Knowledge sharing in an organization – Share or not?

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Abstract- Knowledge sharing is an important issue to knowledge management. Because knowledge is considered as a resource of organization competition and a kind of strategic capital, the more the knowledge is expanded in an organization, the more the capacity of competition is. Although there are many theoretical literatures that suggest management means or normative rules to prompt knowledge sharing in an organization, it is difficult to evaluate the effect of knowledge sharing in an organization. The behavior of knowledge sharing among individuals in an organization is involved in the characteristics of knowledge, a conflict of interests, and interaction among actors and the organization that actors reside in. Therefore, the phenomenon of knowledge sharing is the result of dynamics, complexity, nonlinear interaction among knowledge seekers and providers, and the organization that actors belong to. In this paper, agent-based modeling is proposed for exploring the effect of knowledge sharing in an organization. The decision-making whether an actor share their knowledge with other is simply drawn an analogy to the prisoners’ dilemma game. According to the different actor’s payoff due to the characteristics of knowledge, the situations of knowledge sharing in an organization is discussed. According to the result of experiences, we found that no matter what types of knowledge sharing payoff matrices were, agents finally shared their knowledge with others. Nevertheless, most agents would take the Tit-for-Tat strategy.

I. INTRODUCTION

In the information economy, the building of the organization competition does not simply depend on tangible capital such as lands, labor, and equipment, but intangible capital like knowledge is emphasized. Therefore, in recent years, knowledge management has become popular and many specialists and researchers devoted themselves to research. Although a large number of studies have made on knowledge management, little is known about the individual behavior of knowledge sharing and the interaction among people in an organization.

Knowledge sharing in an organization is an important issue. Because knowledge is considered as a resource of organization competition and a kind of strategic capital in information economy, the more the knowledge is expanded in an organization, the more the capacity of competition is [1]. Although there are many theoretical literatures suggesting management means or normative rules to prompt knowledge sharing in an organization, it is difficult to evaluate the effect of knowledge sharing in an organization. The reason is that the behavior of knowledge sharing between individuals in an organization is involved in the characteristics of knowledge, a conflict of interests, and interaction among actors and the organization that actors reside in [1, 2]. Therefore, the phenomenon of knowledge sharing is the result of dynamics, complexity, nonlinear interaction among knowledge seekers and providers, and the organization which actors belong to.

In this paper, agent-based modeling is proposed for exploring the effect of knowledge sharing in an organization.
organizational artifacts or the knowledge of organization entities. In order to achieve this goal, some practitioners or researchers proposed improving the infrastructure of information exchange or communication by IT. They assume that people are willing to share their knowledge with others via applying novel communication tools or IT. The perspective leads to some criticisms. Because the complication of knowledge sharing is underestimated in an organization, at the organization level some influence factors of knowledge sharing must be considered carefully such as trust between people and organization, organizational climate, and practice communities. Therefore many management strategies, incentives or methods are advocated prompting the knowledge sharing in an organization [1, 2].

III. THE ACTORS’ MOTIVATION AND BEHAVIOR

However, sharing knowledge is a kind of personal behavior. Following the basic assumption in economics, the motivation of personal behaviors is essentially self-interest and people will do their best to maximize individual utility. If the knowledge owned by people is valuable to themselves and organizations and could be exchanged, why would people share their valuable knowledge with others?

The critical question is not on the types of knowledge (explicit or not), but on the motivation of sharing their knowledge of people and later their actions or behaviors based on maximizing their utility. For example, some specific kind of knowledge is valuable to an organization and the people who own the knowledge will gain exclusive benefit in an organization. When people share their knowledge with others and do not gain any other compensation in an organization, the exclusive benefit, which people can gain from the organization, will be decreased, or even lost forever. In this condition, the intension of sharing particular knowledge is weak, even if the knowledge is explicit knowledge.

Consider another context of knowledge sharing. If the knowledge which people share is general in an organization, such as the knowledge about organizational routine procedures, the behavior of sharing their knowledge is expected to have good prospects of gain. Because of their knowledge sharing, they may share their responsibility for their work, but it would not cause any damage to their benefit or utility. It is a basic condition for people to possess some general knowledge that is needed for an organization. General knowledge could not produce additional benefit for people. So people are willing to share with others. People with specific knowledge would make themselves differential among individuals. Therefore, they would obtain additional exclusive benefit because of their specific knowledge. So it is difficult to encourage people to share their specific knowledge, especially contextually specific knowledge.

However, if people can gain additional payoff through sharing their knowledge with others, people might tend to share their knowledge with others in an organization. There is a potential benefit when people share their knowledge each other. That is, they may gain or create new specific knowledge and therefore possess more exclusive benefit in an organization. Because of possibility of obtaining additional payoff, people are driven to share their commendable specific knowledge even if there is potential risk of losing their knowledge advantage in an organization.

“Localness of knowledge” is an important characteristic of knowledge sharing across individuals [1]. People usually share their knowledge with their organizational neighbors. Especially to specific knowledge, the transaction of the knowledge more depends on the mutual trust because of its potential risk. Individuals generally trust the persons whom they know. So, it could be expected that individual’s knowledge sharing would be limited by their interactive network which is composed of different social relationships including formal and informal relationships.

When researchers trying to explore the tendency of sharing knowledge of individuals and the effect on organizations and individuals, the available analysis of knowledge sharing present some underlying analytical difficulties, because of the emergence of global properties that is not predictable on the base of local interaction. Computer simulations seem to be a kind of suitable method in studying those phenomena, which really include elements of complexity.

IV. THE MODEL OF EVALUATION OF THE EFFECT OF KNOWLEDGE SHARING IN AN ORGANIZATION

In order to analyze the complexity of phenomena, the distinction between linear and non-linear systems is an important one of fundamental aspects. The behavior of a whole linear system can be considered as the sum of its constituting parts. Therefore, we may study a linear system with a reductionist method. The system can be divided into several simpler parts, which can be individually studied. The understanding of the individual parts can be superposed and the understanding of the whole linear system should be followed. This is a so-called superposition principle. In this case it may be said that the systems is complicated [5, 6, 7].

Nonlinear systems cannot apply such a superposition principle. Even if the observer has understood the causality of each part, it is impossible to say that he has understood the system as a whole. The kind of systems is so-called complexity systems. Analyzing a complex system, the focus is on the connection between its parts, rather than the understanding of separate parts. This is the fundamental difference between a complicated and a complex system.

The other feature of a complex system is such as emergence. By defining each part’s internal and interaction rules, the outcome of the systems as a whole is different from the simple sum of its parts. The interested coherent behavior may emerge which is not defined priori and spontaneously come out from the aggregate dynamics [6].

When we try to study and evaluate the effect of knowledge-sharing in an organization, it must be kept in mind that the phenomena is not a simple causality,
but is involved in the interaction between individuals and organizational units. The phenomena cannot be considered simply as a linear system that individuals in an organization can spontaneously demand and supply for different kinds of knowledge. They would take actions and apply some strategies for ensuring their utility maximization.

A. Agent-based modeling approach

For exploring the interaction among individuals and the effect of knowledge-sharing in an organization, agent-based modeling (ABM) is a good strategy for studying such complex systems. It is a kind of simulation method and button-up strategy. By ABM, the researcher can create, observe, analyze, experiment with artificial world populated by agents that interact in non-trivial ways. The artificial systems building by ABM exhibits the following two properties: (1) it is composed of interacting agents; and (2) it would exhibit emergent properties, which arise from the interactions of the agents that cannot be deduced simply by aggregating the properties of the agents. [8]

B. The framework of our simulation

Consider that knowledge sharing is a process of interaction of decision-makers in an organization, which is a kind of strategy game. In general, individuals differ in predisposition to share their knowledge. Some individuals tend to share their knowledge regardless of other individuals’ activities, but some don’t.

So one-period iterative prisoner’s dilemma game seems to be an ideal context to formalize the tendency of sharing knowledge of individuals. According to prisoner’s dilemma game, “sharing” could be treated as a kind of cooperating action and “not sharing” could be treated as a kind of defecting action. Each individual would gain their payoff, after interaction between individuals in each period. Due to the payoff compared with other among their neighbor agents, individuals may adapt and choose the best strategy gaining the maximum payoff among their neighbor agents.

We consider the following theoretical concepts:

1) Different payoff matrices of knowledge sharing: Because of different characteristics and classifications of knowledge, an individual would make different decisions. The decision is also influenced by the interaction with the other. The payoff of sharing knowledge depends on the other’s action, the job relationship between the related workers and the characteristics of shared knowledge.

2) Maximizing personal utility: Knowledge is one of important resources for individuals. By sharing their knowledge with others, individuals may accumulate continuously their knowledge. Although individuals have different tendency to share their knowledge, individuals would separately look for maximum payoff in a long time and adjust their tendency of sharing knowledge to maximize their payoff.

3) Organizational payoff on knowledge sharing: In order to measure the organizational payoff, there are several assumptions in this model. It is assumed that there is no cost for organizations in the mutual exchange of knowledge and people will separately apply the knowledge, which comes from sharing knowledge, to their works. Besides, the utility of knowledge will never be exhausted. Therefore, in the model, the organizational payoff is simply considered as the sum of all individual payoffs.

The goal of the simulation is to build a model useful to understand the effect of knowledge-sharing from two different points of views.

First, from a micro perspective we have investigated: (1) why individual would decide to share their knowledge with others in an organization, and (2) how their strategy and actions would be affected according to the payoffs that they face.

Second, from aggregate perspectives we have looked for emergent phenomena coming from the interactions of the simple agents described in the model, and we investigated: (1) what the effect is on organizational payoff after member’s knowledge-sharing, and (2) what an organizational climate is. Is it trusty or suspect?

Employees are the most important assets in a firm. Only by individual’s knowledge, a firm would compete with other firms in the market. An individual must accumulate his (her) knowledge to build the capability to satisfy organizational requirement. Each individual has different tendency of sharing knowledge. It means that an individual will adopt different strategies to share knowledge with another.

In the model, one of assumptions is that individual’s tendency of sharing knowledge depends on the situation which the individual is handled at last period. This is so-called one step memory strategy. The general expression of the strategy is a triple \((i, p, q)\) where \((1) i = 1\) is the probability of cooperating at \(t=0\); \((2) p = 0\) is the probability of cooperating if the opponent cooperated; \((3) q = 0\) is the probability of cooperating if the opponent defected, and \(i, p, q\) has binary value 0 or 1 [9].

There are four kinds of one-step memory strategies induced: (1) ALLC: always cooperate and share his knowledge with another. The triple of Strategy is \((1, 1, 1)\). (2) ALLD: always defect and doesn’t share his knowledge with another. The triple of strategy is \((0, 0, 0)\). (3) TFT: Tit for Tat. He will share his knowledge when the other also shares. Otherwise, he would not share his knowledge. The triple of strategy is \((1, 1, 0)\). (4) ATFT: anti-Tit for Tat. When the other shares his knowledge, he would not share. On the other hand, when the other does not share his knowledge, he would share. The triple of strategy is \((0, 0, 1)\) [9].

In each period, an individual’s payoff is equal to the payoff of personal knowledge accumulation. We assume that each individual will look for personal maximum accumulative payoff. Each individual would adjust his (her) strategy by referring to the neighbor agents’ strategies that have achieved maximum accumulative payoff. In each period, an individual may have some probability of adapting and choosing again his (her) strategy.
C. The different payoff matrices according to the characteristics of knowledge

Next, the payoff should be considered according to the characteristics of knowledge and relatively relevant to each other. The payoff of knowledge sharing to individuals also depends on the other action. So the payoff of knowledge sharing could be expressed as a payoff matrix or the tabular formats like table 1. In this paper, three kinds of payoff matrices are considered because of different kinds of knowledge sharing effects.

1) Knowledge sharing with substitution effect: Assume that a job would require both of two related workers to complete. The piece of the knowledge, which is possessed separately by individuals, is complementary. In this condition, sharing knowledge to the other might reduce individual difference and increase the probability of being substituted by the other in an organization. When one shares their knowledge, but the other does not, the former may be substituted for the latter. Therefore, the payoff of only the other sharing knowledge would be the higher than the payoff of both sharing. So, the payoff matrix for knowledge sharing with substitution effect can be exhibited as table 1.

| TABLE 1 | PAYOFF OF SHARING KNOWLEDGE WITH SUBSTITUTION EFFECT |
|-----------------------------------------------|
| Individual B |
| Share Knowledge | (3, 3) |
| Not share knowledge | (0, 5) |
| Individual A |
| Share Knowledge | (5, 0) |
| Not share knowledge | (0, 0) |

2) Knowledge sharing without substitution effect: Sometimes, knowledge sharing would not cause the substitution effect. Many employees have general knowledge. This kind of knowledge sharing could not make more differences among members in an organization. In the situation, the payoff of only the other sharing knowledge would be equal to the payoff of both sharing. So, the payoff matrix for knowledge sharing without substitution effect could be exhibited as table 2.

| TABLE 2 | PAYOFF OF SHARING KNOWLEDGE WITHOUT SUBSTITUTION EFFECT |
|-----------------------------------------------|
| Individual B |
| Share Knowledge | (5, 5) |
| Not share knowledge | (0, 0) |
| Individual A |
| Share Knowledge | (5, 0) |
| Not share knowledge | (0, 0) |

3) Knowledge sharing with bonus effect: People might create new knowledge or capture new contextually specific knowledge after mutually sharing knowledge. In this situation, it can be expected that the payoff of both sharing separate knowledge would be much higher than others. So the payoff of knowledge sharing with bonus effect can be exhibited as table 3.

| TABLE 3 | PAYOFF OF SHARING KNOWLEDGE WITH BONUS EFFECT |
|-----------------------------------------------|
| Individual B |
| Share Knowledge | (10, 10) |
| Not share knowledge | (0, 5) |
| Individual A |
| Share Knowledge | (5, 0) |
| Not share knowledge | (0, 0) |

Following the above rationale, we utilized Repast [10] to implement the simulation model. The interaction grid space of agents was constructed in which there are 625 agents (25*25). At the start, agents adopting different strategies are randomly well-mixed in the interaction grid space. Agents, who follow the above rules and one kind of the payoff matrices, interact iteratively with their separate neighbors in each run. There are 20% chances that each agent could change its strategy from one run to the next. In the model, several important characteristics could be observed such as the distribution of agents adopting different strategies in each period, organizational payoff, and frequencies of sharing and no-sharing action in each period.

V. THE RESULT OF SIMULATIONS

Three kinds of payoff matrices were applied to the artificial simulation world for observing the emergent phenomenon from interaction of knowledge sharing of agents. In the case of knowledge sharing with substitution effect, the frequencies of agents adopting the ALLD strategy (shown as the black line) are increasing progressively, and later the tendency is decreasing as the iterative interactions between agents go continuously. Finally it will be eliminated through agents’ competition and adaptation. The numbers of agents who use the ALLC (shown as the red line) or ATFT (shown as the light-blue line) strategies are decreasing progressively. Eventually, the TFT strategy (shown as the blue line) dominates over the others strategies. There is only a little percentage of agents, about less 1%, who adopt the ALLC strategy in the world. The pattern goes stable after 46 runs. The tendency of transition appears in Fig. 1.

Another interesting question is what action the agents take in each period. Here is the Fig. 2, which show the statistic of actions, which are taken by agents in each period. As the beginning of simulation, the numbers of non-sharing actions taken by agents (shown as the blue line) are soon increasing and then decreasing in a short time. On the other hand, the numbers of the sharing action taken by agents (shown
as the red line) are declining at the beginning, and then are increasing progressively. Finally, the system would become stable: all agents would share their knowledge with others.

Regarding the organizational payoff, we could also observe the tendency. We could present the trend of change of organizational payoff in a diagram as Fig. 3. As time gone on, the organizational payoff of knowledge sharing was stably increasing.

The same simulation processes were applied to two other kinds of payoff matrices of knowledge sharing, the results are shown in Fig. 4-9. The patterns of organizational payoff in these two situations (Fig. 6 and 9) are similar to Fig. 3. In the context of knowledge sharing without substitution effect (shown in Fig. 4 and 5), the numbers of agents taking the ALLD strategy (shown as the black line) arose just a little and latter declined soon. The ATFT strategy (shown as the light-blue line) taken by agent was given up progressively. In initial several periods, the numbers of agents who took the ALLC strategy (shown as the red line) were slightly swinging and then kept at fixed level, about nearly 20%. So, the TFT strategy (shown as the blue line) still dominated the others although there were no strong motivations not to share their knowledge. The pattern goes stable after 49 runs.

But, it is surprised to find the emergence of phenomena in the simulation for the knowledge sharing with bonus effect (shown in Fig. 7 and 8). Although there were greater benefits of sharing their knowledge, the group of the agents taking the TFT strategy was the greater part, about nearly 64%, in the artificial world. The pattern goes stable after 42 runs.

To sum up, although there were differences in the payoff matrices of knowledge sharing, in the iterative simulation, agents would finally share their knowledge with other. About four kinds of strategies (ALLC, TFT, ATFT, and ALLD), most agents would choose the TFT strategy in spite of the different benefits in sharing knowledge. Because agents finally took the action of sharing their knowledge, the organizational payoff would accumulate continuously under our assumptions of the model.
their self-interest motivation. Reaching knowledge automatically because people would drive by organizational knowledge sharing. The goal would be not invoke any other methods or tools for encouraging organization. In these circumstances, managers need identified, evaluated and priced clearly in an other way, it implied that knowledge would be shared automatically only if the knowledge could be

First, based on the relevance and importance of knowledge, from which people might acquire special or exclusive benefits, it is a reasonable to hypothesize that people would present the different patterns of their behaviors when people expect different payoffs of knowledge sharing and look for maximal personal utility. However, in our simulation model, agents would finally share their knowledge with others no matter which payoff matrices they faced. This means that people may share automatically their knowledge based on their self-interest behaviors even without any external or organizational intervention. To put it another way, it implied that knowledge would be shared automatically only if the knowledge could be identified, evaluated and priced clearly in an organization. In these circumstances, managers need not invoke any other methods or tools for encouraging organizational knowledge sharing. The goal would be reached automatically because people would drive by their self-interest motivation.

Second, it is worth to discuss what condition the organization climate is. We did not any assumption about the organizational climate. This now raises the question of whether the organizational climate is trusty or not according to different payoffs of knowledge sharing. We can observe the distribution of action strategies taken by agents to judge the condition of organizational climates.

In the context of knowledge sharing with substitution effect, the TFT strategy dominated over the other strategies. The ALLD and ATFT strategies were eliminated, and only few agents, less 1%, which took the ALLC strategy, existed in the artificial world. From the above simulation result, it seems that almost all agents might adopt a kind of self-defense strategy, not open their mind with others. We may conjecture that the organizational climate is full of suspect, opposition, and competition in the context of knowledge sharing with substitution effect. However, in the context of sharing knowledge with bonus effect, the percentage of agents taking the ALLC strategy rose to about 36%, though the agents taking the TFT strategy still were the majority. It can be concluded that if benefit conflicts were decreased, the organizational climate would trend to be trustier.

In order to focus on the influences under different payoffs of knowledge sharing, some assumptions have built for simplifying the complexity degrees and analyzing easier. For example, the range of agents’ interaction was limited to the neighbors in the simulation grid space. It seems to be not true that people would share only with their neighbors. In the real world, it is reasonable to suppose that the individuals’ knowledge sharing should not only exist in formal network but also in individual social networks. This complicated situation is worth to explore further.

Other assumptions are as follows. (1) The knowledge is never out-of-date and the utility, which people or organizations could get from knowledge, is also never exhausted. (2) The knowledge sharing in an organization is assumed to have no cost. (3) On the other hand, it was assumed that individuals or organization could identify clearly the knowledge what they want. And (4) the knowledge could also be evaluated and priced. These assumptions might not be true in reality. By way of ABM approach, researchers could tune the interaction rules among agents to simulate reality and then observe the emergent phenomena of various individual behaviors and organizational circumstances. Therefore, in next phase of our research, these assumptions will be released progressively in order to explore the phenomena of knowledge sharing in organizations.

VI. DISCUSSION AND CONCLUSION

It is very important to managers to evaluate the effect of knowledge sharing in an organization. Because opinions are diverse on how to enhance knowledge sharing efficiently and effectively in an organization, this research has proposed the ABM approach to simulate the interactions among agents of an organization. Through the approach, many interesting phenomena could be observed.

REFERENCES


