

Title	JAIST-COE News Vol.4 No.4
Author(s)	
Citation	
Issue Date	2008
Type	Others
Text version	publ isher
URL	http://hdl.handle.net/10119/4740
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Description	Winter, 2008

On Social and Technological Innovations from Knowledge Science

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School of Knowledge Science

The objective of the School of Knowledge Science at Japan Advanced Institute of Science and Technology is: *From the standpoint of knowledge creation as an activity of nature, the individual, organizations and society, to proceed with the creation of an academic discipline that integrates art and the sciences, to perform education and research in an excellent research and education environment on the mechanisms of the creation, accumulation and practical application of knowledge, and to produce researchers and skilled professionals who possess the advanced knowledge, applied skills, broad vision, accurate powers of judgment and advanced communication skills to lead the information society of the future.* (The JAIST Charter, Chapter 9, Article 9-2)

The School of Knowledge Science is original to Japan; it researches “knowledge” and as such has no parallel anywhere in the world. Ours may be the first school in the world to engage in knowledge management research by means of systematic knowledge creation theory and information technology, and it leads the world in research into knowledge creation theory. It was a trailblazer in starting education for working professionals in “management of technology” and “regional revitalization systems” in order to nurture the pioneers of the knowledge-based society, and such activities have made it the leader in educational activities in this area. In the current 21st Century COE Program¹ the research area has been expanded

from the initial knowledge management in the field of business administration at the time the School was founded to include technological innovations in the field of technology development.

The 21st Century COE Program

In the current 21st Century COE Program: “Technology Creation Based on Knowledge Science”, we have aimed to extend the scope of knowledge management research from the field of management and organizational theories to include technology development. Initially the overall development of knowledge science was planned however, based on the interim assessment that a focus was required, and activities to shape the COE were focused on “innovation research and education.” Post-doctoral researchers and students in the Doctoral Program were given training in trans-disciplinary projects between the School of Knowledge Science and the School of Materials Science and courses to train coordinators.

The Integrated Science and Technology Course was established for the sake of students promoting interdisciplinary research (for masters and doctoral students throughout the university, and for regional business people at the Kanazawa campus). The students on this course are attached to one of the schools to do research on a main theme, researching a secondary theme in one of the other schools. 60~70% of the coursework is for the school in which they are enrolled, with 30~40% for the school of their secondary theme. The first batch of 3 students completed the course in September 2007, and 8 students are currently enrolled. Every year 15~20 local business people are trained at the Kanazawa campus as non-degree students.

academic environment among Japanese universities by giving targeted support to the creation of world-standard research and education bases (centers of excellence). By thus raising the standard of both education and research at them, the program seeks to elevate Japanese universities to the world’s highest echelons, while fostering people of talent and creativity who will be qualified to assume roles as world leaders.

¹ 21st Century COE: Based on a MEXT (Ministry of Education, Culture, Sports, Science and Technology) report entitled “A Policy for the Structural Reform of Universities,” this program was established in 2002 to cultivate a competitive

Cross-disciplinary projects on the following research themes have been promoted by the faculty staff and students of the School of Knowledge Science and the School of Materials Science:

- ◆ Innovation in Mature Industries;
- ◆ Knowledge Creation Activities Backed by Research Philosophy;
- ◆ Knowledge Representation Techniques for Coordination;
- ◆ Laboratory Knowledge Management; and
- ◆ Laboratory Management Using Mobile Blog Albums.

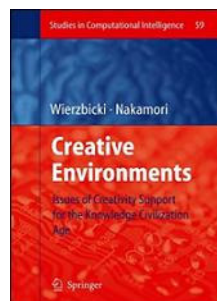
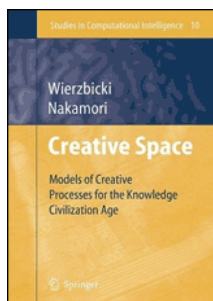
Their research results are open to all students in relay lecture form in the Integrated Science and Technology course's Interdisciplinary Communication Theory.

In addition research into the infrastructure of knowledge science has been promoted by the teaching staff and post-doctoral researchers of the Center for Strategic Development of Science and Technology, as well as the research assistants employed at the Center, in the following project:

- ◆ Evaluation of Knowledge Creation Models and Knowledge-Creation "Ba"²

The books expand Nonaka's Organizational Knowledge Creation Theory and expand the Theory of Creative Space to make it applicable to wider research activities. The second book below is a compilation of project members' research results:

- ◆ Wierzbicki, A.P., Nakamori, Y., *Creative Space: Models of Creative Processes for the Knowledge Civilization Age*, Springer Verlag, Berlin-Heidelberg, 2006.
- ◆ Wierzbicki, A.P., Nakamori, Y. (Eds.), *Creative Environments: Supporting Creativity for the Knowledge Civilization Age*, Springer Verlag, Berlin-Heidelberg, 2007.

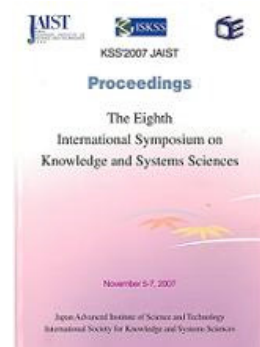


² Nonaka et al. called the dynamic context which is shared and redefined in the knowledge creation process "Ba", which does not refer just to a physical space, but includes virtual spaces based on the Internet, for instance; and more mental spaces which involve sharing experiences and ideas. They claimed that knowledge is not something which can exist independently; it can only exist in a form embedded in "Ba", which acts as a context that is constantly shared by people. See I. Nonaka, R. Toyama and N. Konno: SECI, ba and leadership: A unified model of dynamic knowledge creation. Long Range Planning, Vol.33, pp.5-34, 2000.

Furthermore, a "Social Innovation" project was set up, from academic year 2006 a lecture course on "Regional Revitalization System Theory" was established in the Integrated Science and Technology course in collaboration with the Cabinet Office, and we embarked on an attempt to solve problems in regional communities using knowledge science techniques as well as scientific technology and information technology. In addition, research carried out by faculty staff/students and working professionals/business people based on the university-government collaboration agreement with Nomi City and Kaga City is bearing fruit (for example, nurturing a student venture that resuscitates the local natural resource of undeveloped woodland near populated areas, developing new energies such as environmentally friendly bio energy, and the construction of a medical care and fitness system in collaboration with medical institutions in the cities).

One result of these initiatives was the successful adoption in the spring of 2007 of the "Ishikawa Traditional Handicrafts Innovator Training Unit" on the program for the formation of bases to create human resources for regional revitalization under the budget to promote science and technology. In December of the same year the "Regional revitalization utilizing primary industries and the creation of new local industries in the region by utilizing biomass" proposed by this university at the "Regional economic reconstruction from the provinces" seminar organized by the Cabinet Office's Economic and Social Research Institute was awarded the top Cabinet Minister's Prize from the cabinet minister in charge in the Cabinet Office.

The current 21st Century COE founded the "International Society for Knowledge and Systems Sciences" with its secretariat located in the COE and has published the "International Journal of Knowledge and Systems Sciences" at a pace of four issues a year.



Research on Social Innovations

At the present stage, knowledge science is more a problem-oriented interdisciplinary academic field than a single discipline. Its mission is to organize and process human-dependent information and to return it to society with added value. Its central guideline is the creation of new value (knowledge) - such innovation being the driving force of society, but it mainly deals with the research area involving social innovation (organizations, systems, and reorganization of the mind). However, society's progress is underpinned by technology and the joint progress of society (needs) and technology (seeds) is essential, so it also bears the duty to act as a coordinator (intermediary) in extensive technological and social innovations.

In order to fulfill the above mission, the School of Knowledge Science focuses its research and education on observing and modeling the actual process of carrying out the mission (Nonaka's Systematic Knowledge Creation Theory that was the key factor in establishing this school, the Creative Space Theory developed in the 21st Century COE) as well as developing methods to carry out the mission. The methods are mainly being developed through the existing three fields. These are the application of information technology/artistic methods (knowledge discovery methods, ways to support creation, knowledge engineering, cognitive science), application of business science/organizational theories (practical uses of tacit knowledge, management of technology, innovation theory) and the application of mathematical science/systems theory (system thinking, the Emergence Principle, epistemology).

Knowledge engineering (a branch of information science) is still the mainstream in the world of knowledge science. The School of Knowledge Science is unique and pioneering in that it aims for integration with knowledge management (human management), the importance of which is recently garnering worldwide attention. However, it will take some time to integrate the above three fields theoretically and establish a new academic system. Our aim is to first attempt their integration in practical use (problem-solving projects), accumulate actual results and then to establish them as a discipline in a new field.

The current 21st Century COE Program stresses research and education dealing with technological innovation. As well as being highly regarded for its extension of knowledge science into the field of

technological development and its development of the new knowledge creation theory of "creative space", it has been instrumental in the spread of the technological development system of laboratory knowledge management in postgraduate education. At the same time we have made every effort to fulfill our role as a knowledge center in regional society via education in the management of knowledge and technology for working professionals and business people, and the application of knowledge science to various issues in regional society. The feedback from practical activities has promoted theoretical advances. The major issue actualized in these activities is the lack of human resources to, firstly, coordinate such matters as technology and society, and the diversity in knowledge and values, and secondly, to take the lead in solving problems.

Continuing with dynamic knowledge creation and application (innovation from knowledge coordination) and nurturing the human resources to do this is an urgent issue. Our next aim is that the members of research projects that explore and solve problems should implement them in tandem with young researchers and Doctoral students to nurture talented personnel who can create innovation in a variety of fields and, via these practical activities, to establish knowledge science, the learning to detect and solve problems in a knowledge-based society.

We will store up experience in regional society/corporate collaboration projects and overseas research to train human resources that can play an active role globally in such areas as information system, R&D management, and social system development and management. In research into the infrastructure of knowledge science we will develop research in the fields of social knowledge (the application of tacit knowledge, management of technology, innovation theory), knowledge media (knowledge discovery methods, ways to support creation, knowledge engineering, cognitive science) and system knowledge (system thinking, emergent principles, epistemology).

Academically, we will exploit the advantage of being the first in the world to commence such activities to take the lead in pioneering the new discipline of knowledge science. Based on its achievements so far, we will set up a number of collaboration institutes overseas and promote academic exchanges for faculty members and students. We intend to further expand our scope to cover research into social innovations based on technological innovations.

Combining Natural and Social Sciences: Towards Pragmatic Practice

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Combining natural and social knowledge is a central and persistent theme in the JAIST COE project on knowledge creation and innovation. As the project approaches to completion, it is good time to ask: is the tirelessly pursued combination a realistic endeavor or an illusive dream?

Exploring the differences and commonalities between natural and social sciences may help to answer this question.

Knowledge of the natural and the social are essentially different. The differences lie at the levels of complexity they engage (Boulding), the modes of explanation they demand (Elster), the investigation aims they allow (Flyvberg) and whether they assert a 'double hermeneutic' effect to the behavior of the studied objects (Merton).

Knowledge are significantly in common in that they are all construed out of available resources (Gadamer), justified based on the consequences of acting upon them (Dewey), settled until better, competing alternatives emerge (Pierce), and serving as a walking stick for beating unknown paths in human life (Roethlisbergers).

Because of the essential differences, there can be no hierarchy or unity of sciences. Natural and social sciences, 'science' and 'non sciences', are different forms of knowledge that we create for coping with life projects. One cannot tell which is more true or valuable: Confucius's teaching, Newton's theory or Picasso's painting?

Natural and social sciences have their strengths and weaknesses respectively. While natural sciences are

good at sending men and women to the moon and run more cars on the road, social sciences help raising value-rational issues, focusing attention at interest and power, brining ethics and purpose in, answering basic questions such as 'what shall we do and how shall we live?'.

All the differences make it impossible for detached, formalized, theory-oriented knowledge integration, i.e., to integrate natural and social sciences into a grand theory, a united methodology or a universal combining procedure. It is not surprising that efforts along this direction failed.

Nevertheless, the commonalties allow us to pursue problem-solving oriented conversation and collaboration. There are numerous successful practical examples, from Xerox's Eureka knowledge management project to the UN collaboration project on environment protection.

In pursuing collaboration, our political will, open mind and teamwork skills are critical. Particularly, we need to understand that division of intellectual labor (into natural and social sciences) is valuable only when subsequent exchange happens (between natural and social scientists). We need to overcome 'specialized deafness' (Boulding) and engage in 'dialogical encounters' (Bernstein). To achieve this, continuous education and conversation are the key.

Knowledge serve humankind best when we understand their respective strengths and weaknesses, when we take them as complementary tools for coping with contextual problems, when our judgment and action are guided by situational ethics. We need to bring issues of value and purpose back in, we need to engage passionately in power and politics as we engage in science and technology. Given the interconnectedness in and of real world problems, we need to invite Confucius, Newton and Picasso into our projects, invite them as equals. In every project, our values, intentionality and skills matter. The collaborative possibility is at our hands.

JAIST-COE News is published by the Center for Strategic Development of Science and Technology, Japan Advanced Institute of Science and Technology, 1-1 Asahidai, Nomi, Ishikawa 923-1292, Japan.

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