Beyond Knowledge Management Platform: Design of Organizational Controls in Managing Knowledge

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Abstract

Knowledge has emerged or been regarded as the most strategically significant resource of the firm. From the resource-based view (RBV), the integration of individuals' specialized organizational capability through knowledge management (KM) has been considered crucial to the creation and sustainability of competitive advantages. Recently, KM has drawn immense attentions from researchers and practitioners in many industries and has become increasingly important in business management practice. However, most KM literature tends to focus on the "technology side" of KM such as platform design and knowledge warehousing issues. In practice, implementing KM platforms is also unfortunately considered the most important task of KM, if not the only task. As we've observed, many KM attempts died with their costly and advanced high-tech information and communication systems. In this paper, we argue that KM cannot be successful without appropriate organizational environment. For example, people in organizations are not well motivated to share knowledge and may even prefer not to share their knowledge in order to preserve their intellectual or proprietary values in organizations. This paper aims to study the behavioral dynamics of knowledge sharing in organizations and the design of organizational controls for KM from the perspective of knowledge sharing. First, a theoretic model based on game theory is developed to study the interaction between individuals' knowledge sharing behaviors and firms' strategies. Next, following the view of developed game model, a case study is conducted to study how knowledge is shared in different phases of KM implementation characterized by distinctive organizational controls. Finally, based on the game modeling, case analysis and critical study of literature, an integrated framework for the design of organizational controls in managing knowledge is proposed.

***Keywords*:** Knowledge management, Knowledge sharing, Organizational controls, Game theory, Case study.

1. Introduction

Knowledge has emerged as the most strategically significant resource of the firm, and the integration of individuals' specialized organizational capability is crucial to the creation and sustainability of competitive advantages (Grant, 1996). From the resource-based view (RBV) that treats valuable resources as the cornerstones of competitive advantages, Knowledge Management (KM) can be considered one of the most critical processes for business success in today's intensively competitive environment. Recently, KM has drawn immense attentions from researchers and practitioners in many industries and has become increasingly important in business management practice. Surprisingly, there are only limited studies that address the most fundamental element in KM: the sharing of knowledge. In fact, people in organizations are not well motivated to share knowledge and may even prefer not to share their knowledge in order to preserve their intellectual or proprietary values in their organizations. Without the premise of each individual's willingness to share knowledge, there will be no valuable inputs for any KM platforms. Therefore, when organizations consider implementing costly Information and Communication Technology (ICT) platforms for KM, it is critical to assure that individuals are willing to share their knowledge through the platforms.

This paper aims to study the behavioral dynamics of knowledge sharing in organizations and the design of organizational controls for KM from the perspective of knowledge sharing. First, a theoretic model based on game theory is developed to solve for the conditions that determine the knowledge sharing behaviors of employees. Next, following the view of developed game model, a case study of STAR (pseudo name) Engineering Consultants Inc., one of the largest construction engineering firms in Taiwan, is conducted to study how knowledge is shared in different phases of KM implementation characterized by distinctive organizational controls. Finally, based on the game modeling and case analysis, an integrated framework for the design of organizational controls in managing knowledge is proposed.

2. Game Model of Knowledge Sharing

2.1 Game Theory

Game theory can be defined as the study of mathematical models of conflict and cooperation between intelligent rational decision-makers. There are two basic types of games: static games and dynamic games, in terms of the timing of decision making. In a static game, the players act simultaneously. On the contrary, in a dynamic game, the players act sequentially. Due to the nature of knowledge sharing, the dynamic game will be used for modeling here. Players in a dynamic game move sequentially instead of simultaneously. As to answer what each player will play/behave in this game, we shall introduce the concept of "Nash equilibrium," a set of actions that will be chosen by each player, and no player wants to deviate from the equilibrium solution. Thus, the equilibrium or solution is "strategically stable" or "self-enforcing" (Gibbons, 1992).

2.2 The Model and ITS Practical Implications

2.2.1 Parameters Regarding Employees

- γ_1: Explicit costs of sharing knowledge

The explicit costs exist because individuals have to invest time and efforts to share their knowledge. Therefore, one of the factors that affect individuals' sharing willingness is the explicit costs of sharing. The higher the costs are, the less the sharing willingness is.

- γ_2 : Implicit costs of sharing knowledge

When individuals share their knowledge, they may incur a hidden cost, due to the fact that their competitiveness and uniqueness in an organization may be hampered after sharing their specific knowledge. Such costs are conceptualized as the "implicit cost" of knowledge sharing. The magnitude of such costs depends on the uniqueness and importance of the knowledge within a particular organization.

- S: Intrinsic rewards of sharing knowledge

As individuals share their knowledge in organizations, they may get positive feedback from their colleagues or may enjoy better performance of their work groups. Sometimes one shares knowledge in order to gain respect or appreciation from colleagues or to build up professional reputation in a work group. These non-monetary rewards are regarded as "intrinsic rewards." In study, S is further broken down to S1, Reputation rewards, S2 , performance improvement of work teams, S3, altruism.

- ω: Extrinsic rewards for sharing knowledge

Extrinsic rewards such as monetary rewards are common means for promoting knowledge sharing.

2.2.2 Parameters Regarding Firms

It is assumed that firms will devise certain strategies for better knowledge sharing and management, such as organizational structures or incentive systems, characterized by the following parameters:

- c : Costs for ICT platforms and their implementation

The costs for ICT platforms and their implementation are usually accounted for the major costs of knowledge management and are often considered a costly investment.

- c_R : Firm's costs for providing extrinsic/monetary rewards

Under certain conditions as we shall discuss later, it would be beneficial for firms to provide monetary

rewards for the sharing of particular knowledge. c_R will be one of the decisional factors for organizations in developing knowledge management strategy.

- π : Benefits due to improved firm competitiveness

The benefits due to better or improved competitive advantages are the major reason for KM. Although these benefits are difficult to be precisely quantified, we assume that in practice they can be estimated so as to compare with the costs for KM.

2.2.3 Game Modeling and Knowledge Taxonomy

We assume that knowledge sharing game is a dynamic game with complete information, where firms first provide the environment for knowledge sharing, and then employees decide to share or not. Figure 1 shows the game model of knowledge sharing dynamics. As shown, there are two players in the game, the employee and the firm. The strategy of the firm and the sharing decisions of the employees are made based on the characteristics of the knowledge in the firm. By solving the game trees in Fig. 1 backward recursively, we obtain five possible game equilibria and seven corresponding scenarios numbered in Fig. 1. Due to the length limit, the detailed derivations of each equilibrium and scenario can be found in Ho et al. (2006).

Six types of knowledge are identified or categorized as shown in Table 1 based on the equilibria characteristics. The six types of knowledge are characterized by three dimensions: 1. explicit costs of sharing knowledge, γ_1 , 2. implicit costs of sharing knowledge, γ_2 , and 3. benefits to the firm due to the sharing, π . First, the "simple knowledge" is characterized by low explicit and implicit sharing costs, as characterized by scenarios 1 and 4. A simple database system or sharing community platform would be sufficient for managing scale-sensitive simple knowledge. Second, the "core simple" knowledge is the simple knowledge with the scale economies in dissemination and utilization of the knowledge. Third, the "core non-unique knowledge" is characterized by high explicit but low implicit sharing costs, and high benefits to the firm. Firms need to either largely reduce the explicit sharing cost or provide rewards in order to encourage the sharing. Fourth, the "core unique" knowledge is characterized by much higher implicit sharing costs compared to the core non-unique knowledge. Firms usually need to provide extrinsic rewards for encouraging the sharing. Fifth, the "special knowledge" is characterized by low benefits to the firm compared to the core unique knowledge. For example, knowledge on a firm's IT infrastructure or on tax laws can be regarded as special knowledge. According to the equilibrium, extrinsic rewards are needed to encourage the sharing, but it is not economical to provide such incentives. Sixth, the "spurious knowledge" is characterized by high explicit sharing but low benefits to the firm. The sharing of such knowledge, such as out-dated or irrelevant knowledge, should not be encouraged.

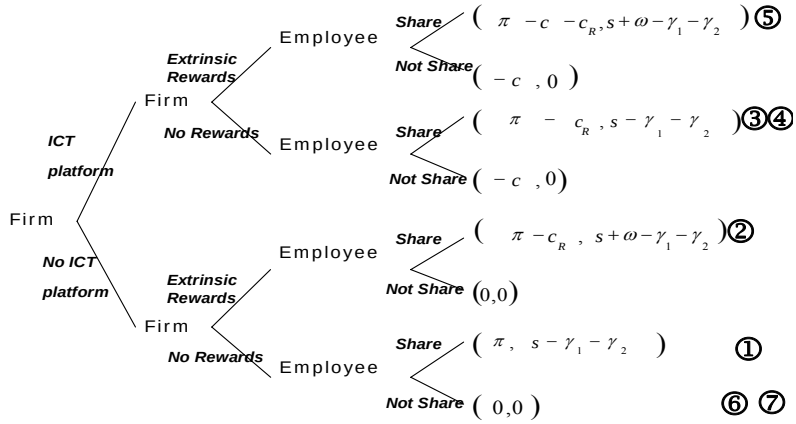

Figure 1. Game Model of Knowledge Sharing Dynamics

Table 1. Knowledge Categorization and Equilibrium Scenarios

	π (L)		π (H)	
	γ_2(L)	γ_2(H)	γ_2(L)	γ_2(H)
γ_1(L)	Simple knowledge ①	Special knowledge ⑦	Core simple knowledge ④	Core Unique knowledge ②
γ_1(H)	Spurious knowledge ⑥		Core non-unique knowledge ③	⑤

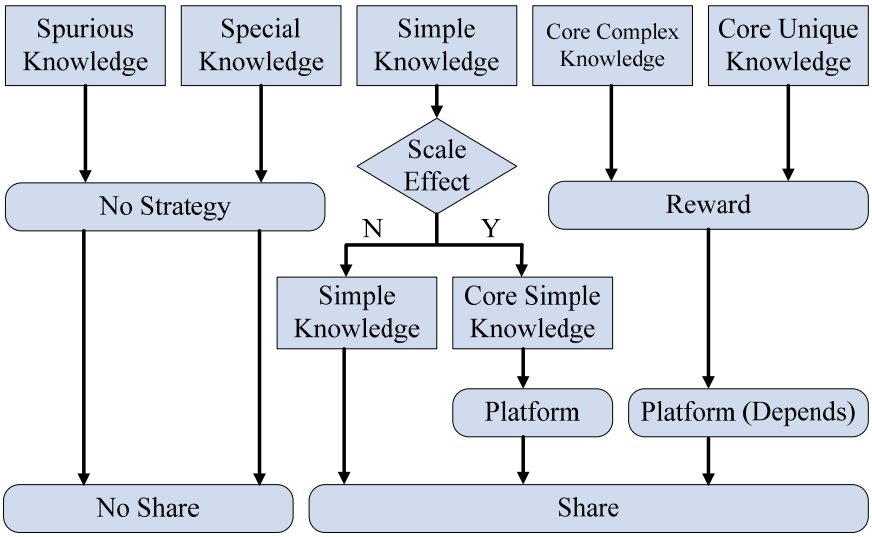

Figure 2. Model Implied Strategies for Knowledge Sharing

3. Case Study

3.1 Background

STAR (pseudo name) Engineering Consultants Inc. is one of the largest engineering consulting firms in Taiwan, also one of the ENR top engineering consulting firms in the world. Beginning from the year 2000, Knowledge Management System (KMS) was implemented to promote its working efficiency and maintain its competitiveness. STAR employed a system that quantifies the sharing efforts of each individual and aims to ensure the minimum level or points of sharing of each individual. Two major ICT platforms were implemented: the KM database system and the knowledge sharing and communication platform, including a so called "Emergency" bulletin (pseudo bulletin name) for timely problem solving and discussions. Several studies, such as Bartol and Srivastava (2002), Cabrera and Cabrera (2002), Pascarelia (1997), suggest that a useful approach for tacit knowledge sharing is to develop various internet-based communities where employees and experts with specific knowledge or skills can gather together to share their knowledge through discussion.

3.2 Survey Study of the Case

3.2.1 Survey Design

The total number of questionnaires sent out was 1164. 958 questionnaires came back and 806 of them were valid for analysis. The survey was designed to verify the hypothesis concerning the knowledge sharing

model. Regarding the knowledge type characterized by the aforementioned three dimensions: γ_1, γ_2, and π, we used three questions to evaluate the three characteristics of the knowledge owned by individuals. Six-point Likert scales were used in the questionnaire to prevent neutral answers to the questions, where scale one was strongly disagree (or very low) and six was strongly agree (or very high). In order to categorize different types of knowledge using the measurements of γ_1, γ_2, and π, we considered Likert scales one to three as low values and scales four to six as high values.

3.2.2 Survey Results and Implications on Knowledge Sharing

- Knowledge distribution and the sharing willingness

As shown in Table 2, according to the proposed categorization the individuals who own core unique, core non-unique or core simple knowledge are about 67% of the total respondents. Given that STAR is an engineering consulting firm, the knowledge profile and distribution as shown in Table 2 is considered quite reasonable according to a senior manager of STAR. Table 2 also shows the statistics of individuals' willingness to share and perceived payoffs from sharing with respect to the types of their knowledge. The ANOVA p-values in each column of Table 2 are less than 0.001, indicating that the distinction between different categories is statistically significant. According to the survey, the individuals who own core-type knowledge have higher willingness of sharing than those who own spurious and special knowledge. This indicates that the knowledge sharing incentive system of STAR was in the right direction in terms of the types of knowledge to be encouraged for sharing. However, the mean willingness to share core (unique and non-unique) knowledge is still far from scale five or six, showing that although many efforts were employed to encourage the sharing of knowledge, these efforts were not very effective. We shall discuss later what could be more effective means to promote the sharing of core knowledge.

- Perceived payoffs due to knowledge sharing

Table 2 also shows four major possible payoffs from sharing knowledge perceived by different types of knowledge owners. These payoffs include the extrinsic rewards, omega ω, and the intrinsic rewards, S. According to Table 2, the extrinsic rewards are significantly lower than others in all types of knowledge. The highest and lowest payoffs among intrinsic rewards are altruism and reputation, respectively. We shall discuss their impacts on knowledge sharing later in details.

Table 2. Sharing Willingness and Perceived Payoffs

Knowledge Types	%	Sharing Willingness	Omega	S1	S2	S3
ALL	100 %	**3.484**	2.548	3.553	3.725	4.145
Spurious Knowledge	12.3%	**3.051**	2.091	2.929	2.939	3.778
Special Knowledge	5.5%	**3.295**	2.477	3.523	3.614	3.932
Simple Knowledge	14.8%	**3.025**	2.378	2.697	2.908	3.496
Core Simple Knowledge	12.0%	**3.825**	2.526	3.835	3.990	4.079
Core Non-unique Knowledge	19.6%	**3.573**	2.373	3.696	4.013	4.316
Core Unique Knowledge	35.8%	**3.689**	2.889	3.952	4.100	4.388

- Who are the owners of different types of knowledge?

Table 3 shows the demographic profile of different types of knowledge, which may help us identify the owners of each type of knowledge, as shown in the last column of the table. For example, we consider that the owners of simple knowledge are mostly experienced supporting staff because its demographic profile shows the highest percentage of female employees, lowest education level and relatively low salaries. Particularly, we find that the core unique knowledge is mainly owned by senior engineers, characterized by highest level of education, relatively high pay and medium seniority. The ANOVA p-values in each column of Table 3 are less than 0.001. When our conclusion concerning knowledge owners was presented to STAR's top managers, they considered such matching between knowledge owners and specific knowledge reasonable. The purpose of locating the owners of different types of knowledge is twofold. First, a reasonable match between knowledge owners and knowledge indicates that the knowledge taxonomy implied by the knowledge sharing model was supported by the data. Second, characteristics of the owners of specific knowledge may help to devise further strategies for sharing knowledge. For example, since the senior middle to high level managers typically do not have time to sit in front of computers for an extended amount of time, to promote their sharing of the core non-unique knowledge, it is crucial to include other sharing channels or approaches that are not computer based, such as mentoring.

Table 3. Knowledge Owners and Their Demographic Profiles

Knowledge types	Age	Salary (K)	Education	Years	Male%	Who are the Owners?
Spurious (99)	37.55	49.29	4.40	8.68	62.6%	Junior engineers and supporting staff
Special (44)	39.48	52.39	4.25	10.55	72.7%	Professional supporting staff
Simple (119)	39.34	50.29	4.04	11.05	58.0%	Experienced supporting staff
Core Simple (97)	43.10	64.27	4.30	13.71	81.4%	Senior lower level managers
Core Non-unique(158)	43.60	69.56	4.51	13.78	79.1%	Senior middle to high level managers
Core Unique(289)	41.39	61.21	4.52	11.98	76.8%	Senior engineers

Salary: monthly pay, in Taiwan Dollars; Education: 3=senior high, 4=Bachelor's, 5=Master's; Years: number of years working in this firm.

4. Implications on Organizational Controls for Better Knowledge Sharing

4.1 Focusing on the Sharing of Core Types of Knowledge

- Only core types of knowledge deserve specific resources for promoting the sharing

Since only core types of knowledge can bring enough benefits to cover the costs of resources for managing knowledge, the organizational arrangements or strategies for knowledge sharing should make sure that core types of knowledge are shared. A good criterion to identify core knowledge is to evaluate whether the sharing of the knowledge can enhance an organization's competitive advantage.

- The sharing of non-core types of knowledge will pollute the knowledge bases and hamper the utilization of KM systems

Garbage In Garbage Out (GAGO) also applies to KM systems. The more useless or spurious knowledge is in the systems, the less the individuals of an organization is likely to benefit from or utilize the systems. As a result of oversharing of non-core types of knowledge, either the individuals are less motivated to use the systems or the organization has to incur significant costs to differentiate the quality of shared knowledge.

- Use different "individual's minimum sharing requirements" for different types of knowledge owners

The use of "individual's minimum sharing requirements" may help to ensure the overall minimum level of sharing that may help to alleviate the social dilemma complex (Cabrera and Cabrera, 2002); i.e., why I am the only one contributing. However, according to our case study, the use of uniform sharing requirements may force those own non-core types of knowledge share low value knowledge or even garbage in order to meet the requirements. An organization should try to identify the owners of different types of knowledge similar to those shown in Table 3 and impose lower requirements for the owners of non-core types knowledge, such as the new comers or supporting staffs.

4.2 The Use of Extrinsic Rewards

- Using extrinsic rewards but mainly as the symbol for reputation

Although our game model indicates that extrinsic rewards are one of the major incentives that an organization can use to promote the sharing of core unique and non-unique knowledge, the case study shows that the use of high rewards may not be a good strategy because 1. high extrinsic rewards usually encourage high frequency of sharing, particularly the sharing of easier-to-share non-core types of knowledge and 2. it is too costly to differentiate the quality of shared knowledge. However, extrinsic rewards can be an excellent symbol for reputation of sharing core types of knowledge; especially the rewards are given by the high ranked manager in an open setting.

4.3 The Use of Intrinsic Rewards

- The intrinsic rewards can be critical incentives for the sharing of core types of knowledge

As shown in Table 2, if the extrinsic rewards cannot be too large as argued above, then the intrinsic rewards must be high enough to promote the sharing of core types of knowledge. Reputation is usually associated with the quality of the shared knowledge (how many people find it helpful). Performance improvement of work teams is often achieved when project/department leaders or managers share their knowledge. Altruism is found to be the highest among all perceived payoffs in the studied case. This indicates that the culture of helping each other, cooperation, or team spirit will strengthen the altruism rewards and hence enhance the sharing willingness.

4.4 The Use of ICT Platforms

- Advanced ICT platforms should be used only when the platforms can help to achieve either scale economy in disseminating the knowledge or significantly lower explicit costs of sharing.

The use of advanced ICT platforms does not necessarily increase the probability of a successful KM. For example, for organizations of small scale or non knowledge-intensive, basic ICT platforms may be enough for managing knowledge.

4.5 Three Stages of Promoting Knowledge Sharing

- First stage: using carrot and stick to break an old culture

Carrot and stick strategy is used when the systems are implemented. Carrot is used to promote sharing. Over-sharing and the sharing of non-core types of knowledge should not be a concern. The purpose of sharing at this stage is to familiarize the individuals with the systems and to establish the habits of sharing. Stick is used to maintain a minimum level of sharing within an organization to reduce the social dilemma problems discussed previously and also to help individuals establish the habits of sharing through systems.

- Second stage: shaping a new culture

In this stage, extrinsic rewards are reduced and intrinsic rewards are emphasized. Organizations begin to focus on the sharing of core-types of knowledge and shaping the culture that strengthen both the magnitude and the effect of intrinsic awards.

- Third stage: sharing core types of knowledge as a culture and an institution

In this stage, organizations mainly focus on using intrinsic rewards. Punishments for not meeting the minimum sharing level are significantly reduced.

5. Conclusions

In this study we introduce a game-theoretic model for analyzing the knowledge sharing dynamics and defined six types of knowledge, characterized by three dimensions. In our corporate-wide single case study, we find that the survey results are largely consistent with model implications. Combing the model and case study, we derive organizational control strategies and propose some illustrative practices for better managing knowledge.

Acknowledgement

The support of STAR (pseudo name) consulting firm is greatly appreciated. Without their support, this study is not possible.

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