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Dynamical assessment for evolutions of Atomic-Multinology (AM) in technology innovation using social network theory

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ABSTRACT

The technology evolution is investigated. The proposed Atomic Multinology (AM) is quantified by the dynamical method incorporated with Monte-Carlo method. There are three kinds of the technologies as the info-technology (IT), nano-technology (NT), and bio-technology (BT), which are applied to the nuclear technology. AM is initiated and modeled for the dynamic quantifications. The social network algorithm is used in the dynamical simulation for the management of the projects. The result shows that the successfulness of the AM increases, where the 60 years are the investigated period. The values of the dynamical simulation increase in later stage, which means that the technology is matured as time goes on.

1. Introduction

The technology assessment is performed by the dynamical analysis. Newly introduced technology trend in nuclear industry is investigated for the evolutions of the Atomic Multinology (AM) (Woo, 2010). Social network theory has been accounted for the several kinds of social relationships in the interested group, organization and industry. Following the industrial challenges for the better profit creations in the nuclear industry, global nuclear communities have focused on how to make the renaissances in the nuclear power plants (NPPs) marketing. The 21st century style R&D trend as nano-technology (NT), info-technology (IT), and bio-technology (BT) has showed the light on the clue of solving the matter in the stagnated industry.

Social network is one of important tools to make the analysis in the social relationships which is interpreted by the statistics. The appearance of new social phenomena related to the internet (Social Media, Collaborative Filtering, Social Tagging, etc.) whose interactions can be captured in large databases and the tendency of social scientists to move towards the formulation of simplified models and their quantitative analysis, have ushered in an era of scientific research in the field of Social Dynamics (Lazer et al., 2009).

One of important characteristics is interdisciplinary R&D in this 21st century. The major factors are NT, IT, and BT. This paper investigates on the nuclear industry. The social popularity of the new industry promotion is useful to make the management for the new field of the technology. Currently, 436 NPPs are operating in 2009 which is in Table 1. Therefore, these NPPs are the object of the application using the interdisciplinary technologies in this work, where the conventional nuclear technology has focused on the NPPs related areas. Some concepts of the modeling are to evolution of AM which is classified in Table 2. The trend of the industrial progress is shown in Fig. 1. AM is expected to be developed like this procedure in the initial stage of the academic aspect. Fig. 2 shows the combination of three kinds of different technologies.

Historically, the NT was initiated for the new technology innovation in 1990s as the National Nanotechnology Initiative (NNI) which has promoted to be applied in the wide ranges of science and technology. It is considered that the pursuit of the promotion is to make the better efficiency in the variety of fields. Basically, the IT has been represented by the computer and its applications. The IT, macroscopically, has encompassed a variety of aspects of computing and technology, which is to transmit, convert, process, store, and protect. Similarly to NT, it examines on the nuclear industry with the NPPs. Finally, the BT has been developed in the areas of the biology, medicine, agriculture, and food science. The United Nation defined any technological application that uses biological systems, dead organisms, or derivatives thereof, to make or modify products or processes for specific use (United Nation, 1992).

The nuclear industry has the stagnation in promoting the NPP constructions due to the long-period continued anti-nuclear mood. Especially, there were several serious accidents of NPPs in Three Mile Island (TMI), Chernobyl and Fukushima. The conventional

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Table 1
World nuclear power generation units (Nuclear Energy Institute, August 2009).

Country	Number of unit	Country	Number of unit
Argentina	2	Mexico	2
Armenia	1	Netherlands	1
Belgium	7	Pakistan	2
Brazil	2	Romania	2
Bulgaria	2	Russia	31
Canada	18	Slovakia	4
China	11	Slovenia	1
Czech RP	6	South Africa	2
Finland	4	Spain	8
France	59	Sweden	10
Germany	17	Switzerland	5
Hungary	4	Taiwan, China	6
India	17	UK	19
Japan	53	US	104
Korea Rep.	20	Ukraine	15
Lithuania	1	Total	436

Table 2
Basic concept of modeling.

Classification	Contents
Initiations	• R&D promotions in the nuclear industry • Solving stagnation of nuclear industry
Methods	• Applications using Info-Technology (IT), Nano-Technology (NT) & Bio-Technology (BT) • New classification from the conventional academic sorting system
Tool	• Social network theory
Goals	• Advanced energy management construction

Fig. 1. Procedure of the new industrial field.

classification of the nuclear industry has the limitations to be adapted in the 21st century style technology where the IT, NT, and BT are applied in the broad wide industries. Therefore, it is necessary for the classical nuclear industry to make use of this new technology concept. Since the linear algorithm can show just the exact feature where the uncertainty of the future event cannot be seen well, the non-linearity of the social network could make the future expectation comparatively easily. The basic concept of the hypotheses is shown Table 2.

The applications of the atomic multinology are shown as new classifications (Woo, 2010). That is, the info-technology includes

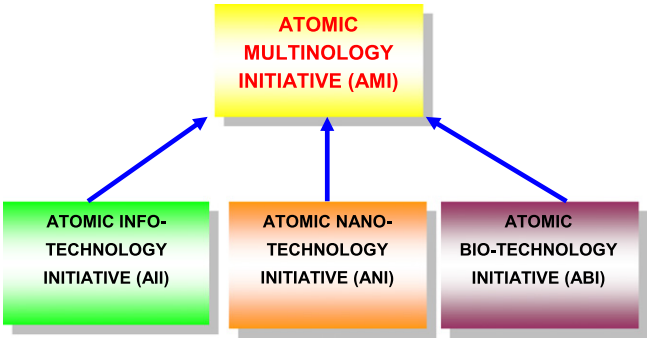

Fig. 2. Strategy for the Atomic Multinology Initiative (AMI).

the nuclear reactor theory and nuclear safety analysis where the computing technology is a key factor. The speed and memory quantity in the computing are considered in the improved technology. For example, the supercomputer could make the molecular level dynamics calculation of the fuel element for neutron behaviors. This is basically comparative from current calculation of probability based transport equations of neutrons. Also, the telecommunication technology can enhance the control system of the NPPs site. The control room could be controlled by the remote worker with the long-range control system like applications of the current tablet computer like the iPad of Apple Inc. In addition, the nano-technology can be applied to nuclear material, nuclear chemistry, and nuclear thermohydraulics. This area has been developed very fast. Nanoscale material is very popular in the industry where the molecular level investigation in radiation and material interaction is used for the advanced applications. Nano-fluid is under development for the industrial field. The bio-technology is applied for the cancer treatments using radiation. Additionally, the robot technology is used of the substitutions with human workers in the high radiation dose area in NPPs in which the biological mechanics and artificial intelligence technologies are important matters.

There are several studied for the social networks in the nuclear energy. Zijlstra showed the network of interlocking directorates as a part of public policy analysis of nuclear energy policy in the Netherlands (Zijlstra, 1978–1979). In addition, the applicability of the social network analysis (SNA) technique to identifying the characteristics of crew communications was investigated in the study (Park, 2011). Also, Marktanner et al. studied one important and under-researched aspect of nuclear energy refers to the trade-off between socio-economic development and political power conservation (Marktanner and Salman, 2011). Section 2 explains the method of the study. The calculation for the modeling is shown in Section 3. Section 4 describes results of the study. There are some conclusions in Section 5.

2. Method

It has been thought that people have used the idea of social network loosely for over a century to connote complex sets of relationships between members of social systems at all scales, from interpersonal to international. In 1954, J.A. Barnes started using the term systematically to denote patterns of ties, encompassing concepts traditionally used by the public and those used by social scientists: bounded groups (e.g., tribes, families) and social categories (e.g., gender, ethnicity). Scholars such as S.D. Berkowitz, Stephen Borgatti, Ronald Burt, Kathleen Carley, Martin Everett, Katherine Faust, Linton Freeman, Mark Granovetter, David Knoke, David Krackhardt, Peter Marsden, Nicholas Mullins, Anatol Rapoport, Stanley Wasserman, Barry Wellman, Douglas R. White, and Harrison White expanded the use of systematic social network