Analysis on Competence of Creators Based on the Theory of Knowledge Recombination

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Abstract: innovation has been viewed as a recombinant process involving much extant knowledge to create new knowledge. The theory of knowledge recombination reveals the essential nature of knowledge creation from a new perspective. During couples of years, this theory had been developed dramatically, and the competence of creators had been emphasized through the analysis on the knowledge recombination mechanism. Previous research also analyzed levels of creators, and revealed characteristics of knowledge recombination on different levels. This paper reviews the stream of this research and reveals the saltatory increase both in potential optimal results and in the complexity of the recombination. Further, we explore potential issues involving in this academic direction that are valuable to be studied in future research.

Keywords: knowledge recombination; knowledge creation; the creator; competence

I. Introduction

As early as 100 years ago, Henri Poincaré pointed out that, new knowledge stems from existing knowledge and is the combination of existing knowledge [1]. This view continues to today and forms the increasingly prosperous theory of knowledge recombination. This theory stresses that, the knowledge creation activity is the recombination to the existing knowledge [2-4] and the existing knowledge involved in the knowledge recombination is the material for the creation of the new knowledge.

The recombination theory of knowledge clarified the process of knowledge creation from unique viewpoint, ingeniously summarized the creation as the combination to existing knowledge elements, cleared complex and abstract and elusive activities of understanding, absorption and conversion, etc and increased the operability of research. And the knowledge recombination process with high degree of summarization is still able to accurately express the creation of knowledge [5]. Thus, the in-depth study of this theory can reveal the inherent mechanism of creation of high-value knowledge, raise people's awareness of the knowledge creation and make theoretical contribution of knowledge creation and study.

Previous studies discussed the internal mechanism of the recombination of knowledge, analyzed the complex nature of the knowledge recombination and revealed the key factors impacting the knowledge recombination, among which, the actor's capability is essential and determines the successful feasibility of knowledge recombination. The actor's knowledge recombination features in levels of individual to team and then to firm. With the level increasing, the complexity faced by the knowledge recombination increases and meanwhile the potential best result also increases. The key whether the knowledge recombination is successful or not is whether the actor is able to deal with complexity to achieve best result of knowledge recombination. This paper analyzes the difficulty and potentiality of knowledge recombination of various levels and summarizes the key capability which the actor of various levels should own to theoretically guide the knowledge recombination in different contexts.

II. Knowledge Recombination and Its Mechanism Studies

Emergence of Knowledge Recombination Study

In the research field of innovation economy, very long ago, somebody once recognized the importance of recombination. Earlier studies concerned about the recombination of product parts, such as, Schumpeter viewed that the innovation activity is trying the new combination to the parts [6], Henderson and Clark proposed the concept of construction innovation which is found as the very important innovation method [2]. The combination of parts can be approximately regarded as the combination of knowledge elements. Nelson and Winter expressly proposed the concept of knowledge combination. They stated that any activity producing new things in the arts, science and real life includes the recombination on existed concept or material object [7]. The knowledge creation activity is based on some existing knowledge elements. Controversies on where the knowledge elements should be selected from still remain among scholars. Some scholars stressed the "path dependence" feature of knowledge innovation [8], they viewed that, the industries are divided clearly, various technical fields are strongly fortified and the knowledge inside the fields can hardly be understood by outsiders, therefore, the new knowledge is often built on the knowledge elements within the fields [9]. The innovated development is the dynamic process of knowledge of internal fields and viewed from the long term, appeared as technical development path of internal fields. Other scholars stressed the cross-fields knowledge creation mode, for instance, Hargadon discussed the importance of technical convergence. He thought that the technical convergence is to

combine knowledge from different fields and this combination can create huge market return [10], this is because, collecting a large amount of knowledge from different fields can obtain multiple ideas to bring the new knowledge elements for the innovative actor, challenge the actor's existing concept, stimulate the actor for transform and bring breakthrough innovation [11]. Exactly, whether the high-quality knowledge innovation is more reliable on the recombination of knowledge within the fields or more reliable on the knowledge overlapping of multiple fields, we need to analyze the internal mechanism of the knowledge recombination to answer this question.

Mechanism Study of Knowledge Recombination

At beginning of the 21st century, scholars started to launch in-depth analysis on the knowledge recombination mechanism. Fleming and Sorenson viewed the knowledge recombination process as the complex adaptive system. They verified that the features of the knowledge elements affiliated field are decisive to the new knowledge's value [12]. Specifically, they focused on analyzing two parameters' decisive role, namely, N indicates the number of the knowledge elements affiliated field and K indicates the interdependence between the fields. Among which, greater the K value is, greater N fields' knowledge elements' joint action to the innovation result is. When K is equal to zero, each field contributes to the innovation independently and the knowledge inside the field i's contribution to the result is not impacted by other fields' participating conditions. When K value is very great, discussion of certain field's knowledge's contribution to the innovation should be based on other fields' participating conditions. When other fields' investment conditions are different, the field i's contribution to the result is very different. This paper's author viewed the creation of actor excellence-searching process as a complex adaptive process. When K is equal to zero, NK terrain is the single peak, the excellence-searching is very easy. Namely, all fields select the condition with greatest contribution to the result. When K is very great, NK terrain is very complex with multiple peaks occurred. The excellence-searching process is very difficult. The selected under most of circumstances are local optimum and all locations' excellence is not available. The modular combination (K=0, namely, there is no inter-independence between the fields) and the interactive combination (with very great K value, namely, there is very strong inter-independence between the fields) owns its own advantages and disadvantages, the certainty of the former is more greater and its various combinations' average contribution is more greater, while the latter's overall most excellent value is more greater. They comprehensively analyzed the role of N and K, the conclusion is that, when N and K are very great, the innovation result variance is very great, they thought this is caused by the capability difference of creation actor. When the actor's capability is very powerful, the actor can control a wide range of knowledge and search the overall most excellent value from the complex terrain. When the actor's capability is less powerful, the actor trends to fall into the local search and the final searched is sub-excellent conclusion.

Fleming deeply discussed in another article the creation actor (what he analyzed is the creation personnel)'s decisive role to the knowledge recombination, he viewed that the creator's difference of controlling ability on innovation is the origin of the caused uncertainty of the technical innovation [4]. Specifically, he viewed that the creator with high level should be very familiar with the knowledge elements and very experienced to related knowledge fields, and then he can promote the result of the knowledge recombination and lower the uncertainty. He further explained that, if the creator relies on the familiar field greatly, it will soon run out the potentiality of the knowledge recombination, therefore, the creator shall not indulge in his own familiar field.

We can see from the above studies on the knowledge recombination mechanism that, exactly select single field's knowledge or select multiple fields' combination, the key depends on the capability of the actor. When the knowledge inside the field still owns the potentiality and the actor's capability is not sufficient to control the complexity brought by greater N and/or greater K, we should select the innovation inside the field. When the actor's capability is very powerful and can control the complexity brought by greater N and/or greater K, we should select the recombination mode of the multiple fields and fully use the multiple-field's crossing to expect for the breakthrough result.

Generally speaking, the crossing mode of multiple field knowledge is more potential to bring the breakthrough innovation. However, providing that, the creation actor shall own corresponding capability. Different level actor owns its own feature and the needed actor capability is featured respectively. The following analyzes each actor level's complexity facing the knowledge recombination and discusses each needed capability.

III. Levels of Creators in the Knowledge Recombination

Levels of actors in the knowledge recombination include personal, team and firm. They own the containing relationship from the above to the bottom, the personal stands on the foundation status and the above are the team and firm. The layer is the unit composing of the upper layer and the upper layer is impacted by the lower layer's features and composed structure.

Personal Level

The person is the actor foundation of the knowledge creation. All knowledge creation activities should be processed by the personal thinking activities. Fleming's analysis of the personal capability concerned the creator's capability to specific recombination activity and deeply discussed the

personal familiarity to the knowledge field and the familiarity to various field combination and their impacts to the knowledge recombination result. After that, the joint study between him and Sorensen more generally discussed the personal capability difference. They thought that, what covered under the appearance of scientific promotion of technical innovation is the personal scientific knowledge's decisive role to the knowledge recombination. Gruber， Harhoff and Hoisl more systematically analyzed the creator's knowledge recombination capability. They found that the creator's educational level, working experiences, scientific qualification, creation experiences and team cooperative capability determine his knowledge recombination capability [14].

Team Level

In the study on the knowledge recombination of the innovation team, the person is often equal to the knowledge elements which can not be sub-divided. The team composed of many persons can remarkably increase N and K and can gather the mass capability to control the complexity brought by greater N and greater K. However, this is the ideal status and the actual conditions are more much more complex. From reality-based observation, it is generally considered for a long time that, multi-person cooperation does not produce the breakthrough creation, for instance, John Steinbeck's viewpoint is very extreme, he thought that, human creativity comes from the personal wisdom and spiritual strength, any combination with over two persons owns no creativity, the cooperation between persons is to deal with larger scale of innovation activities and the team as a whole own no creativity [15]. This extreme viewpoint hasn't accepted in the managerial study. We think that the team as a whole owns the characteristics of the initiative creation and can be viewed as the independent creation actor. However, the team creativity is currently a topic of academic debate. For instance, Taylor and Greve's study verified that, in the cartoon book creation industry, the team creation's uncertainty is greater and the team's organization capability to the multi-field knowledge is not better than the independent personal creator [16]. Girotra，Terwiesch and Ulrich found that, after the individual joins in the team, his creativity is lowered, the creator created less new knowledge in the team than his independent creation and his capability of searching most excellent innovation result is also less standard [17]. However, Fleming and Singh analyzed the team cooperative advantages. They thought that, there is the strict mutual criticism mechanism in the team which can nip the wrong in the bud, therefore, the possibility of the team innovation obtaining the failure result is less. The team's knowledge quantity is larger than the individual's and fine development direction can be rapidly found, so the possibility for the team innovation to get the breakthrough result is greater. To achieve the team innovation's advantages, staffing is very important. Fleming and Singh further clarified that the diversity of the members' knowledge and background can promote the team's innovation [18]. This shows that a good team's knowledge structure shall own greater NK and the knowledge combination mode among the team members is also very important.

Firm Level

When the creator is the firm, the corresponding study is often based on firm performance. Kogut and Zander thought that the firm should own the capability to integrate various kinds of knowledge [19]. Similar to this, Rosenkopf and Nerkar also suggested that the firm should enhance the cross-knowledge-border creation capability [20]. Henderson and Cockburn showed that the firm should increase the knowledge's diversity, and this can not only increase the potential of innovation but also enhance the firm's absorptive capability [21]. The diversity of knowledge is the linkage of the input and output. Wadhwa and Kotha discussed the relationship of the investment and innovation output of the firm and found that the higher the firm's knowledge diversity's degree is, the more significant the two's positive relationship is [22]. The knowledge recombination needs the broad knowledge transfer among the departments as the basis. Miller, Fern and Cardina verified that the knowledge transfer among the departments can promote the firm's innovation [11]. Recombination of various fields' knowledge may be obstructed by the department boundary, for instance, Tsai analyzed the social relationship's influence to the knowledge transfer and sharing within the firm [23]. Birkinshaw, Nobel and Ridderstrale discussed the firm's organizational structural influence to the knowledge transfer within the firm [24]. Carlile more fully analyzed the cross-department-boundary characteristics of the knowledge within the firm [25].

When the firm faces huge competition pressure, obtaining the external knowledge is an important method. Scholars have long noticed the external knowledge's promotion role to the firm [26]. Chesbrough introduced the concept of "open innovation" and thought that the firm's innovation activities should be accompanied with large introduced external knowledge [27]. Menon and Pfeffer found the manager's emphasis to the external knowledge far exceeds that of internal knowledge [28]. Some scholars have verified the external knowledge's promotion role to the firm's performance [29, 30]. Additionally, researchers discussed the complementary relationship between the external knowledge acquisition and the internal innovation [31, 32]. Studies on use of external knowledge have penetrated to different external contexts, such as multinational firm's branches and the county where they locates [33], industrial clusters[34], high-tech firms and universities and research institutes [35], among partners of supply chain [36] and alliance network [37], etc. These studies respectively highlighted each studied situation's features. In recent years, some studies discussed the distribution of external knowledge sources, and found that the external knowledge

source's breadth impacts a firm's innovation [30, 38]. Recent studies focus on applies the analysis in connection with different knowledge varieties to the firm's external knowledge use. Phene, et al analyzed the influence of the firm's "similarity" of obtained external knowledge and internal knowledge to its breakthrough innovation [39]. Operti and Carnabuci analyzed the influence of the linkage of the knowledge between the firm and its partners to the innovation performance [40].

IV. Competence of Creators

It can be seen from the study of the knowledge recombination mechanism that, the basic factor to impact the knowledge recombination effect is the number of elements in their respective areas of knowledge, the inter-independence among the knowledge fields and the capability of the creation actor. Among which, increasing the first two will increase the optimal result of the innovation, but meanwhile also increase the difficulty of optimization, so the actor needs to own certain capability to overcome this difficulty. Analyzed from the level of the creation actor, take the lower level of actor as the foundation of the higher level of actor. The former knowledge source elements varieties and its correlation among the knowledge elements are accumulated by the latter. Namely, the higher level of actor's optimized innovation result is better than that of the lower level. This reveals the potentiality of the higher level of knowledge recombination. However, the higher level of actor can also leap in bring about system complexity and the needed actor capability also increase layer by layer.

The actor's various levels needed capability is shown on the following Table 1.

Table 1 Various Levels of Actor Needed Capability

Actor Level	Actor Needed Capability	
Enterprise	External	Construction of Open Innovation Mechanism Selection Capability of External Knowledge Absorption Capability to External Knowledge
	Internal	Organizational Structure Conducive to Knowledge Exchange Enterprise Culture Conducive to Knowledge Integration
Team	Effective Resource, Staffing and Capability of Labor Division Effective Knowledge Integration Mechanism Effective Internal Judgment Mechanism Effective Incentive Mechanism	
Individual	Cognitive Capability to Various Knowledge Elements Recombination Capability to Various Knowledge Elements	

Note: The upper level contains the lower level's content. For simplicity, this table only lists out the newly added content of the upper level of the actor.

On the individual level, the key to search the optimized innovation plan is the knowledge creator's controlling capability of the knowledge elements listed into the creation scope and the combination capability of various elements. The knowledge elements are the "building materials" in the course of the knowledge recombination. The creator can use various knowledge elements into appropriate situations in the knowledge recombination and fully play various elements' potentiality only after he is very familiar with various knowledge elements' features and familiar with their nature and adaptable scope. At the same time, the knowledge creator also needs to be familiar with various knowledge elements' combination, especially when very powerful inter-independence relationship exists among various knowledge elements, various elements' combination will bring huge uncertainty, this proposes challenge to the creator, the creator can search optimized creation result with own keen ability to judge and abundant experiences for knowledge recombination, therefore, for the individual, he can obtain the breakthrough innovation result only after he owns broad range of knowledge span and capability to combine different knowledge.

On the team level, the team is composed of many creators. The team is composed with clear objective. This brings very strong utilitarian overtones to the knowledge recombination course with the team as the creation actor. The knowledge owns very strong sense of direction and it is often for achievement of certain specified design. Under this circumstance, the capability of the team as a whole is not the simple total of the individual capability in the team, the individual of the team can not normally play its potentiality, while participates in the knowledge recombination activity as a member of the whole team. In the entire team's knowledge creation activity, each member assumes his own innovation task and the members need to exchange each other, thus the entire team becomes a organic creation actor. As a actor, in addition to need to be familiar with various needed knowledge elements and combination elements like the individual creator, on this basis, the team also needs to solve the matters of labor division and staffing, needs to know about the specialty of each member entering into the team and the social relationship among the members, fully consider the resource condition upon the feature of the innovation project, internally divide labors inside the team and try to fully play all the team members' creativity to let each person be capable of participating in the innovation that he is familiar with. In addition to having the fine staffing program, there should also be the knowledge integration mechanism, the breakthrough innovation is often the result from full exchanging among the creation staff, so establishment of high-efficiency knowledge sharing and knowledge transfer atmosphere, site, media and mechanism is very important. The team should also regularly organize the members related to key knowledge field or field with stronger inter-dependence for formal or informal talks. It is necessary to carry out frequent mutual evaluation activities in the team and establish the sound evaluation mechanism for the team. Each person's creation activity needs to accept his colleague's evaluation and searching the mutual matching better form in this course is helpful to search the best result of the knowledge recombination in the complex conditions. Finally, the innovation team must own high-efficiency excitation mechanism. The member with good performance in the course of innovation should be granted

appropriate material or spiritual reward by which healthy competition mechanism can be established inside the team to promote each member to fully play his potentiality and fully participate in the knowledge sharing and exchanging activities and be conducive to enhance the effect of the knowledge recombination.

On the enterprise level, to obtain fine innovation result from the knowledge recombination of the internal enterprise, there should not only the capability of the internal members and resources and the knowledge integration capability, etc, more importance is to establish the soft environment of the knowledge management, lead the enterprise's various source's knowledge to participate in the knowledge recombination activities and ensure the combination of various knowledge elements to get fine innovation result. We need to establish the assuring system of the knowledge recombination from the organizational and cultural construction. The organizational structure adaptable to the knowledge recombination should be flat, flexible and network-based. Such organizational structure can assure the knowledge from various branches to fully collide and staff from various branches to fully exchange and easily search most valuable program of knowledge recombination. The enterprise culture capable of promoting the knowledge exchanging is also the important means of ensuring enterprise to obtain the best knowledge recombination. Good enterprise culture should be learning-oriented, sharing type and creative type. Good enterprise culture can maximum play the personal potentiality, establish the excitation mechanism of improving the knowledge recombination and create the environment suitable for the knowledge innovation. Good cultural atmosphere is the prerequisite condition to promote the growth of talents, stimulate the creation of enthusiasm and innovation of the idea. Good culture promotes the mutual supporting and coordination between person and person to eliminate the confrontation, promote the knowledge exchanging and sharing and maximize the combination effect of the enterprise internal knowledge.

The open innovation should be developed to use the knowledge recombination of the enterprise external knowledge on the enterprise level. The open innovation needs to be carried out with other enterprises or organizations or greatly introduced talents. To protect the knowledge recombination effect, the enterprise needs to establish the open and innovative safeguard mechanism not only including the cultural but also including the systematic, not only assuring to get the external knowledge but also ensuring the enterprise's core knowledge unable of being disclosed. The enterprise also needs to establish the path to obtain the external knowledge. The commonly used path to obtain the knowledge is the alliance with the enterprise and introduction of talents. The key point of these two paths is how to select the appropriate target, on the one hand needing to understand the knowledge owned by the external knowledge source and on the other hand needing to understand whether the knowledge elements from different knowledge sources can compose the high-quality knowledge. This requires the enterprise to own super skills. The enterprise also needs to train the absorption capability for the external knowledge. Change the external knowledge into the enterprise's own knowledge through the courses of exchanging, understanding, learning, internal digesting and external digesting, etc and obtain the actual use through the operation and application course or compose with his own previous knowledge to create the new knowledge and new application.

V. Conclusion and Extension

This paper overviewed and analyzed the relevant studies on the knowledge recombination mechanism and the knowledge recombination features on the actor level and summarized the key elements in the course of the knowledge recombination of knowledge elements' field distribution, inter-independence of knowledge elements fields and capability of the creation actor. On various levels, the creation actor faced complexities are different. This paper focused on analyzing the features of the knowledge recombination and the actor needed capability on different levels, revealed the creation actor faced complexity increasing and the creation actor needed capability also increasing with the level rising and detailed analyzed various levels needed various capacities.

Based on this paper's studies, the future study work can be carried out in the following:

Deeply analyze the members' role differences when the actor level leaps, respectively analyze the individual role in the knowledge recombination played when individually innovating and participating in the team innovation and respectively discuss the individual borne liabilities and needed capacities under two circumstances.

Upon various levels' creation actor, analyze their relevance among various capacities and search various levels' most important capability impacting the knowledge recombination.

The future study also needs to explore how to upgrade the actor's capability for the knowledge recombination and establish various levels actor's capability training mechanism based on various levels faced features of the innovation issues.

Reference

[1] Carnabuci, G., J. Bruggeman. 2007. Knowledge Competition and Knowledge Growth. SDA Bocconi Research Paper.
[2] Henderson, R., K. Clark. 1990. Architectural innovation: The reconfiguration of existing product technologies and failure of established firms [J]. Administrative Science Quarterly, 35: 9-30.
[3] Hargadon, A., R. Sutton. 1997. Technology brokering and innovation in a product design firm [J]. Administrative Science Quarterly, 42: 716-749.
[4] Fleming, L. 2001. Recombinant Uncertainty in Technological Search [J]. Management Science, 47(1): 117-132.
[5] Weitzman, M. 1998. Recombinant Growth [J]. Quarterly Journal of Economics, 113(2): 331-360.

[6] Schumpeter, J. 1939. Business Cycles [M]. McGraw-Hill Book Company, Inc., New York.
[7] Nelson, R., S. Winter. 1982. An Evolutionary Theory of Economic Change. Belknap Press, Cambridge, MA.
[8] Dosi, G. 1982. Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change [J]. Research Policy, 11(3): 147-162.
[9] Henderson, R., Jaffe, A., Trajtenberg, M. 2005. Patent citations and the geography of knowledge spillovers: a reassessment: comment [J]. American Economic Review, 95(1): 450-460.
[10] Hargadon, A. 1998. Firms as knowledge brokers: lessons in pursuing continuous innovation [J]. California Management Review, 40(3): 209-227.
[11] Miller, D., Fern, M., Cardinal, L. 2007. The use of knowledge for technological innovation within the diversified firm [J]. Academy of Management Journal, 50(2): 308-326.
[12] Fleming, L., Sorenson, O. 2001. Technology as a complex adaptive system: evidence from patent data [J]. Research Policy. 30: 1019–1039.
[13] Fleming, L., Sorenson, O. 2004. Science as a map in technological search [J]. Strategic Management Journal, 25(8-9): 909-928.
[14] Gruber, M., Harhoff, D., Hoisl, K. 2008. The jack of all technologies: knowledge recombination across technological boundaries. www.epip.eu/conferences/epip03/papers/Gruber_Harhoff_Hoisl_EPIP 2008.pdf.
[15] Steinbeck, J. 1952. East of Eden [M]. New York: Putnam Penguin.
[16] Taylor, A., Greve, H. 2006. Superman or the Fantastic Four? Knowledge combination and experience in innovative teams [J]. Academy of Management Journal, 49(4): 723-740.
[17] Girotra K., Terwiesch, C., Ulrich, K. 2008. Idea generation and the quality of the best idea. INSEAD Working Paper.
[18] Fleming, L., Singh, J. 2008. Lone inventors as sources of breakthroughs: Myth or reality? Working paper, Harvard Business School, Boston.
[19] Kogut, B., Zander, U. 1992. Knowledge of the firm, combinative capabilities, and the replication of technology [J]. Organization Science, 3(3): 383–397.
[20] Rosenkopf, L., Nerkar, A. 2001. Beyond local search: Boundary-spanning, exploration, and impact in the optical disk industry [J]. Strategic Management Journal, 22(4): 287-306.
[21] Henderson, R, Cockburn, I. 1996. Scale, scope and spillovers: the determinants of research productivity in drug discovery [J]. Rand Journal of Economics, 27(1): 32–60.
[22] Wadhwa, A., Kotha, S. 2006. Knowledge creation through external venturing: Evidence from the telecommunications equipment manufacturing industry [J]. Academy of Management Journal, 49(4): 819-835.
[23] Tsai, W. 2002. Social structure of "coopetition" within a multiunit organization: coordination, competition, and intraorganizational knowledge sharing [J]. Organization Science, 13(2): 179–190.
[24] Birkinshaw, J., Nobel, R., Ridderstrale, J. 2002. Knowledge as a contingency variable: do the characteristics of knowledge predict organization structure [J]? Organization Science, 13(3): 274–289.
[25] Carlile, P. 2004. Transferring, translating, and transforming: an integrative framework for managing knowledge across boundaries [J]. Organization Science, 15(5): 555-568.
[26] von Hippel, E. 1988. The sources of innovation [M]. Oxford University Press: New York.
[27] Chesbrough, H. 2003. Open innovation [M]. Harvard University Press: Cambridge, Mass.
[28] Menon, T., Pfeffer, J. 2003. Valuing internal vs. external knowledge: explaining the preference for outsiders [J]. Management Science, 49(4): 497–513.
[29] Rosenkopf, L., Nerkar, A. 2001. Beyond local search: Boundary-spanning, exploration and impact in the optical disc industry [J]. Strategic Management Journal, 22: 287–306.
[30] Laursen, K., Salter, A. 2006. Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms [J]. Strategic Management Journal, 27(2): 131–150.
[31] Cassiman, B., Veugelers, R. 2006. In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition [J]. Management Science, 52(1): 68–82.
[32] Fabrizio, K. 2009. Absorptive capability and the search for innovation [J]. Research Policy, 38(2): 255-267.
[33] Almeida, P., Phene, A. 2004. Subsidiaries and knowledge creation: the influence of the MNC and host country on innovation [J]. Strategic Management Journal, 25: 847–864.
[34] Darr, E., Kurtzberg, T. 2000. An investigation of partner similarity dimensions on knowledge transfer [J]. Organizational Behavior and Human Decision Processes, 82(1): 28–44.
[35] Agrawal, A., Henderson, R. 2002. Putting patents in context: exploring knowledge transfer from MIT [J]. Management Science, 48(1): 44-60.
[36] Lakshman, C., Parente, R. 2008. Supplier-focused knowledge management in the automobile industry and its implications for product performance [J]. Journal of Management Studies, 45(2): 317-342.
[37] Schilling, M., Phelps, C. 2007. Interfirm collaboration networks: the impact of large-scale network structure on firm innovation [J]. Management Science, 53(7): 1113–1126.
[38] Phene, A., Almeida, P. 2008. Innovation in multinational subsidiaries: the role of knowledge assimilation and subsidiary capabilities [J]. Journal of International Business Studies, 39(5): 901-919.
[39] Phene, A., Fladmoe-Lindquist, K., Marsh, L. 2006. Breakthrough innovations in the U.S. biotechnology industry: the effects of technological space and geographic origin [J]. Strategic Management Journal, 27(4): 369-388.
[40] Operti, E., Carnabuci, G. 2008. Knowledge growth through inter-organizational knowledge recombination: An analysis of the semiconductor industry in the period 1976-2002. Paper prepared for the DRUID-DIME Academy Winter 2008 PhD Conference.

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