Management Principles for Knowledge Creation System: A Case Study

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Abstract: This study discusses management principles which provides computational aid to management including monitoring, analysis and navigation of knowledge creators activities. Firstly, it attempts to identify two management principles based on the Ontological Shift Model, and give three indicators to diagnosis knowledge creation projects. Boom-ups are indicator of enablers, slip-downs are indicator of barriers, and social-network are indicator of “Ba”. This proposition is verified based on real case in Company K, an global Japanese company with over hundreds of years history and leading company in the industry. Since knowledge is defined as “information” and “people’s judgement to information”, both information and knowledge creator’s activities are expected to be managed in a knowledge system efficiently. Information could be processed to trash and also could be processed to be knowledge. The only difference is how the knowledge creators can efficiently analyze and rebuild new information which we can call it the knowledge without errors and mistakes. Current IT technology gave two efficient tools for knowledge creation: the “SNS”, hereby is capable to describe knowledge network and illustrate people connections, and the “data mining” is well implemented in information society for digging out knowledge from “BIG data”. In this research, computer cognizable principles is presented based on the ontological shift model, to provide algorithms in manage knowledge creation activities with computer aids. The validation of our proposal and associated knowledge creation system is supported by real company case.

Key Words: Organizational Knowledge Creation, Ontological Shift, Project Management, Knowledge System

1. Introduction

From 1959, when Drucker (1993) [11] argued that knowledge turned to be the basic economic resource in “knowledge society”, research on organizational knowledge creation capability (KCC) is receiving increasing attention. Generally, knowledge creation research has three main tasks: explanation of organizational knowledge creation (Nonaka and Takeuchi, 1995) [17]; discovery of enablers and barriers (Nonaka et.al, 1999; Krogh et.al, 2000; Szulanski, 1999) [14][19][23]; and improvement of organizational infrastructure.

In recent years, technology aid for knowledge management has attracted a lot of interest amongst researchers, managers and software engineers. Great effort have been made to ensure knowledge mining, knowledge-base construction or learning program. However in recent decades, claims rise that “knowledge” can not be managed (Grant, 1996; Teece, 2000)[3][4] especially through information systems (Terra and Gordon, 2002) [5].

In this paper, the authors adopted a business view (RAKID view refereed by Ward and Peppard, 2002)[6] to design the system, which provide computational aid to management including monitoring, analysis and navigation of knowledge worker’s activities relates to both tacit and explicit knowledge.

In the following section 2, simple and computer cognizable knowledge management principles are proposed based on literatures and concepts. In Section 3, the principles are verified in Company K’s real cases. Section 4 presented the functional characteristics in design knowledge system, and manifests the significance of finding these management principles in design a knowledge system, and in the last section 5 we conclude our research and cases and address some future extension.

2. Computer cognizable management principles

2.1 Manage activity rather than knowledge

To answer the question that whether knowledge could be managed and how it could be managed, it is necessary to examine the three basic concept of data, i.e., information and knowledge. According to Bell (1999)[7], data is “an ordered sequence of given items or events”, information is “context-based arrangement of items whereby relations between are shown” while knowledge, which is beyond the former two concept, refers to “the judgment of the significance of events and items which comes from a particular context.” Bell’s definition indicates that “information” was never transformed to be “knowledge” unless human’s “judgment” was involved. However, most of existing computational system attempts to manage “knowledge” emphasizing on construction of the so-called “knowledge base” by computer system, which is, in fact, still an “information base” or “data base” because of the absence of human’s activities.

Knowledge does not exit unless human activities of “judgment” are involved. Therefore is not manageable by any information systems (Teece, 2000; Terra and Gordon, 2002)[4][5] unless the system takes “human” instead of “knowledge” as management target. In human-centered design perspective, Computers monitor human activity, record human interaction,
and take the role of assistants rather than substitutes of human work.

### 2.2 Enable, Support, and Nurture Rather Than Control

How to set adequate and correspondence principles to manage knowledge creation activities? Although “knowledge worker’s activities” is drawing increasing attention, the way to manage these complicate activities is still in fog. In knowledge management perspective, the traditional management approach of “control” has been questioned. According to Fayol (1949)’s [8] definition, control “consists of seeing that everything is being carried out in accordance with the plan which has been adopted.” However, no fixed plan is adequate to direct individual’s activities towards organizational knowledge creation. Individual’s activities contributes to organizational knowledge creation are too various to be clearly defined. To most managers, administrating creating activities in organization is not to make choice amongst a set of given alternatives as Simon (1997) [9] suggested, but to generate new “irresolution” according to the circumstance (Winograd and Flores, 1986) [9]. Generating “new” irresolution to the specific situation is a creative process rather than a critical one. People do not expect any management system to output a closed and scientific answer to “what we ought to do”, but do seek for a open and ethical answer to “what else we may do.” This fact prevent engineers from using artificial intelligence to manage knowledge creation related issues.

Considering the open feature of knowledge creation activities, some recent literatures tried to persuade managers “not to control, but to propagating and nurturing the autonomy and self-control of organization” (Malhotra, 2001). Such “autonomy” is stressed in Nonaka and Takeuchi’s (1995) [18] work as one of the five enablers essential to organizational knowledge creation. In addition, Nonaka et al (2000) [19] further clarified that “knowledge cannot be managed, only enabled... from our perspective, managers need to support knowledge creation rather than control it.” In sum, to “enable”, to “support” and to “nurture” knowledge creation related activities are preferred rather than to “control” it.

### 2.3 SECI Model and The Ontological Shift Model

According to Nonaka’s theory, organizational knowledge creation is the conversion between tacit knowledge and explicit knowledge. It has two dimensions: epistemological dimension and ontological dimension. Epistemologically, the knowledge creation involves four modes: socialization, externalization, combination and internalization. Ontologically, the knowledge level is from individual, group organization to inter-organization. The knowledge spiral grows through the SECI modes from individual level to inter-organization level and completes organizational knowledge creation.

Generally speaking, the SECI model is hard to be used directly in computer systems. The epistemological dimension attracted most knowledge managers and researcher’s attention and has been well discussed in the recent decade. It is a widely accepted proposition that in order to enhance organizational knowledge creation capability, the four modes (SECI) should be encouraged and a “ba” (which indicates shared context) should be built. However, people unconsciously (or sometimes, intentionally) overlook the implication of ontological dimension, which defines the subject (or creation entity) of each process. As a result, this model have met difficulties in connect specific knowledge creation project and discrete contributivle activities with enterprises’ continuous innovation objective. Glisby (2003)[12] regards SECI model as “universally valid in conception and implications”, but with “contextual constrains” in process. According to Gourlay (2006) [13], the construction of SECI model focused on the “content” rather than “process” in organizational knowledge creation, which prevent organizations from management control in operations and knowledge management projects.

Therefore, the authors presented a ontological shift model (O5 model) in former research (Wu, Senoo, etl., 2010)[25], in order to diagnosis the feasibility of each creation activities in knowledge creation project. This model is capable to find out the systemic, consistent and holistic knowledge creation mechanism especially in ontological perspectives as Fig.1 Shows.

Even though “autonomy” is to be encouraged in knowledge creating company, it is absurd to claim that all activities (even which are irrelevant or damaging) should be encouraged in organization. Nonaka and Takeuchi presented a knowledge creation model. Organizational knowledge creation are interpreted as processes of socialization, externalization, combination and internalization. Knowledge are created through the spiral covers the four processes, therefore from the authors’ view, activities contribute to the four processes are regard as key activities. Based on such perspective, the management principles are defines as two simple rules for computer comprehension:

**Principle 1.** The “happy loop” of knowledge creation activities should push the knowledge creation forward towards successful boom-ups.

**Principle 2.** The happy loop of knowledge creation activities should realize SECI in every creation entity, no matter it was individual, group, organization or social-network.

Besides the two simple principles to define the happy-loop for knowledge creation, there are 2 indicators to identify enablers and barriers in organization:

- **Indicator 1.** Successful boom-ups indicates organizational enablers for knowledge creation projects
- **Indicator 2.** Repeated slip-down indicates barriers in knowl-
edge creation projects.

2.4 Social Network

The concept “social network” is presented by Barnes in 1954. [21] A social network’s general feature is a social structure made of nodes (which are generally individuals or organizations) tied by one or more specific types of interdependency (Stokes, 1983; Wellman, 1997) [20][22].

In recent years, with the development of IT, social network analysis is realized by computer aid. By detecting people activities and connection, social network site as web-based service is assumed to construct public profile, to articulate list of people who shared connections, and view connections of throughout the system (Boyd, 2008)[26].

From knowledge management perspective, Ba is defines as shared context (Nonaka and Takeuchi, 1995) [17]. Knowledge is not “transferred” from one node to another, but “shared” in a certain network. Analysis tool based on social network help researchers find the mechanism and dynamic of Ba in a certain knowledge creation circumstance. By concept definition, the following principle could be:

Indicator 3. Social network manifest the dynamic of Ba.

3. Principles Verification: a Case Study

3.1 Backgrounds

Company K is a global technology based enterprise. From 19 century, it adopts aggressive innovation strategy, and extended its major business from telecommunication manufacture, electronic lifestyle provider, to information society vacillator. In 2009, the enterprise Planning Department met the following problems:

1. Technology innovation teams and product planning teams worked solely with their independent objective and techniques. No machinist help to start collaboration amongst project teams. As a result, many technology contribution is not transferred to be products.

2. From the enterprise strategy, the competitive advantage of the enterprise is defines the speed, amount and feasibility of new products. Company K does not expect the No.1 of each industry, and emphases on radical innovation rather than incremental ones. Therefore, it is necessary to apply and combine the enterprise knowledge resources, including technics, know-how, and knowledge workers throughout departments and teams, in order to enable new innovation duly.

3. To realize the intra and inter organizational collaboration, Company K plan to use SNS (social network system). How can SNS help?

3.2 Entry and Data Collection

Facing the practical problems, our research team participate in the knowledge management mechanism design in Company K in late 2009. During 4 months diagnosis and research, more than 30 interviews with enterprise planning department, SNS teams, R&D managers are conducted, and the solution is given based on the principles presented in this paper. Feedbacks come from the enterprise planning department, which proved the feasibility of the tool and principles.

3.3 Diagnosis and Analysis with the OS Model

To solve the three problems for Company K, the authors follow three steps: firstly, the specific problem is described by the OS model, and the ontological layers are defined. Secondly, based on interview, the problems is interpreted to be practical scenarios, and the activity map is composited. After all, the diagnosis and solution is conduct with the principles presented in this paper.

The three problems are shortly describes as: Problem 1. From technic to product; Problem 2. Combine knowledge resource. Problem 3. Use SNS for innovation.

- Problem 1: From technic to product

From the perspective of product innovation, the individual layer of OS model is the R&D researcher. Group layer is R&D teams. Organizational layer is the enterprise planning and product planning department, in which the techniques is transformed to product by commercial operations. The Social network is the market, partners, inter and intra organizational experts and other knowledge resources the organization and individuals are expected to use.

However, the problem is that the contribution of R&D team is hard to be transferred to product. According to interviews, there are two scenarios to describe activities between the commercial team and R&D team.

- Scenario 1: E-boom-up Only

Description: R&D team submitted contribution by documents only. “Technics” and “business” are packaged into a black box. Lack of technology support prevent commercial team from understanding the R&D team’s contribution. On the other hand, without the information for commercial team, R&D team is difficult to make innovation based on market feedback.
Two Teams

R&D Team
     Commerical
Team
     Knowledge
Worker
Organization
Individual
     SECI
Enabling
     SECI
Enabling
Group
Intra-SN

Fig. 4 Integrated Solution for Problem 1

Solution: According to Principle 2, boom-ups in all SECI modes should be enabled.

1. S-Boom-up. Periodically arrange meetings between the two teams, in order to share objective, progress and generate ideas. Besides formal socialization activities, change the office layout to make the two teams neighborhood, as an approach to enhance Ba.

2. E-Boom-up. Set demanding documents from commercial teams and technical documents from R&D teams accessible to both sides. Encourage document study as daily routine work.

3. C-Boom-up. Give part of the commercial teams work and decision making power to R&D group.

4. I-Boom-up. Short-term work-shift between the two sides.

– Scenario 2: S-Slip-down Case
Description: The market demand as well as innovation requirement is unclear. R&D teams were always informed by telephone, informal dialogue or meetings. Innovation process depends on not the demand from market but the tacit knowledge of R&D teams. Misunderstanding and intention of avoiding responsibility prevent the two sides from collaboration. Solution: According to Principle 1, the happy loop of knowledge creation project relies on boom-ups. And Indicator 1 and 2 shows that slip-downs indicate barriers in knowledge creation projects. Commercial team should not only make decisions on the R&D contribution, but also take part in R&D process.

Intergraded Solution: The organizational layer should be the decision center of technology-product transformation, which should be combination of both R&D teams and Commercial teams. SECI activities should be enabled between knowledge worker in R&D team in order to make commercial team knowledge creation resources. SECI activities should also be encouraged between R&D and the combined decision center of two teams, in order to make the knowledge creation towards rent-yielding.

Problem 2: Combine knowledge resource
Description: Two sorts of knowledge combination is expected to conducted to solve this problem: integrate the knowledge between the commercial teams and R&D teams, and collaboration between R&D teams. The solution of the former combination is isomorphic with Problem 1. Therefore, the later combination is discussed in this section.

The ontological layers are R&D team 1 and R&D team 2.
Scenario. No connections between Team 1 and Team 2. Generally, knowledge creation activities boom-up from a specific R&D team to organizational layer, and other team is regard as social network, or applicable knowledge resource. However, no official ba or incentives to encourage a team seek its knowledge resource. Two team are isolate layer in the ontological map.

Solution: According to principle 1, boom-up should be encouraged when knowledge creation projects. A new layer called “collaborative group” is created in the knowledge creation process. R&D teams are the members of collaborative group, and submit their innovation contribution to the higher layer in the activity map, as shown in the following figure.

1. S-Boom-Up The collaborative group hold official and unofficial meetings between teams.

2. E-Boom-Up Documents are shared to the collaborative group, and then shared amongst teams.

3. C-Boom-Up The collaborative group evaluate “influencial innovation in enterprise scope”, and facility the cross team collaboration.

4. I-Boom-Up Short team work shift amongst R&D teams.

Problem 3: Use SNS for Innovation
Description: Company K construct the SNS team, and developed the intra-enterprise social network system. Company K was seeking for a management machinists to enhance the influence of SNS team and get help from SNS in future innovation. Solutions: According to indicator 3, SNS shows the dynamic Ba in knowledge creation organization. The following process is presented to describe key knowledge creation activities of SNS team when communicate with other groups.
1. S/E- Boom-up: Individual SNS team member get company social network knowledge from friend, family, TV, newspaper or other social network.

2. S-Boom-up: Unofficial salon was held inside Company K to integrate knowledge resource and enhance SNS.

3. SECI in individual layer: Based on the understanding of the Company’s requirement, create concept, do experiments and make prototype.

4. E-Boom-up: Report the result of the contribution to the team.

5. C-Slip-down: If the team does not accept the individual’s contribution, ⇒ do the (1), (2), (3) processes again.

6. S/E-Boom-up: Persuade the R&D group to use the SNS in order to enhance Ba.

7. C in R&D Layer: The SNS is accepted and adopted in R&D teams.

8. I-Slip-Down: If resistance comes from the R&D team, the prototype of SNS slip-down to individual layer. ⇒ do the (1), (2), (3) processes again.

9. S-Boom-up: Discuss with the Soft2001 PJ (the software management team).

10. SECI in PJ Layer: The prototype is enriched to be a product and be used throughout Company K.

11. I-Slip-down: It is difficult to use or useless and be refused by the PJ group. ⇒ do the (1), (2), (3) processes again.

12. E-Boom-up: A improved prototype is presented.

13. SECI in PJ Layer: Integrated solution is presented by the PJ layer.

14. E-Boom-up: The PJ group report the new SNS to Company K.

15. SECI in Company K: Prototype is accepted by the organization, and the new SNS is transformed to be a internal product. ⇒ The first loop, which is SNS prototype design is completed.

In sum, the management principles and indicators are verified by Company K’s case. By drawing the activity map, the project managers noticed that frequent Slip-downs led to dead loops existed in the creation activities. These Slip-downs and loops prevented the knowledge spiral from upward development and led to delays in the project implementation.

If computer is capable to capture knowledge creation activities, it could apply these principles in diagnosis and navigation of knowledge creation projects.

4. Knowledge System Design with The Proposed Principles

Terra and Gordon (2002) summarized two of the main concerns of the knowledge management related system, which are (1) “the provision of context for and validation of available information” and (2) “increasing the connections among people”. These two concerns distinguished knowledge management system from original information system (as well as from the information centric knowledge system). Besides the functional concerns of “knowledge context” and “people connections”, interviews show that the operational concerns of a “automatic” and “smart” system rise as well in recent years.

In order to solve problems in knowledge creation projects, three levels of human’s activities are to be aid by the computer, as shown in Fig.7.

The first level is activities relates to human and computer interface. In a human-centered system, the activities are not limited to the physical processes that knowledge worker operates computer, but involves the cognitive process that artificial intelligence observe the knowledge worker in his daily work. Based on the comprehension and analysis of these activities, the system should be capable to navigate group cooperation towards the group goal, and give advices in network collaboration.

In sum, the system is designed to have the following functions:

1. Automatically identify people’s key activities in knowledge creation projects, and comprehend the meaning and
Fig. 8 Knowledge System Design Objectives

significance of each activities. Analyze these activities according to knowledge creation theories, and provide diagnosis and navigation to the ongoing knowledge creation projects.

2. Automatically capture the knowledge network inside the company, in order to enhance the connection of people.

3. Automatically process information as the basic element of knowledge, and manage information flow according to knowledge creation Ba.

Fig. 8 illustrate the three objective of a knowledge system. Since knowledge is defined as “information” and “peoples judgement to information”, both information and knowledge worker’s activity are expected to be managed in a knowledge system. Besides manage the activities of how specific people process information, the connection between people is significant as well.

Current IT technology gave clear direction on the later two function. SNS algorithms has well developed for half century, hereby is capable to describe knowledge network and illustrate people connections. Data mining is well implemented in information society. In this research, computer cognizable principles is presented based on the ontological shift model, to provide algorithms in manage knowledge creation activities with computer aids.

5. Summary

As the key activities (including people’s communication behaviors) could be captured by the artificial intelligence, the knowledge worker’s network could be analyzed by the social-network methodology. Therefore, the management principles discussed in this paper not only help computer system to provide realtime diagnosis and navigation to knowledge creation projects, but also have potential to direct the right person to the right expert for specific knowledge fields.

As limitation to such a system, not all activities are able to be captured by computer. A significant percentage of people’s communication and knowledge creation activities are not computer-based. Such principles are valuable only when a major part of work is conducted by computer-aid, and people are familiar with communication tools such as instant-messenger and email system.

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