Session 3: Examples of good practice for the use of information and communication technologies

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After the discussion on the questions: “What is knowledge?” and “What is knowledge science?” we briefly introduce a systems methodology for knowledge integration and creation. Then, we present mathematical modeling techniques to express and manage human knowledge that is essentially vague and context-dependent. Finally, we consider the main theme on the role of information technology in knowledge integration and creation.

Definitions of knowledge range from the practical to the conceptual to the philosophical, and from narrow to broad in scope. For instance, knowledge is organized information applicable to problem solving, knowledge is information that has been organized and analyzed to make it understandable and applicable to problem solving or decision-making, or, knowledge is reasoning about information and data to actively enable performance, problem solving, decision-making, learning, and teaching. These definitions require clear distinctions between data, information, and knowledge. Several authors try to distinguish them. Other authors define typologies of knowledge, for instance, Nonaka and Takeuchi suggest that the conversion from tacit to explicit knowledge and vice versa is crucial in knowledge creation.

We consider the deference between information and knowledge simply, but consider deeply the power or ability to convert from one to another, which is the ability to understand and learn things, or the ability to think and understand things instinctively or automatically. This consideration suggests that what we should do research by the name of knowledge science. This consideration also suggests the basic elements of knowledge science, which are people, information, and system. These are hints on developing a systems methodology for knowledge creation. Creation means here that it is performing new combination of a material group, and it is realized by a certain fixed procedure rather than by a mystical leap. There is the sound "a completely new thing" in the word "creation." However, it is
big peacefulness to accept this definition for the human being who is not God.

The developing system can be called a knowledge-creating system. The system integrates statistical data and individual persons’ fragmentary knowledge, and then creates new knowledge nobody had before. Such knowledge must be tacit, otherwise someone including the system had it; this is a contradiction. Therefore, the system should have a process to convert tacit knowledge into explicit knowledge. This means that the members of the project or relevant people constitute a part of the system. This systems methodology itself is a system consisting of five subsystems, which are called intelligence, imagination, involvement, integration, and intervention. First three subsystems correspond to scientific, information, and human dimensions, respectively, in knowledge creation. Intervention coordinates these subsystems by taking into account confronted concrete problems, and integration manages knowledge provided by the above three subsystems, and produces systemic knowledge.

In the scientific dimension of knowledge creation, one of the most important activities is mathematical modeling based on existing data. Here, we think that the so-called context model is the most promising, which can be converted into a rule-based model often used in the field of artificial intelligence. Knowledge of people is subjective, ambiguous, and vague in addition to circumstantial. To deal with these properties, we are developing an ensemble modeling technique, which provides the tendency of people’s opinions and at the same time their diversity. This is achieved by extending the traditional multivariate statistical analysis, such as factor analysis or regression analysis, utilizing the fuzzy modeling technique. This ensemble modeling is useful to analyze complex feeling of people in total and to support, for instance, merchandise planning, city planning, or any social decision-makings.

We then consider the role of information technology in knowledge integration and creation. By introducing the activities in the School of Knowledge Science, Japan Advanced Institute of Science and Technology, we present the state-of-the-art of management of increasing information volumes, standards for knowledge engineering and management, and new approaches to information collection and storage. Finally, we mention the possibility of a strategic global database related to the global environmental issues, which we are developing in cooperation with
the National Institute for Environmental Studies, Japan.

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