# Two Organizational Knowledge-Sharing Models and Their Simulation Studies

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## 1. Introduction

The paper proposes two new computational models to represent knowledge sharing in organizations. Knowledge Chain Model (KCM) formalizes knowledge logistics in terms of physical logistics and extend the concepts of flow of materials. The another model is Distributed Decision Making And Leaning Model which formalizes organizational decision making and learning when knowledge is distributed. Especially, on the both models, we focus on the adaptation problem when an organization undergoes changes of environment.

## 2. Knowledge Chain Model (KCM)

### 2. 1 Background

In an organization, intellectual capital is usually maintained in each department. However, if you would simply accumulate such intellectual capital of each department and make the total list, you could not prospect the intellectual performance of the organization in total. The total throughputs of knowledgeable activities are sometimes constrained by the bottleneck of sharing tacit knowledge. Demand information or knowledge must be represented in context of supply-chain management (SCM). We extend the concept of knowledge logistics proposed by Wijnhoven [7] and develop the simulation model: Knowledge Chain Model (KCM).

Some firms pursue codification strategies for their knowledge management [1]. They have developed elaborate ways to codify, store, and reuse codified knowledge. We examine the quantitative effect of codification strategies in detail by simulations.

### 2.2 Knowledge Chain Model

Thompson categorizes interdependences in organizations, that is, pooled interdependence, sequential one and reciprocal one [6]. One example of pooled interdependence is that among branches of the same organization. As pooled interdependence does not share physical resource in an organization, SCM theories have not yet concerned the type of interdependence. However, the operationalization of knowledge sharing must concern with pooled interdependence, because the scope of knowledge sharing must be beyond the sharing of physical resources and IT can support well knowledge sharing for the interdependence now.

Knowledge flow augments the total performance dramatically by connecting much pooled interdependence in an organization. Therefore, we will concern the augmentation effect as well as constraint in knowledge logistics. The augmentation effect is very important for improve total throughput of organizations. Well-combination of less bottleneck and more augmentation-effect leads to maximum performance for a total organization.

We define knowledge as a pair of information and context. If they share knowledge, the information is applicable to a new context after interpretation. We introduce the concept of meta-knowledge, which means knowledge about reusability of knowledge to another context. We regard the meta-knowledge as critical for efficient knowledge sharing.

We develop the model that can analyse the knowledgeable activities in an organization and maximize the total performance. Our goal is that KCM will have the roles to knowledgeable activities as SCM has been done for manufacturing and logistics of physical products.

We add three basic KCM characteristics added to the traditional SCM model. The introduced concepts are (a) bi-directional knowledge flow, (b) augmentation by knowledge reuse, and (c) knowledge-creation by combining knowledge inventory.

### 2.3 Simulation Results and Discussion

We use SLAM II [3] as simulation language.

In the first simulation studies, we compare the total throughput of knowledgeable activities in an organization with tacit knowledge sharing and with explicit knowledge sharing. As the number of groups that share knowledge grow, the total performance of sharing explicit knowledge also grow. However, the growth of the total performance of sharing tacit knowledge is limited, even when the number of groups that share the knowledge grow.

The result suggests that competitive advantages of sharing explicit knowledge grow as the scope of sharing knowledge broadens. Therefore, meta-knowledge about reusability of knowledge is critical for competitive advantages.

In the second simulation studies, we examine the relationship between varieties of codification-strategy and the interval of environment-changes. We compare the total performance of knowledgeable activities in an organization against the different codification-strategies. As the interval of changes of the environment becomes shorter, the “codify with refinement” strategy is less efficient than “codify without refinement” strategy because it can reuse little codified knowledge.

## 3. Distributed Decision Making And Leaning Model

### 3. 1 Background

Many theories of organizational learning have been proposed. However, we have not yet had any clear explanation as to why these theories of organizational learning are required. We represent such a learning mechanism by simulation, and study how the methods of organizational learning work.

It is said that it is difficult to extract and analyze the cooperating mechanisms of intellectual activities in an organization. Therefore, we have adopted a synthetic approach to investigate the dynamics of intellectual activities in an organization.

### 3. 2 A multi-agent model to represent organizational intellectual activities

Distributed Decision Making And Leaning Model is a computational model based on the concepts of distributed artificial intelligence. In this model, we assume incomplete communication of knowledge among agents, that is called commensurability, and examine methods for pragmatic cooperative decision making and learning.

Authors would like to represent following way of knowledge-supplementing computationally. Besides transferring knowledge formally, we supplement our knowledge from others in the context of activities in organization. For example, we sometimes believe in others' reasoning complementarily without understanding it explicitly.

In the model, agents have disparate knowledge, and using the knowledge, reason, make decision and learn simultaneously from each viewpoint. Although each agent is informed from the outside as to the truth or falseness of the decision it made, it cannot understand the causal relation as a whole. Each agent has an individual learning mechanism to become more effective. In the concept "composite decision" by Simon [5], the decision premise plays an important role. The model has mechanisms to learn factual premises from others, has two types of learning, i.e., learning from success and learning from failure, and lets individuals learn simultaneously on each viewpoint. Such a learning mechanism is similar to that in theory by Minsky [2]. He points out that learning from success leads to relatively small improvement, while learning from failure leads to more productive thought even though it involves risk.

### 3. 3 Simulation Results and Discussion

We have implemented two typical variations of the model, the Specialists-Model and the Generalists-Model, in Prolog, and have carried out the simulations that learn the right decision in a given environment.

(1) Specialists-Model

We assume all agents are specialists in Specialists-Model. Each is equipped with a specialized knowledge for a specific domain; these domains do not intersect each other.

The result is that the organization seldom arrives at the fittest condition. Rather, it shows adaptive behaviors. Sometimes, the organization of agents becomes difficult to adapt to a new environment. We classify the conditions being difficult to change into three types: 1) Overconfidence of each agent, 2) Trusting other's knowledge too much, 3) Inflexibility of meta-rules. The three types correspond to the typical causes of organizational inflexibility that are pointed out in the behaviors of Japanese organization.

We also change environment in the midst of the simulation. When the degree of the changes is small, agents can adapt easily. However, when the degree of the changes is large, agents can not adapt easily. Thus, this type of knowledge sharing can adapt when the changes of the environment is small, because adaptive learning of a organization as a whole is attempted by a variety of aspects, as agents reason and learn respectively. However, this type of knowledge sharing is fragile when large changes occur to the environment.

(2) Generalists-Model

We assume all agents are generalists in Generalists-Model. They are all equipped with a general knowledge that can be contradictory to each other. Knowledge can be supplemented using a common word, even if the meaning of the word is not accurately the same. In the model, a subgoal can be shared among agents and agents cooperate to solve the entire problem.

As for the accuracy of learning, the Generalists-Model can learn more accurately, because agents try to understand others' knowledge deeply. The ability to communicate with the other agents in addition to the two agents in the Specialists-Model will enable the organization learn more accurately.

Senge [4] points out that the attitude "I am my position" is one of the learning disabilities and that it is important to be freed from being a "prisoner of the system". The Specialists-Model represents such a situation. Thus, it is harmful for the activity of an organization to consider as only a part of the system and not to take account of the organization as a whole. Senge stresses the importance of system thinking and generative learning. Understanding the causal relations of the whole makes organizational learning more accurate, because the partial view of causal relations does not bring accurate learning as shown in the simulations. Thus, system thinking, or trying to understand the causal relation of the whole, is important to improve the quality of organizational intelligence.

## 4. Conclusion

We have investigated the quantitative aspects of organizational knowledge sharing by KCM, and the qualitative aspects by Distributed Decision Making And Leaning Model .

**References**

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