms applied to, or used in, other fields may have somewhat different definitions" [Ibidem]. The included elucidation evidences the fact, that nuclear knowledge management is understood as an applied field of knowledge management. However, the well-known collision emerges with this respect. The point is that knowledge management was originally developed as applied to economics.

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All outstanding knowledge managers, in particular, Drucker et al. [7–9] are more inclined towards economic knowledge. Nevertheless, they presented their conclusions using the terminology neutral with respect to different fields of knowledge. As the result the impression is formed that they managed to develop the general theory of management which can be applied, for instance, to the specific field of nuclear technologies. One cannot but doubt the above, especially considering that, as it is demonstrated in [10], conceptual and methodological basis of management as a whole, including knowledge management, evidently requires further specification.

Thus, as of today, inflow of conceptual and methodological currents comes to nuclear knowledge management mainly from the side of general management. However, it can be approached as well from the side of theory underlying nuclear technologies. When experts in nuclear technologies discourse about knowledge management they to this or that extent necessarily take into consideration their special status. Unfortunately, even under such approach to nuclear knowledge management obviously insufficiently thoroughly developed conceptual and methodological foundations of in this case technical science (technicology) including nuclear science let themselves be known [11].

By definition fundamentals of a science constitute the subject of metascience. Thus, fundamentals of mathematics are studied by metamathematics, the founder of which was Gilbert. Unfortunately, as it was demonstrated in the whole series of our monograph studies, due attention is not paid to metascientific studies in each of a couple of dozen fields of science. Taking into consideration the above discussion we will first familiarize the reader in the thesis form with main conclusions of metascience [12] undertaking the commitment that they are applicable to nuclear technological theories. And only after that a number of important present day provisions of nuclear knowledge management will be addressed in the light of these theories.

In order to escape misunderstanding let us note that in the present paper we do not refer to the so-called philosophy of science. Contemporary philosophy of science constitutes part of philosophy represented, first of all, by analytical, hermeneutical and poststructuralist concepts. These concepts are not discussed in the present paper. Metascience, in contrast to philosophy, is not a special field of science.

Main provisions of general metascience

1. Knowledge means the theories understood and accepted by people and nothing else. Notwithstanding in which form knowledge is manifested, for example, in mental or in lingual form, it constitutes representation of a theory.
2. Theory consists of concepts and methods for their management. These concepts include principles, laws and variables. They are necessary for developing conceptual images of subjects, i.e. people possessing knowledge, and objects. Humans are the subjects of nuclear power generation, while objects are, for instance, power generation installations and their equipment. Fundamentals of theories of nuclear technologies are represented, in the first place, by safety, efficiency, reliability, failure-free operation, lifetime, durability, maintainability and serviceability principles. The variables are the measured characteristics of objects and subjects. The laws are the relations between variables expressed in the form of equations or inequations. Thus, for instance, dependence of thermal efficiency factor for power generating installation versus temperature and coolant pressure is the law. In contrast to variables laws and principles are not measurable.
3. Management of principles, laws and variables is implemented by the following four methods: deduction, experiment, induction (data processing) and correction of originally formulated principles. Operations of abstraction and idealization are often used in concept management. These operations are the simplification techniques and usually they are disposed of as the result of the undeviating ascension from more simplified to less simplified description.
4. Theories are managed by the following three methods: problematization (revealing certain obstructions in the old concept), innovation (invention of new theory) and interpretation (old theory through new concept). The developed theory is the key to understanding the theory part of which becomes obsolete. Less developed theory does not allow expressing the full scope of the richer concept. The following two sets of theories are formed in the process of multiple repetition of the cycle of theory management: originally problematic theories followed by interpreted theories, i.e. theories harmonized under the aegis of the most developed theory.

Problematic set of theories is following: $T_1(p_1) \rightarrow T_2(p_2) \rightarrow T_3(p_3)$, where T_i is the denominator of the theory and p_i is the denominator of the problem.

Interpretation set of theories is following: $T_3 \rightarrow T_2\{T_3\} \rightarrow T_1\{T_3\}$, where $\{\}$ is the denominator of the interpretation. Record $T_2\{T_3\}$ means that the scope of theory T_2 is interpreted from the viewpoint of theory T_3.

Knowledge is decisively harmonized using series of interpretative theories. Let us illustrate the above using the example of electrodynamics, where in succession theories initially by Maxwell, and then by Einstein and Dirac form the series of problematic theories. Dirac's theory allows correcting the scope of theories by both Einstein and, as well, by Maxwell. As the final result the series of interpretative theories, namely, the Dirac-Einstein-Maxwell electrodynamics, appears.

Obviously, harmonization of knowledge takes place, as well, in the field of nuclear technicologies. Let us assume that theories of light-water, as well as alkali and heavy liquid-metal coolants are examined. It is clear that one will have to do with a relay of three types of theories, in particular, theories related to sodium–potassium or to lead–bismuth coolant. Pace of problematic theories allows revealing and explaining shortcomings of original theories. As the final result

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