2H21 Developing Knowledge Management System in Academia

—A Survey-based Study in Research University

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Abstract:

Most of knowledge management (KM) research and the available knowledge management system (KMS) pay little attention to its implementation in academia. This research concentrates on understanding the situation and problems of knowledge creators per se, as disclosed in field research by a survey of the scientific knowledge management and creation process in one research institute. Some serious obstacles and hidden problems have been discovered in this survey. It is necessary and urgent to develop a KMS to improve knowledge sharing and creativity support in academia. Along with these findings, we also present our framework to develop KMS in laboratory for more effective KM and better creativity support.

1. Introduction

Research on knowledge management (KM) came into being in the early 1990s. It has gained very tremendous and quick development in the business field in past more than decade, while the information technologies play an important role in initiating knowledge management as well as supporting and enhancing the processes of knowledge storage, transfer, application and creation in firms.

In contrast to the significant successes and achievements of knowledge management in the business area, it is only recently that educational administrators have begun to look at how they might apply knowledge management principles and technologies to create effective teaching and learning environments and support educational decision-making [1]. The subject studied was usually a general educational organization, for example, high school, colleges and universities rather than a research institutes. Moreover, the attention of existing papers concentrated mainly on building information systems or corporate portals to support the administration of educational institutes [2][3][4].

Now things are changing. Some researchers and scholars have realized it is important to apply knowledge management practice to facilitate the scientific knowledge creation. As mentioned by Nakamori [5], "it is vital to begin to continuously and systematically develop the theory of technology creation, verifying the theory in scientific laboratories, and improving the theory by feedback from practice". Academic laboratories, as the basic research units, are typical place of producing scientific knowledge. Their targets should be "emerging technology" and "creative invention". In this paper, we will put forward a perspective of developing a knowledge management system (KMS) to improve research efficiency and effectiveness and promote scientific knowledge creation by a Knowledge Management Survey in a research institute. The point is that our study is based on the feedback of knowledge creators in a typical knowledge creation organization, which makes our analyses and conclusions more comprehensive and persuasive from both theoretical and practical point at view.

In the work described here, we focus on initiating knowledge management and the role of IT in the process of scientific knowledge creation in one research institute. The population investigated consists of only masters students, doctoral students, post doctors, and research associates/assistants, i.e. the backbone of knowledge creators. Based on the statistical results, we discovered some hidden problems and obstacles that here never mentioned in existing research works as far as we know. We think it is necessary and urgent to develop a KMS to improve knowledge sharing and creativity support in academia. Furthermore, we outline the main features, functions as well as structure of the laboratory knowledge management system (LKMS).

2. Knowledge Management and Scientific Knowledge Creation

Knowledge discovering, possession, handling and enhancement seems to become an issue of increasing importance and actualization in the contemporary society. In order to keep sustaining competitive competencies, new knowledge and

technologies appear to be faster required by individual, organizations, even nations. Thus, the creation of knowledge and technology was given more and more attentions in scientific research and practice.

Polanyi divided human knowledge into two dimensions: explicit knowledge (written and formalized) and tacit knowledge (the action related and unformulated). Nonaka and Takeuchi [6] analyzed the interaction between tacit and explicit knowledge and proposed SECI model for *organizational knowledge creation*. There are four consecutive transitions in this model: (1) socialization (from individual tacit knowledge to group tacit knowledge); (2) externalization (from group tacit knowledge to group explicit knowledge); (3) combination (from group explicit knowledge to individual explicit knowledge); (4) internalization (from individual explicit knowledge to individual tacit knowledge).

Parallel, Holmberg [7] divided human knowledge space into four two-dimensional fields. Those are, (1) what you do not know that you know, (2) what you know that you know, (3) what you know that you do not know and (4) what you do not know that you do not know. The fourth field extends all the way into infinity, so human knowledge space has no outer boundary. From Holmberg's knowledge space theory, we can explain *scientific knowledge creation*, which is *the process that human stand on conscious knowledge to reveal unconscious knowledge, discover aware unknown knowledge and explore unaware unknown knowledge.*

Human knowledge is infinite, but our rationality is critically bounded at least three different ways [8]: restricted memory content and memory access mechanism, restricted computational capacity as well as restricted space of attention. Thus, the appropriate resolution or support may help us to overcome or diminish the restrictions and enhance the capability of knowing world. As we know, knowledge management practice has gotten some significant successes and achievements in the business area by effectively managing knowledge of the firm. It refers to identifying and leveraging the collective knowledge in an organization to help the organization competition. Similarly, in research institutes, laboratory is an academic space and a basic organization entity devoted to research, creation of new knowledge, and innovation, knowledge management must also play a significant role in improving and sustaining research and scientific knowledge creation in academia. Therefore, we define KM in academia as *any systematic activity related to the storage, capturing, sharing and application of knowledge for creation of scientific knowledge and achievement of research goals.*

With the development of Information Technology (IT), it has shown its strong properties where the human being is restricted, in other words, IT can help us in better organizing our current knowledge and effectively guiding us in learning the right things from right people/place at right time. Hence, researchers have promoted IT-based knowledge management system (KMS) to support and enhance the life cycle of organization's KM tasks, functions and processes [9]. So, it is natural that IT as knowledge enabling tools may also benefit the process of *scientific knowledge creation*. The effective IT supporting will enable and facilitate the communication within researchers, collective learning, information and knowledge sharing, collaborative problems solving and new idea generation in academic units. For example, web-based knowledge repository for storing and sharing knowledge among researchers, BBS for discussing and communicating to capture the knowledge residing in the mind, an online videoconference for transferring and integrating knowledge from partners abroad or other experts. However, as far as we know, few works have been done to develop an IT-based and functions-integrated system or KMS. In terms of scientific knowledge creation in academia, it is the motivation of this study.

3. Survey Study on research institute

The survey was conducted to investigate the current situation of using IT in research activities, the requirements of different researchers in different area, and the researcher's attitudes to initiate KM and develop KMS in laboratory. The case study approach is used here because the concepts under study are abstract and the boundaries of this phenomenon are still unclear.

Our target institute is a relatively new (1990) Japanese national institute, established to do research at the highest levels in selected fields of science and technology. We considered it to be a representative research institute for our study, because: (1) It consists of three schools: Material Science, Information Science and Knowledge Science. In term of knowledge management, they

are typical representatives for the study of basic, information, and interdisciplinary science. In addition, the School of Knowledge Science was the first school established in the world to claim knowledge as a legitimate target of science. (2) The institute enrolls only master students and doctoral students. From this point of view, it is more like a knowledge creating organization than a general educational organization, such as a university that includes undergraduate college students.

The respondents of this survey included all students (doctoral student and master student), post doctors and research associates/assistants. We did not include professors because we considered that they were a different group who used quite different methods to do their research as compared with our designated respondents, which would make it difficult to get valuable information from the same questionnaire.

We published the questionnaire on the website, along with a printed paper version for people who preferred it. A total of 118 responses were received. The response rate was 11.8%. The survey was completed and analyzed at the end of April 2004. The results and analyses pertain only to this period.

The image as defined by the respondents shows both positive and negative characteristics in the survey. On the positive side, there was a high awareness of knowledge issues, knowledge resources, and the concept of knowledge management, along with the respondents' strong desire to develop a knowledge management system or LKMS. Some results were negative, in that they showed that there were still some serious obstacles and hidden problems preventing efficient knowledge management and personal research. Some important findings as well as the conclusions discovered by this survey are as follows.

- There is a serious disparity in the technical supports and average personal IT skill between the different schools at JAIST. Respondents of Material School have poor IT skill and feeble technical supports. Information School has the best situation of three schools. Knowledge Science is the medium level compared with other schools.
- The respondents are not familiar with or have not understood the function and advantage of IT tools in the process of managing knowledge.
- There is no systemic KM framework for the scientific research in the lab. In this case knowledge is highly fragmented and inefficient to access what, when and where needed.

4. The Framework of LKMS

From the survey results, it appears that an integrated knowledge portal or platform connecting to all kinds of information and knowledge sources is most needed and desirable. In our case, it can be called LKMS. The goal of LKMS is toward knowledge search, acquisition, communication, management and creation in research activities. Essential characteristics of LKMS include combining disparate applications as well as providing integrative and interactive functionalities.

Hence, the main features of LKMS are:

- It combines and integrates functions for the contextualized handling of all kinds of knowledge source needed by research activities.
- Besides offering an environment for accessing knowledge, it tries to bring knowledge where people are doing their work.
- It supports knowledge management both for laboratory and for members.
- It creates knowledge networks and brings researchers together virtually to exchange and build their collective knowledge in their research areas.

The LKMS must be interface-friendly, user-oriented as well as easy to operations. Usually it is personalized desktop type.

The combination of technologies upon LKMS should primarily be on enhancing two broad areas: knowledge storage and retrieval as well as communications. According to requirements of respondents and feature of research activities, the flowing functional subsystems should be provided and integrated into the system as a whole seamless platform:

1. *Scientific knowledge repository subsystem*, storing and linking the theoretical and practical knowledge for the research concerned. For instance,
   - Basic and background knowledge in the field;
   - Skill knowledge, e.g. how to do research; how to write paper; how to use apparatus and so on.
   - Laboratory information, including introduction of all members, their research interests, publication list and laboratory schedule, seminar and so on.
   - Introduction and links to the leading

groups, labs and famous researchers in the field;
- Introduction and links to the major journals and research organizations in the field;
- Links to literatures database, etc.

2. *Social information subsystem*, offering the information from professional database, periodicals, and relevant web site, even newspapers so that researchers can look for the collaborations and easily search the information they need. For instance,
   - Information and knowledge about government industry policy;
   - Industry database built by agencies;
   - Patent database, etc.
3. *Communication subsystem*, for the exchange of knowledge and ideas between the members of lab as well as outside researchers through e-mail, BBS, video conference, and etc.
4. *Personalization subsystem,* providing individual module for researchers to manage their personal research.

Because different laboratories are diverse, those in different research areas have diversity in research activities, this system should be designed to be adaptable to different kinds of lab by different requirements. In particular, each module can be different with regard to available interaction interfaces, archiving systems, internal work organization, and finally technology.

In addition, considering the great disparity in personal IT skills and technical support among various schools, we think the most practicable and effective way is to focus first on the requirements of researchers without computer science background to smooth the unevenness. In other words, we can get biggest and quickest positive feedback through this way, and then try to extend it to the whole organization/institute based on accumulated experiences.

5. Conclusions

In this paper, we have identified and analyzed some interwoven contributing factors as well as inhibitors to management and creation of scientific knowledge in academia based on the KM survey of JAIST. We have also further proposed the framework of LKMS, including its features and mainly functional subsystems.

Our further work is to implement LKMS in the selected laboratory. Developing a knowledge portal based on existed laboratory homepage will be a good beginning.

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