African Journal of Business Management Vol.5 (8), pp. 3040-3046, 18 April 2011
Available online at http://www.academicjournals.org/AJBM
DOI: 10.5897/AJBM09.164
ISSN 1993-8233 ©2011 Academic Journals

Full Length Research Paper

Knowledge-management strategy and organizational learning: An agent-based simulation

Liao Liefa[1,2]*, Jiang JinHu[2] and Wang KanLiang[3]

[1]Faculty of Information Engineering JiangXi University of Science and Technology, GanZhou, 341000, China.
[2]School of Management, Xi'an Jiaotong University, Xi'an, 710049, China.
[3]School of Business, Renmin University of China, BeiJing, 100872, China.

Accepted 18 January, 2011

The objective of this study is to explore the effects of knowledge management strategy on organizational learning by a simulation model. The study extends the March simulation model and compares the effectiveness of the codification and personalization knowledge management strategies in a different context. First, the study finds that codification strategy can improve knowledge rapidly while personnel strategy can reach higher knowledge level more slowly. Second, an inverted U-shaped relationship exists between organization knowledge and personnel turnover when using codification strategy, while personnel turnover is negatively related to organization knowledge in personnel strategy. Third, codification strategy is more susceptible than personnel strategy in an environment turbulence situation.

Key words: knowledge management strategy, organization learning, exploration, exploitation, simulation.

INTRODUCTION

The ability of an organization to learn and acquire knowledge has become a key factor influencing organizational performance and survival. Many organizations are increasingly adopting knowledge management systems (KMS) to effectively manage knowledge within the organization. However, many knowledge management efforts result in less than desirable outcomes, even backfire, and undermine competitive performance (McDermott 1999; Haas 2006). While organizations implement similar KMS, the success of a KMS depends on the characteristics of the strategies themselves, the organization's culture, organizational turnover and environmental turbulence. Existing research has addressed various issues relating to knowledge including the taxonomies (Nonaka and Konno, 1998), knowledge sharing (McLure Wasko and Faraj, 2005), types of KMS (Hansen, 1999; Earl, 2001), effective use of KMS (Poston and Speier, 2005; Kulkarni et al., 2006) and influence factors on success knowledge management practices (Kane and Alavi, 2007). Little is understood about how to implement effective KMS.

*Corresponding author. E-mail: liaolf@126.com. Tel./Fax: 0086—13607077261.

In this research, the paper extends the model of organizational learning developed by March (1991) and Miller et al.(2006) to explore the impact of the codification and the personalization knowledge management strategies (Hansen, 1999) on organization learning. More specifically, the study examines how different characteristics of KMS, the individuals using them, and organization context each have an impact on organizational learning performance.

Knowledge management strategies and organization learning

In the knowledge-based view of the firm, an organization that can draw on diverse knowledge assets can maintain an enterprise long-term competitive advantage (Kogut and Zander, 1992; Conner and Prahalad, 1996).

Knowledge is complex and itself cannot turn into a competitive advantage; an organization should implement a knowledge management strategy to create and transfer knowledge between employees. As Nonaka mentioned (Nonaka and Konno, 1998), knowledge always has explicit and tacit dimension. Organizational knowledge is created through a continuous dialogue between tacit and explicit knowledge. Hansen (1999) found that consulting

businesses employ codification knowledge management strategy (CKM) and personalization knowledge management strategy (PKM) to managing knowledge. In codification strategy, the knowledge is carefully codified and stored in knowledge repositories. Everyone in the organization can access these knowledge repositories and learn explicit knowledge. In this "people-to-documents" approach, knowledge is extracted from the person who developed it, made independent of that person, and reused for various purposes. In personalization strategy, knowledge is closely tied to the person who developed it and is shared mainly through direct person-to-person contact. In this "people-to-people" approach, knowledge is transferred in tacit form, and is difficult to imitate and replicate by others. Compared to explicit knowledge, tacit knowledge is difficult to transfer and learn.

Organizational learning (OL) is the dynamic process of creating new knowledge and transferring it to other people. OL is related to the concept of KM, however, KM emphasizes the static stock knowledge while OL is emphasizes the dynamic process. In this paper, the study focuses on two forms of OL, exploration and exploitation. Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, and innovation. Its focus is on developing new knowledge. Exploitation includes things such as refinement, choice, production, efficiency, selection, implementation, and execution (March, 1991). Its focus is on reuse of existing knowledge. Previous research has noted that KM can influence OL, but the underlying mechanism is not fully explored.

In the knowledge transformation cycle, Carlile and Rentibish (2003) identified three stages of individual learning knowledge: accessing knowledge, transforming that knowledge according to their own experience, and contributing the transformed knowledge for later use by others in the organization. Knowledge converges more quickly, resulting in exploitation. In codification knowledge strategies (CKS), individuals access the same knowledge resource and contribute their knowledge to the same knowledge repositories. In personalization knowledge strategies (PKS), individuals have different knowledge sources and transfer knowledge in an open transformation cycle, there, knowledge converges more slowly and exploration occurs.

There are two distinct knowledge transferring approaches in the knowledge sharing process. The first is through direct contact between individuals. One characteristics of this approach is that the handover of knowledge is through direct contact between the provider and receiver. The second way is from documents. The feather of such approach is the separation between the provider and receiver. Martine (Haas 2006) found that sharing codified knowledge in the form of documents saved time but did not improve work quality when performing the task. In contrast, sharing personal advice improved work quality but did not save time. Thus, the study proposed:

H_1: In a stable closed system, CKM yielded more rapid short-term performance benefits than PKM, while PKM got higher long-term knowledge level than that of CKM.

In a complex environment, individuals can only grasp part of environment knowledge, so the knowledge level and knowledge structure is different between employees in organization. Personnel turnover affects the balance and location of knowledge in the organization (Carley 1992). In CKM, a stable organization without turnover can yield rapid knowledge homogeneity and balance. Appropriate personnel turnover can import new knowledge into the organization and may be codified into repositories. At the same time, a new-comer with a low knowledge level cannot affect other individuals' knowledge directly and may not influence codified knowledge repositories. This means that appropriate turnover may increase organization knowledge level. As turnover rate increases, more knowledge is lost than gained, decreasing the overall organization level. In PKM, personnel turnover affects interactive learning among individuals, it needs a longer period for new-comer to improve their knowledge and as a result of slow learning rate, and the overall organization level is decreased by the new-comer. As discussed above, the study is proposed :

H_2: In personnel turnover organization, organization knowledge has an inverted U-shaped relationship to turnover rate in CKM, while it has a negative relationship to turnover in PKM.

As March (1991) and Henri (2005) found that both environmental turbulence and organizational turnover detriment average knowledge levels in the organization, the degeneracy created by environmental turbulence can be avoided by turnover (March, 1991). In a stable organization, CKM resulted in quicker convergence of knowledge levels to equilibrium. It is difficult for the organization to cope with environment knowledge belief changing. In PKM, the rate of organizational learning is slower, thus resulting in organization knowledge heterogeneity in the long run. Organization knowledge deals with environmental changes and avoids rapid knowledge level decreases. Thus, the study suggests:

H_3: In turbulence environment, PKM can keep a better organization knowledge level than that of CKM.

METHODOLOGY

The research conducts in this study using simulation. Simulation is a particularly effective method for research when the basic outline of a theory is understood, but its underlying theoretical logic is limited. It is also useful when research is non-linear and empirical data is challenging to obtain.

The study regards an organization as a complex adaptive

system, where individuals interact with other individuals. In particular, the study views individuals as carriers of ideas and knowledge, and OL as a property that emerges from interactions among individuals in the organization. An individual interacts with other individuals, who may influence him or her to adopt new ideas and to discard old ideas. This assumption of interpersonal learning makes the paper distinct from March's (1991) work, and builds on recent work by Miller et al. (2006). The study models OL as a process by which individuals within an organization interact to exchange and jointly create knowledge.

The simulated organization's goal is to maintain the best possible representation of an exogenous environment. The model has six main entities.

1. External Reality. Like March (1991), the study describe reality as having *m* dimensions, each of which has a value of 1 or -1. The probability that any one dimension will have a value of 1 (or -1) is 0.5.
2. Individual. There are *n* individuals in an organization. Each individual holds beliefs about the environment in an m-element vector at each time step, $B^i = b_1^i b_2^i .. b_m^i ; b_j^i \in \{-1,0,+1\}$. A value of 0 reflects the absence of a belief about a particular dimension of the organization environment.
3. The organizational code, from which individuals acquire knowledge, is a vector, also with m elements. Individual knowledge in the simulation is defined as the extent to which a belief structure matches the exogenous real world. An individual's knowledge is calculated as:

$$IK_i = \sum_{j=1}^{m} (b_j^i * e_j)$$

The average level of individual knowledge is given by

$$AOK_i = \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{m} (b_j^i * e_j)$$

This measure is bounded at +1 and -1. The upper bound, 1, indicates complete correspondence between all individuals' belief structures and the environment.
4. Knowledge update method. During the simulation, the knowledge update method is calculated as

$B_{i.t}=B_{i.t-1}*(1-p1)+SuperKN*p1$

Where: $B_{i.t-1}$ is i individual's knowledge vector in t-1cycle; Bi.t is individual's knowledge vector in t cycle, SuperKN is high knowledgevector; p1 is learning speed.

Similarity, the knowledge update method in community is calculated as:

$B(randpart)_{i.t}=B(randpart)_{i.t-1}*(1-p4)+SuperKN(randpart)*p4$

Where: p4 is learning speed in community; randpart is the knowledge dimension in learning.

The knowledge codification is calculated as:

$OK_{i.t}=OK_{i.t-1}*(1-p2)+NewOK*p2$; where $NewOK=o_1o_2o_3\ldots o_s$

Where

$$o_i = \begin{cases} +1 & if \sum_{j=1}^{k} b_i^j > 0 \\ 0 & if \sum_{j=1}^{k} b_i^j = 0 \\ -1 & if \sum_{j=1}^{k} b_i^j < 0 \end{cases}$$

k is individual number whose knowledge is codified as organization knowledge.

5. Knowledge management strategy. In this paper, two types of KMS were considered; the knowledge management processes of these strategies are conducted in following way (Figure 1).

In CKM, the process of using the CKM for knowledge learning involved three stages: first, individuals contributing to CKM by identifying which members of the team have a higher knowledge level than the CKM. Second, the organization synthesizes knowledge from each team into a knowledge vector. In this stage, organizational code adjusts over time to reflect the dominant beliefs among better-performing organization members. The s-dimensional organizational code consists initially of all zeros. It is updated every beta periods by identifying whether -1 or 1 is the most widely held belief among those individuals whose knowledge levels are superior to that of the code. The organizational code adopts the more widely held value with probability *p*2. Third, the CKM disseminates the knowledge by allowing individuals to search knowledge held in each team codification knowledge, when individuals access knowledge through the codified knowledge, they search the knowledge vectors by assembling those codified team knowledge that have knowledge levels that are higher than the individual's level. In any given period, individuals learn from the code with probability *p*1.

In PKM, besides learning from the working team (the learning rate is p3), the PKM were organized along particular interest groups and involved individuals learning from a sub network of employees within the community with learning rate p4 every gamma periods. Using PKM is regarded as a relatively lean learning mechanism when compared to other mechanisms. The study model is characterized by specifying that individuals can only exchange a portion of their knowledge dimensions (k dimensions) with others.
6. In every period, the organization conducts personnel turnover with probability p5 and environment turbulence with probability p6.

RESULTS

The study constructed the simulation model 100 times for each set of parameter specifications (Table 1). For each run of the model, the average knowledge levels of all individuals were calculated. Upon completing specification analysis, the study focused the discussion on the simulation result related to the hypothesis; first, it explore exploration and exploitation characteristics of specific KMS, second, it compared knowledge levels among different KMS, and discussed the effect of personnel turnover and environmental turbulence on the knowledge level in the end.

KMS and knowledge level

The simulation result shows that different KMS appears to have different effects on exploration and exploitation. The simulation result demonstrates two learning patterns in organization. In CKM, a fast learning rate yields very rapid short-term performance while a slow learning rate reach stable status more slow. However the long-term organization knowledge level is similar between different learning rates, these patterns suggest that CKM tend to be an exploitation learning style. Conversely, knowledge levels under other KMS tend to increase more slowly in

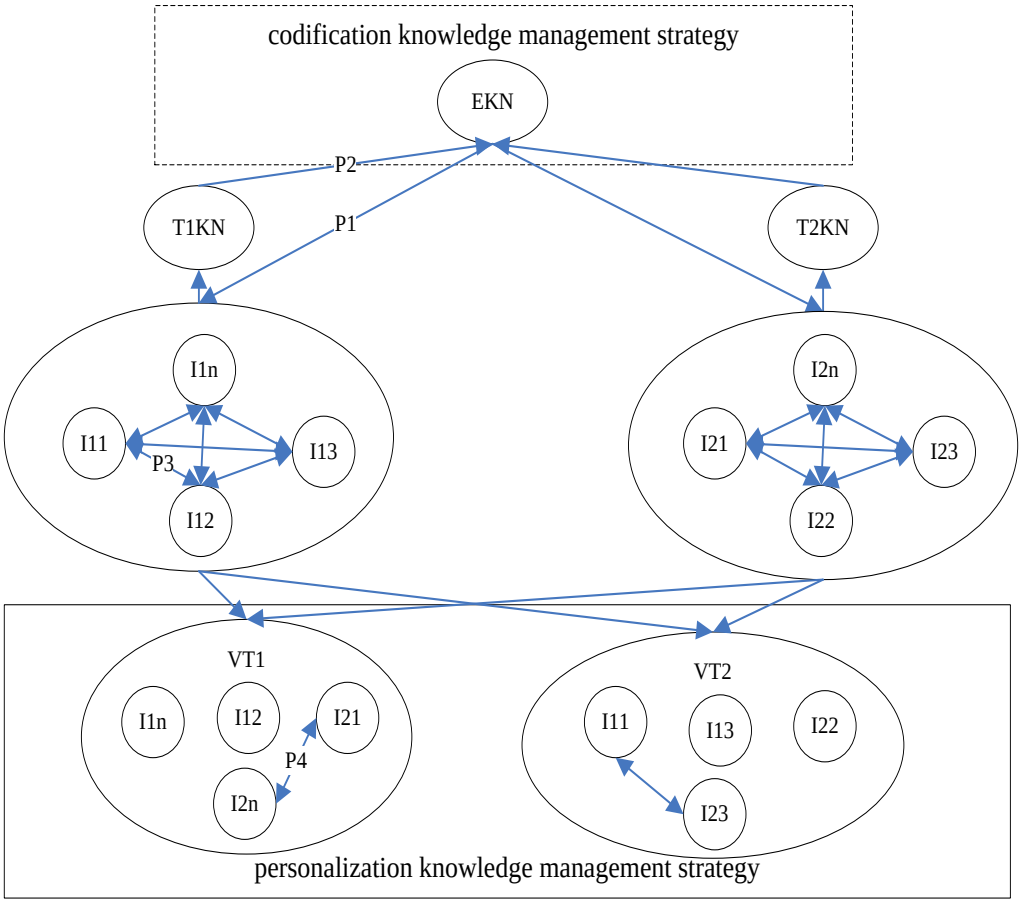

Figure 1. Knowledge management strategic framework
EKN: enterprise codification knowledge; T1KN: team knowledge; I11: team member; VT1: community team

Table 1. Simulation parameters.

Parameter	Meaning of parameter	Values used in the model	Sensitivity analysis
N	Individual number	100	80, 100, 120, 150, 200
M	Dimension of knowledge	150	90, 120, 150, 180, 200
S	Knowledge codification dimension	75	45, 60, 75, 90, 100
p1	Individual knowledge learning speed from codification knowledge	0.5	0.1. 0.3, 0.5, 0.7, 0.9
p2	Knowledge codification speed	0.5	0.1, 0.3 , 0.5, 0.7, 0.9
Beta	Knowledge codification cycle	5	1, 2, 3, 4, 10, 20
p3	Individual team learning speed	0.5	0.1, 0.3, 0.5, 0.7, 0.9
p4	Individual community learning speed	0.5	0.1, 0.3, 0.5, 0.7, 0.9
K	Community knowledge learning dimension	50	30, 50, 80, 120, 150
Gama	Community learning cycle	5	1, 2, 3, 4, 10, 20
p5	Personnel turnover rate	0.1	0.05, 0.15, 0.2, 0.5
p6	Environment turbulence rate	0.03	0.01, 0.02, 0.04, 0.05
Teamno	Team number in organization	10	5, 20, 25
commno	Community number in organization	5	4, 5, 8, 10

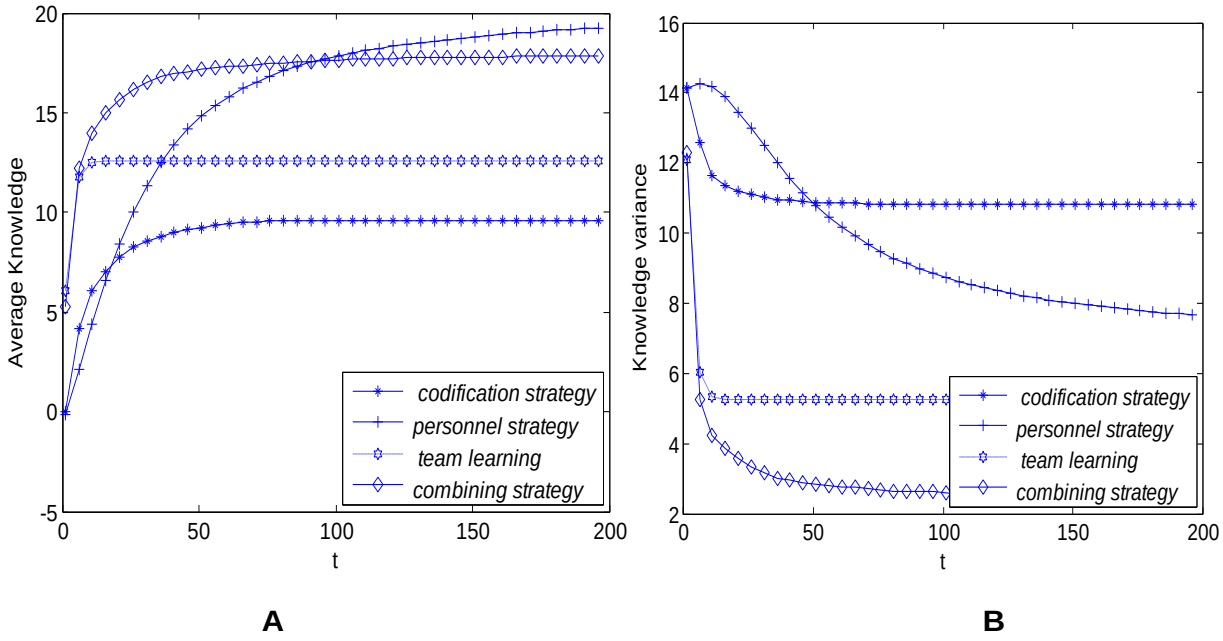

Figure 2. The effect of learning strategy on knowledge level.
A: Learning strategy and knowledge level; B: Learning strategy and knowledge variance.

the slow learning rate, but the long-term performance is much higher than the fast learning rate. This pattern is labeled as exploration learning by March (1991), and the simulation suggests that KMS such as PKM has an exploration effect on organization learning.

Figure 2 demonstrate the result of different knowledge management strategy on average population knowledge levels and knowledge variance in the same learning rate (p1~p4=0.9). The simulation result shows that even at a very high learning rate, PKM improves organization knowledge level very slowly, but the knowledge level is higher than other KMS after simulation round 100. The CKM result in the lowest organization level among all learning mechanisms. This result is consistent with March (1991) and Miller (2006). Figure 2b also shows that the knowledge variance of CKM is higher than other KMS. The reason for this result is that only parts of knowledge is explicit and can be codified in repositories, the rest of tacit knowledge is maintained in variance during the simulation periods. The simulation result supports hypothesis 1.

Personnel turnover and knowledge level

As the personnel turnover can produce knowledge variability in organization, in this situation, as March (1991) demonstrated, the low learning rate results in knowledge decline, however, the combination of fast learning and a modest level of turnover improves aggregate knowledge. Figure 3 shows that in CKM, the moderate turnover rate and fast learning rate improves overall knowledge level as well as codification knowledge, while CKM has no effect on tacit knowledge level. On the other hand, in PKM, individuals learn knowledge in an interactive approach and the communicate content of knowledge is smaller than CKM.

The figure demonstrates that there is a negative relationship between personnel turnover and organization knowledge level. The other two learning mechanisms (team learning and combining learning) result in similar pattern to CKM, which is consistent with Miller (2006). The simulation result supports hypothesis 2.

Environment turbulence on knowledge level

The March (1991) simulation model showed that environment turbulence had a deterioration effect on organization knowledge and found that personnel turnover can resists the degrading effects of environment turbulence. Figure 4 show that different KMS has different effects on turbulence deterioration in a stable organization. Compared to PKM, in CKM, the knowledge between individuals is kept in heterogeneity and is more susceptible to environmental turbulence.

In CKM, organization knowledge converging to equilibrium level quickly and then deteriorating down. However, in PKM, the knowledge deterioration rate is much slower than CKM. Figure 4a shows when the turbulence rate is low (p6=0.01), the overall knowledge is keep at a high level around 20. The simulation result demonstrates that PKM can keep better organization knowledge level than CKM in a turbulent environment.

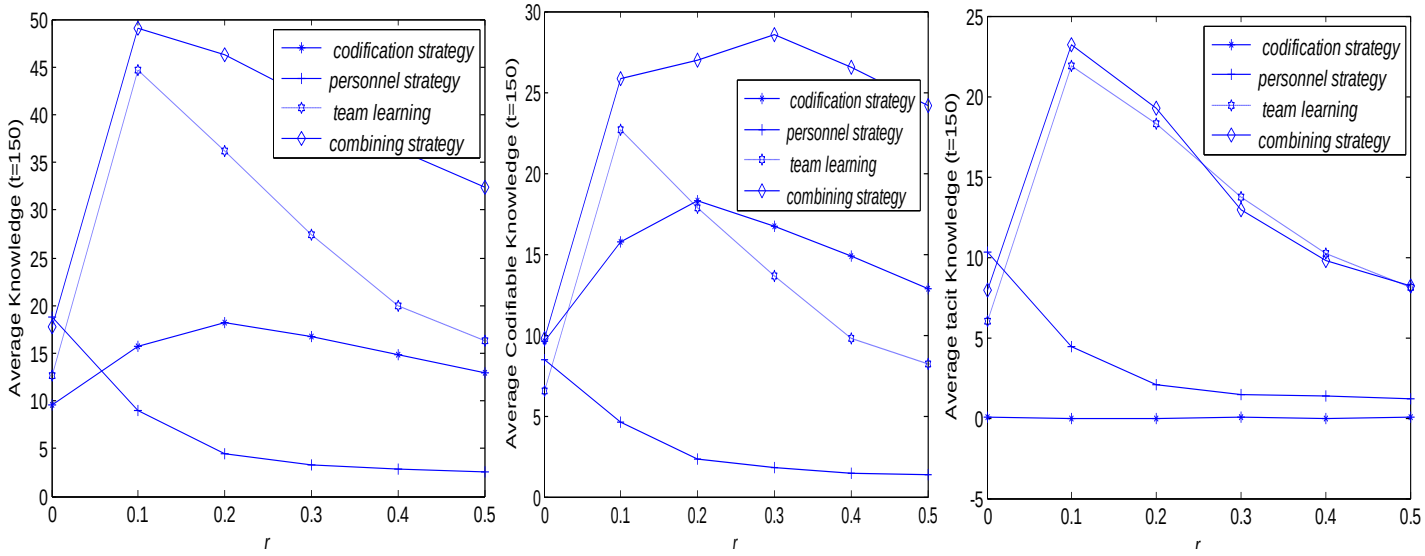

Figure 3. The effect of personnel turnover on knowledge level.
p1=p2=p3=p4=0.9, beta=gamma=5

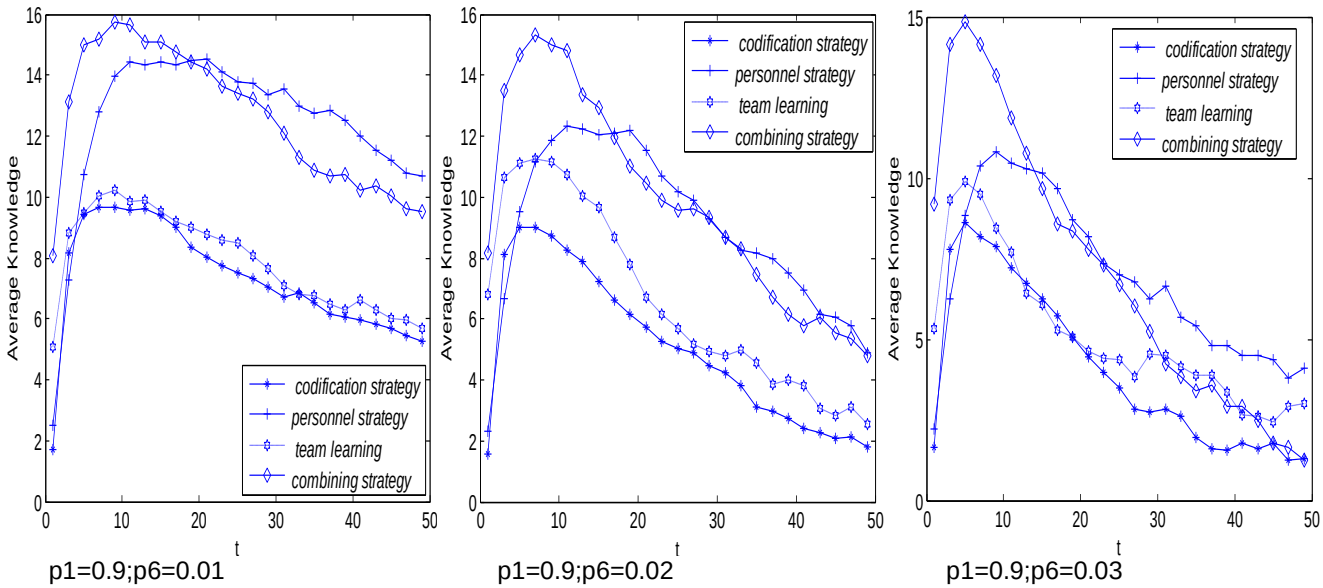

Figure 4. The effect of environment turbulence on knowledge level.

The hypothesis 3 is supported.

DISCUSSION AND CONCLUSION

In this paper a simulation model to study the effectiveness of KMS on organization learning was used. The result indicates that different KMS has different effects on organizations under different environments. If an organization uses the wrong type of knowledge management strategy, the organization cannot get its organization learning aim. This work provides some insights on how to implement KMS under specific conditions.

First, different KMS have different effects on exploration and exploitation processes, a new established firm who wants to survive in a market should use CKM to promote its knowledge rapidly, while a dominant firm that has already grasped a great deal codified knowledge should pay more attention to exploration learning using PKM. Second, this research suggests that an organization can use different KMS to cope with personnel turnover and environmental turbulence.

For an organization under conditions of modest turnover rate, CKM can improve organization's overall

performance while PKM is negatively related to personnel turnover. On the contrary, for an organization under conditions of environment environmental turbulence, PKM can preserving preserve higher organization knowledge heterogeneity and better retain knowledge level than CKM. By incorporation of different organizational structures and heterogeneity heterogenic learning rates, these findings can be empirical empirically investigated in actual organization organizations in future research.

ACKNOWLEDGEMENTS

This research was supported by the National Natural Science Foundation of China under Grant 70890081, 71061008 and Jiangxi Social science research project (08YJ36).

REFERENCES

Carley K (1992). Organizational Learning and Personnel Turnover. Org. Sci., 3(1): 20-46.
Carlile PR, Rebentisch ES (2003). Into the Black Box: The Knowledge Transformation Cycle. Manage. Sci., 49(9): 1180-1195.
Conner KR, Prahalad CK (1996). A Resource-based Theory of the Firm: Knowledge Versus Opportunism. Org. Sci., 7(5): 477-501.
Earl M (2001). Knowledge Management Strategies: Toward a Taxonomy. J. Manage. Inform. Syst., 18(1): 215-233.
Haas MR (2006). Acquiring and Applying Knowledge in Transnational Teams: The Roles of Cosmopolitans and Locals. Org. Sci., 17(3): 367-384.
Hansen MT (1999). The search-transfer problem: the role of weak ties in sharing knowledge across organization subunits. Admin. Sci. Q., 44: 82-111.
Kane GC, Alavi M (2007). Information Technology and Organizational Learning: An Investigation of Exploration and Exploitation Processes. Organ. Sci., 18(5): 796-812.
Kogut B, Zander U (1992). Knowledge Of The Firm, Combinative Capabilities, And The Replication Of Technology. Organ. Sci., 3(3): 383-397.
Kulkarni UR, Ravindran S, et al (2006). A Knowledge Management Success Model: Theoretical Development and Empirical Validation. J. Manage. Inform. Syst., 23(3): 309-347.
March JG (1991). Exploration and Exploitation in Organizational Learning. Organ. Sci., 2(1): 71-87.
McDermott R (1999). Why Information Technology Inspired But Cannot Deliver Knowledge Management. Calif. Manage. Rev., 41(4): 103-117.
McLure WM, Faraj S (2005). Why Should I Share? Examining Social Capital and Knowledge Contribution In Electronic Networks Of Practice. MIS Q., 29(1): 35-57.
Miller KD, Meng Z, Calantone RJ (2006). Adding Interpersonal Learning and Tacit Knowledge to March's Exploration-Exploitation Model. Acad. Manage. J., 49(4): 709-722.
Nonaka I, Konno N (1998). The Concept of "Ba": Building A Foundation For Knowledge Creation. Calif. Manage. Rev., 40(3): 40-54.
Poston RS, Speier C (2005). Effective use of knowledge management systems: a process model of content ratings and credibility indicators. MIS Q., 29(2): 221-244.