An Integrated Knowledge Management Development System (IKMDS)

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Abstract

In this paper we address the problem of how to integrate diverse aspects of knowledge management into an integrated model that would increase understanding of how to depict knowledge management from the perspective of systems methodology, and would help to overcome the gap between knowledge creation and knowledge adoption. We propose a Committing, Convincing and Adjusting (CmCvAj) model, on the basis of which we present an Integrated Knowledge Management Development System (IKMDS). It consists of three dimensions and a cycle of nine development stages, which originate separately from studies of knowledge creation and knowledge adoption, but are integrated in a whole system by the use of developing and adjusting processes. Together these nine stages form a complete framework and relate to essential aspects of either knowledge creation or knowledge adoption. Relating the CmCvAj Meta-Model to some other models in the field of knowledge management shows it acts as a bridge and a supplement to them. Using the IKMDS we give theoretical support for the JAIST Nanatsudaki model, with its seven creative spirals, each with four balanced elements. Using the CmCvAj model we suggest that there are two more spirals yet to be explored by knowledge systems scientists. We also show links between the JAIST model and many others, thus offering the prospect of mutual enrichment.

Keywords: Committing, Convincing and Adjusting (CmCvAj) Model; Integrated Knowledge Management Development System (IKMDS); Nomology

1. Introduction

As worldwide knowledge-based economies develop rapidly, knowledge management systems theory and practice is becoming more important. Researches about knowledge management have occurred. Some is directly concerned with the question how to create knowledge for current needs. Examples are the Shinayakana Systems Approach (Nakamori and Sawaragi, 1990), the SECI spiral of knowledge creation (Nonaka and Takeuchi, 1995), the OPEC spiral (Gasson 2004), the DCCV spiral (Kunifuji 2005), the I5 spiral (Nakamori 2000), the EDIS spiral (Wierzbicki 2004), the EAIR spiral (Wiezbicki and Nakamori, 2005), and the EEIS spiral (Wiezbicki and Nakamori, 2006). However, most of these researches concentrate more on knowledge creation processes and interplays between different types of knowledge (e.g., explicit vs. tacit knowledge, individual vs. group knowledge, intuitive vs. rational knowledge, etc.), while less

on knowledge adoption processes in terms of Knowledge Management Systems Development (IKMDS), which is the focus of this paper.

To complement the extant models, Wiezbicki and Nakamori (2006) proposed a new model of knowledge and technology creation processes, the JAIST Nanatsudaki model, which is more integrated than any of the others. It consists of seven creative spirals; and each of these spirals might be as beautiful and unpredictable in its creativity, as water whirls in seven waterfalls. The seven spirals include three academic and three organizational spirals that are supplemented by a planning roadmapping spiral based on the I-system. The model is based upon the assumption that its applications will concern technology or material science development, thus the application phase consists of experimental work. The JAIST Nanatsudaki model perfectly combines different knowledge creative spirals and properly describes

the application phase by taking account of experimental work. However, when viewing knowledge management in a more systemic sense, and linking knowledge creation with knowledge adoption more closely in all of the individual, group, and organizational levels, one might suggest it could benefit from a more compelling integration.

In their concluding article in the Management Science special issue on "Managing Knowledge in Organizations: Creating, Retaining, and Transferring Knowledge," Argote et al. (2003) provided an integrative framework for organizing the literature on knowledge management. The framework has two dimensions. Knowledge management outcomes of knowledge creation, retention, and transfer are represented along one dimension. Properties of the context within which knowledge management occurs are represented on the other dimension. These properties, which affect knowledge management outcomes, can be organized according to whether they are properties of a unit (e.g., individual, group, organization) involved in knowledge management, properties of relationships between units or properties of the knowledge itself. To increase understanding of how to depict knowledge management from the perspective of systems methodology, however, one needs to have an interpretive meta-model.

To study knowledge management issues in the context of system science, many researchers focus on building integrated models. For example, Carlile and Rebentisch (2003) examined how knowledge is integrated in complex technology and product development settings. By framing the task of knowledge integration as a cycle, they highlighted the inability of current knowledge transfer theories to explain the consequences that arise from the path-dependent nature of knowledge. They outlined three stages of the "knowledge transformation cycle": knowledge storage stage (accumulation of Knowledge from past

transformations), knowledge retrieval stage (searching for and assessing relevancy), and knowledge transformation stage (resolving the consequences and creating solutions). However, in practice it is not always easy to uniquely define one stage in the absence of others or define where one begins and another ends. Further complicating this situation is that, as different individuals, groups, or organizations collaborate, they may be at different stages in the cycle in relation to each other. Therefore it is important to depict all the stages in "knowledge transformation cycle" in more complicated situation with different levels, such as individuals, groups, and organizations.

In this paper we would regard a knowledge creation process and a knowledge adoption process as interactive parts of a whole process of an Integrated Knowledge Management Development System (IKMDS). Therefore, we address the problem how to integrate diverse aspects of knowledge management into an integrated model that would increase understanding of how to depict knowledge management from the perspective of systems methodology, and would help to overcome the gap between knowledge creation and knowledge adoption. We attempt to do this with Committing-Convincing- Adjusting (CmCvAj) model for knowledge management systems that has three dimensions and a cycle of nine development stages, which are integrated in a whole system.

In the remainder of this paper, we will present our CmCvAj model of Knowledge Management Development Systems (IKMDS), relating it to the JAIST Nanatsudaki model, address its implications for knowledge management systems, and suggest directions for model validation and further research. We believe that this can add verification to the JAIST Nanatsudaki Model.

2. CmCvAj Model
CmCvAi model is based on the Committing,

Convincing and Adjusting (CmCvAj) dimensions of Nomology. As shown in Table 1, Convincing process X has technical (involving), contextual (protecting), and situational (observing) stages; and Committing process Y has somatic (having), psychic (doing), and pneumatic (being) phases. Types of thinking in knowledge management arise as each phase of commitment goes through a convincing process, forming nine stages, which could better reveal the activities of whole knowledge management process. They are intuiting, recognizing, believing, sensing, learning, trusting, experiencing, understanding, and realizing, seven of which parallel the seven stages of knowledge creation processes in JAIST Nanatsudaki Model (Wierzbicki and Nakamori, 2006).

The first three stages correspond to analysis of the problem, Creating Knowledge in Argote et al's. (2003) language, Storing Knowledge in Carlile and Rebentisch's (2003) language. According to Brugha (1998c) the process of doing this convincingly involves three stages, relating to technical/self, context/others, and situations/goals. In the intuiting stage, one just wants to get involved in doing something for knowledge management by using one's intuition in the self-dimension. Initial ideas on knowledge management are generated and objectives about knowledge management are set in this stage. In the recognizing stage, one wants to seek patterns from other people in their context to confirm one's intuition. In this stage one wants "others" to know and give (political) support to the initial ideas and objectives, by trying to explain them and get recognition for them. Hence, hermeneutics are used in the recognizing stage to protect the initial ideas and objectives. In the believing stage, one believes some initial ideas to be good and some objectives to be achievable, one wants to put initial ideas and objectives into a wider situation (business or world), confirming beliefs in them by

observing how well they may contribute to (economic) success.

The second three stages correspond to design of the problem, Retaining Knowledge in Argote et al's. (2003) language, Retrieving Knowledge in Carlile and Rebentisch's (2003) language. In the sensing stage, one would like to know challenging knowledge creation problems and solutions associated with initial ideas and objectives, trying to sense and search in the self dimension. So "socialization" is used to change individual knowledge into group knowledge in this stage. In the learning stage, one would like to develop the ability to recognize patterns at the level of one's senses rather than using intuition. In this stage, one learns about and works with other people to solve problems, for example using brainstorming. Following on from the learning stage, one next extends one's belief to the point of trusting one's instincts or feelings, and tries to get the trust of all participants and their commitment to knowledge management objectives. So debates are aimed at forming convergent group rationality.

The third three stages correspond to implementation of the problem, Transferring Knowledge in Argote et al's. (2003) language, Transforming Knowledge in Carlile and Rebentisch's (2003) language. In the experiencing stage, one wants to fulfill the value of having and doing in the self-dimension, relating initial ideas to practice. So roadmapping as shown in I5 Spiral (Nakamori 2003, 2004, 2006) occurs. In the understanding stage, focusing on the aspect to do with others, one moves toward getting other people to understand and contribute to the application of initial ideas in practice. In the realizing stage, objectives should be attained and the value of initial ideas should be fulfilled by maintaining and improving the application of knowledge creation in practice.

Among nine stages intuiting is a basic stage for convincing and committing processes. Two

extensions develop based on intuiting stage. The first extension goes introvertedly in the self-dimension from intuition through sensing to experiencing. This clearly represents the development of commitment within the involvement of self. The second extension moves extrovertedly away from self into the "others" dimension and the "world" dimension. Therefore, intuition naturally becomes a recognizing activity as one seeks patterns from other people and situations to confirm one's intuition. Extending this further extrovertedly, at the fullest development of conviction on the somatic level one reaches a stage of believing something to exist or be true.

Table 1. Stages of Thinking in Knowledge Management

Y: Committing phases (Introverted development)	X: Convincing stages (Extroverted development)		
	Technical-self (Involving)	Contextual-others (Protecting)	Situational-world (Observing)
Somatic-having-wants	Intuiting (Objectives)	Recognising (Hermeneutics)	Believing
Psychic-doing-likes	Sensing (Socialization)	Learning (Brainstorming)	Trusting (Debate)
Pneumatic-being-values	Experiencing (Roadmapping)	Understanding (Implementation)	Realising

There are two levels of adjusting process: micro-adjusting and macro-adjusting. They distinguish one another in the scope involved in adjusting process. Micro-adjusting has a narrow scope, often corresponds to a fine-tuning process within a stage. Differently, macro-adjusting has a wide scope, often corresponds to a wider adjusting process across the stages in the whole knowledge management system development process. It applies when adjustments to different stages have to be made, and in the process involved in doing that.

Comparing the nine stages of thinking in knowledge management to the exemplar process of knowledge and technology creation presented in the JAIST Nanatsudaki model (Wiezbicki and Nakamori, 2006), one can find that roughly Objectives corresponds to Intuiting, Hermeneutics to Recognising, Socialization to Sensing, Brainstorming to Learning, Debate to Trusting, Roadmapping to Experiencing, and Implementation to Understanding. Here in the CmCvAj model, there are two more stages: Believing and Realising, which advance the convincing process to a higher level in somatic and pneumatic phases of committing dimension.

3. Integrated Knowledge Management Development System (IKMDS)

As shown in Table 2, the Knowledge Management Development System (IKMDS) is related to the Committing process of analysis, design, and implementation phases, which combined with a Convincing process Knowledge Management Development System are expressed as the nine stages of the Systems Development Life Cycle (e.g. Whitten, Bentley and Barlow, 1989). With these nine stages, knowledge creation and knowledge application could be described in one development system.

In first stage, survey knowledge management scope and feasibility, initial ideas and objectives are set, initial individual knowledge creation occurs (OPEC). In second stage there is a study of the current situation of knowledge management, individuals interact with each other and individual knowledge creation is integrated in group knowledge creation (EAIR). The third stage

defines the criteria and requirements for knowledge management, group knowledge creation develops in organizational situation and constitute organizational knowledge creation. The fourth stage selects a feasible knowledge management solution from candidate solutions, organizational knowledge is distributed and improved among individuals, and applicable created knowledge is chosen among available created knowledge (SECI). The fifth stage designs the new knowledge management system, new knowledge is learned and absorbed in groups (DCCV). In the sixth stage, corresponding to acquire supporting hardware and software in information systems development, prices and policies for applying new knowledge are analyzed and made in the context of organization (EDIS). The seventh stage constructs the new knowledge management system, new knowledge is adopted and applied in practice by individuals and individual knowledge develops in practice (I System). The eighth stage delivers the new knowledge management system, new knowledge is spread and transferred in groups and the value of knowledge creation is fulfilled (EEIS). The ninth stage maintains and improves the new knowledge management system, as new organizational knowledge extends into policies, procedures, and daily routines and processes. Then, a new cycle starts again from first stage.

Table 2. Stages of Knowledge Management Development System (IKMDS)

Y: Committing phases	X: Convincing stages		
	Technical-self (individual)	Contextual-others (group)	Situational-world (organizational)
Analysis	Survey knowledge management scope and feasibility (OPEC)	Study the current situation of knowledge management (EAIR)	Define criteria and requirements for knowledge management
Design	Select a feasible knowledge management solution from candidate solutions (SECI)	Design new knowledge management system (DCCV)	Acquire supporting hardware and software (EDIS)
Implementation	Construct new knowledge management system (I System)	Deliver the new knowledge management system (EEIS)	Maintain and improve the new knowledge management system

Among the nine stages of IKMDS, the first stage is a bridge between the previous old knowledge management system and the current new knowledge management system, based on which the convincing and committing processes develop. In the committing process, the development of knowledge management goes introvertedly from analysis through design to implementation. This typically represents the development of commitment in knowledge management. It also reflects the progress that knowledge develops and transforms from tacit knowledge to explicit knowledge and from created knowledge to applied knowledge. In the convincing process, the development of knowledge management goes extrovertedly from individual through groups into the ways the organization deals with situations. This typically represents the development of conviction in knowledge management. It also reveals the knowledge flow and evolution from individual knowledge through group knowledge into organizational knowledge.

Comparing the nine stages of IKMDS to the seven creative spirals in JAIST Nanatsudaki model (Wiezbicki and Nakamori, 2006), OPEC is parallel to Stage 1, EAIR to Stage 2, BECI to Stage 4, DCCV to Stage 5, EDIS to Stage 6, I System to Stage 7, and EEIS to Stage 8. When relating the CmCvAj model to the "knowledge transformation cycle" (Carlile and Rebentisch, 2003), one can see that knowledge transformation cycle corresponds

to Stage 9 in the CmCvAj model.

In IKMDS, micro-adjusting is similar to "adjusting world" in that they both occur within each stage of the nine stages in IKMDS. In the description of the key characteristic of adjusting structure we have given the definitions of micro- and macro-adjusting. In case of the JAIST Nanatsudaki model (Wiezbicki and Nakamori, 2006), when adjustments to OPEC, EAIR, SECI, etc. have to be made, our macro-adjusting would apply. However, such adjustments are not mentioned in the JAIST Nanatsudaki model.

Moreover, to our knowledge, very few researchers have incorporated such a macro-adjustment idea into their knowledge management framework. It could be an innovation that we bring macro-adjusting to knowledge management model.

To analyze macro-adjusting process, let us take the stages in Knowledge Management Development System (Table 3) as examples. Adjusting and adapting interact and convert one another in the last three stages of the nine, as shown in Table 3.

Table 3. Macro-adjusting Process in the Stages of IKMDS

Committing (adducing) phases	Convincing (evincing) stages		
	Technical	Contextual	Situational
Analysis	1. Survey knowledge management scope and feasibility (micro-adjusting, adjusting world)	2. Study the current situation of knowledge management (micro-adjusting, adjusting world)	3. Define criteria and requirements for knowledge management (micro-adjusting, adjusting world)
Design	4. Select a feasible knowledge management solution from candidate solutions (micro-adjusting, adjusting world)	5. Design new knowledge management system (micro-adjusting, adjusting world)	6. Acquire supporting hardware and software (micro-adjusting, adjusting world)
Implementation (adducing)	7. Construct new knowledge management system (adjusting self, then adapting self)	8. Deliver the new knowledge management system (adapting world)	9. Maintain and improve the new knowledge management system (inducing)

In Stage 1, only committing is involved and one should make a micro-adjusting and adjust world. In Stages 2 and 3, convincing develops and one should continue micro-adjusting and adjust world. In Stages 4 to 6, adjusting dominates the three dimensions of committing, convincing and adjusting, and the process of adjusting world occurs across the three stages. In Stage 7, adjusting and adapting self are the two things to do respectively in two periods of Stage 7. The two directions of adjusting occur consecutively. In the first period of Stage 7, when initially constructing the new knowledge management system, one should adjust self (where the system is used, for instance, decision makers who make decision on adopting a new IKMDS), take initiatives to form a perfect system. In the second period of Stage 7, one should adapt self to the new constructed system, recognizing and fitting into new system. In Stage 8, adapting world is the most important thing to do, making the delivered new system adapt to the world where it works. In Stage 9, inducing (adducing and evincing together) dominates the four dimensions of adducing (committing), evincing (convincing), adapting (adjusting) world and adapting (adjusting) self. In this stage, one should target a perfect fit between new system and where it is used, convincing the people who use the new system and adjust the world where the new system works, trying to maintain and improve the delivered system. Exactly speaking, in Stage 9, committing becomes adducing, and convincing becomes evincing, and they together form inducing.

4. Discussion and Conclusions

In this paper we have presented CmCvAj model and IKMDS. We have made comparisons of the CmCvAj model with some other models in knowledge management field and found that stages arising from convincing-committing processes in the CmCvAj model are consistent with and can be rationally corresponded to most parts of the other models. Moreover, the CmCvAj model has complemented a few flaws and a little incompleteness in two ways. First, it has included two more stages, which were missing in the other models. With these two more stages, the process of thinking in knowledge management and the process of IKMDS become more complete. As a result, knowledge creation and knowledge adoption can be integrated in one system, overcoming the gap between knowledge creation and knowledge adoption. Second, the macro-adjusting in the CmCvAj model has depicted three levels of adjusting process. Using this methodology in knowledge management system will reduce imbalances in knowledge management process and fine-tune the IKMDS project, and then improve effectiveness of knowledge management.

Relating the CmCvAj model to WSR systems and ideas of the Eastern philosophy, we have shown that the CmCvAj model of knowledge management system integrates the souls in Western philosophy with those in Eastern philosophy. Using comparisons with other systems we have revealed that not only is adjusting process embedded within each stage of the IKMDS but it is also used as a method to reduce and eliminate the imbalances among stages of the IKMDS in a whole process. Superficially this justifies the statement of the IKMDS as an important knowledge system methodology.

The CmCvAj model reveals the requirements of "middle of the road" and "harmony" in Confucianism in oriental philosophy. Therefore it may bridge western and eastern philosophies and may form a new model framework and a new methodology which combine both the distillates in West and those in East and integrate these elite souls in a flexible structure.

However, it appears that the future of KMS will be characterised by changing groupsof decision-makers, multiple projects, conflicting strategies, and dynamic organizational environment. At any point we should be able to reconsider our commitments to IKMDS projects, check how convinced we are about their benefits, and be able to make appropriate adjustments. In this context we could benefit from having a better understanding of the processes involved and how they inter-relate in practice. Therefore, we need to apply and test the CmCvAj model of knowledge management in practice and modify it according to feedback from empirical application and tests. This work will be done in our further research.

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