



## Study on the Network Structure Character of Core Enterprises in the Innovation Network

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### Abstract

The formation and development of core enterprises is very important for enterprises and the whole innovation network. The correct cognition about core enterprises can instruct the enterprise to intentionally cultivate its own network state and enhance its competitive force. Based on relative theories of network structure, this article points out that network is the set of relationships, and the network structure comprehensively reflects various relationships of enterprise in the network. In this article, the network structure character of core enterprises is analyzed, the representation and the function of the centrality of network structure of core enterprises are described, and relative advices about cultivating core enterprises and enhancing the network state of enterprise are proposed based on above results.

**Keywords:** Innovation network, Core enterprises, Network structure, Structure holes

In the quickly changing market environment, the technical innovation network formed by the cooperation of various innovation subjects has been the important organization form of the technical innovation activity of the enterprise. In the technical innovation network, the network states of various node enterprises are different, and they occupy unequal knowledge, which will certainly induce that some part of enterprises in the network develop more quickly than other enterprises, and become into core enterprises in the technical innovation network, and core enterprises in the technical innovation network is very important for the whole development of the network. And it is very important to correctly know the character of core enterprises in the network for deeply studying and promoting the growth of common enterprise in the technical innovation network, helping enterprises to deeply know their actual representations of the core state in the cooperation network, enhancing the independent innovation ability of the enterprise, cultivating the technical innovation ability of the enterprise, and driving the whole development of the technical innovation network. Therefore, the network structure character of core enterprises in the technical innovational network organization is analyzed as viewed from the network structure.

### 1. Technical Innovation Network is the Main Organizational form of Technical Innovation for Enterprises

The quick development of IT industry makes the social and economic life enter into the network time which offers more possible implementation forms for the organization of technical innovation. For the importance of cooperative innovation, the consensus has been achieved at present. By the surveys in Germany and Portugal, Pedro Faria studied the cooperation between enterprises with foreign enterprises, and thought that the cooperation has played important role in the innovation process of enterprise, and the behavior of innovation cooperation had been regarded as the effective industrial organization form of the complex innovation R&D process. Aschhoff and Schmidt thought that the cooperation with other enterprises or institutions was an opportunity by the enterprise, and it can acquire the supplement of technical resources needed by the quickly innovational development, promote the market entrance, acquire scale economy and range economy, share in costs, and decentralize risks (Birgit Aschhoff, 2008, P.41-62). Based on the view of innovation network, Zhang Weifeng discussed the network property of technical innovation, and pointed out that the innovation network was the innovation platform of interactive function of relative enterprise knowledge, and was a new innovation mode which can adapt the knowledge economy society and the technical innovation.

As a representative complex network organization, the uniform definition of the technical innovation network has been deficient at present. Freeman's definition about the innovation network was quoted many times, and they thought that the innovation network was a basic system arrangement to deal with systematic innovation, and it had abnormal relationship network with hidden characters (Freeman C, 1991, P.499-514). Some other scholars pointed out that the innovation network was a form of the network among companies or the network among organizations. The research of the sociology indicated that the innovation network was the special relationship network among enterprises, not common relationship among enterprises.

The enterprise cooperation taking the technical innovation as the basic start universally exists, and when the enterprises

cooperating mutually achieve certain amount, the technical innovation network will be formed (Dang, 2004). The technical innovation network is a organization form established by relative enterprises or organizations on different layers based on common target of technical innovation to solve the predominant conflict between the uncertainty of technical innovation with the limitation of innovational resource of single enterprise in the network environment, and this organization form implements the communication of materials or non-materials by various cooperative forms of technical innovation to enhance the competitive force and the anti-risk ability of the whole network and profit all members.

## **2. Main Function of Core Enterprises in the Network of Technical Innovation**

The core enterprises in the technical innovation network always have stronger technical innovation ability and the ability to manage the whole network and harmonize the exchanges of materials, information and energy among enterprises in the network. The researches about the function of core enterprises in the technical innovation network can be mainly classified as the relationship maintenance, the information communication and the network management of core enterprises to the network.

Agrawal and Cockburn thought that core enterprises led the diffusion of technology and knowledge in the technical innovation network (Agrawala A., 2002). Leach & Makatsoris thought that the core enterprise controlled the whole network organization (including technical alliance and dummy enterprise), and it had the right to decide the production activity of other enterprise, and whether the corresponding enterprise existed in the network organization. The core enterprise in the technical innovation network could enhance the technical innovation ability of enterprise in the technical innovation network, and stimulate the demand and creation of new technology and acquire exterior market (Schmitz, Lazerson & Lorenzoni), and the role and task of these enterprise in the network are heterogeneous and irreplaceable, and the cause of heterogeneity is because they are in the key nodes in the network, and they have ability to design and operate large network relationship different with other enterprises (Lorenzoni, Baden Fuller & Uzzer). Owen-Smith and Powell studied the biologic innovation network in Boston, and emphasized that core enterprises need to change the information flow in the whole network by sharing the knowledge of enterprise, which would actively increase the patent amount in the whole network (Jason Owen-Smith & Walter W. Powell, 2003, P.1695-1711).

Morrison and Malipiero thought that in the growth process of core enterprises, core enterprises mainly utilize the interior knowledge in the network to promote their growth, and comparing with other enterprise, the knowledge utilization degree was higher. It is obvious that the exterior resource base formed by core enterprises in the technical innovation network is the quality and the quantity of knowledge in the network, and they decide the size of the knowledge acquirement opportunity of core enterprises. At the same time, core enterprises are not to simply absorb network knowledge, and with the enhancement of influencing power of core enterprises in the network, they will influence the flow of network knowledge. Rosenkohf & Almeida thought that the growth process of core enterprises was not only a knowledge absorption process, but a process with the technical standardization in the network, and the technical standardization would simulate the transfer of relative knowledge among enterprises, which would induce quicker growth of core enterprises.

## **3. Actuality of Character Analysis of Core Enterprises in the Network of Technical Innovation**

The technical innovation network is a representative cooperative organization, and in this organization, the relationships among enterprises and the characters of core enterprises have much commonness with other cooperative organizations. Because different scholars have different cognitions about the connotation of core enterprises in the cooperation among enterprises, so many different indexes are adopted in the empirical researches, such as sale (Zhang, Yuli, 2003, Wu, Aiqi 2005, Wan, Weiwu, 2004), employee amount (Delmar, 1997), asset (Flamholtz, 2003), market share (Weinzimmer, 1998), enterprise scale (Vlachopoulou and Manthou, 2003), and knowledge absorption and creation ability (Pittaway and Robertson, 2004). It is obvious that the description about the characters of core enterprises in cooperative organization is mainly centralized in the attribute data of enterprise, and the essential of "core" of core enterprises still has not been grasped. The cooperative organization is a network of social relationship, and the mutual relationships among enterprises should be the essential, and the relationships between enterprises with other node organizations in the network forms the most basic character in the cooperation process of technical innovation.

## **4. Essential Character of Core Enterprises in the Network of Technical Innovation**

### *4.1 View of network structure*

Scott (Scott, 2000) thought that the data of social science are mainly divided into three sorts including attribute data, relationship data and concept data. Though existing researches all admit that core enterprises occupy very important state in the cooperation process among enterprises, but the descriptions about the characters of core enterprises in the cooperative enterprises are very different, and most of them adopted the index of attribute. But in the real world, enterprises (actors) are not in the completely free and competitive market environment like "atoms", and they are connected and influenced each other, and they are embedded into the society and the network with the exchange

relationship of professional factors and other organizational factors (Gulati, 1998, P.293-317). Vijay's research (Vijay, 2001) also pointed out that the network was formed among participants by achieving certain sharing contract for key resources in the technical innovation network. Kamann & Strijker thought that the network included all mutual relationships among organizations, and this extensive definition makes any two organizations with mutual relationship to be brought into same one network. The technical innovation network is the representative complex social network organization, and the relationship is the base of network research, and the mutual influence and dependence is the core of network relationship, so to analyze the characters of core enterprises from the relationship among nodes in the technical innovation network more can grasp the essential of the technical innovation network.

In 1985, Granovetter introduced the concept of "Embeddedness" (Uzzi B, 1997, P.35-67), and emphasized the structured embeddedness was on the macro layer of the network, and the relationship network composed by node enterprises was embedded into the social structure composed by node enterprises, which was influenced or decided by the cultural and valuable factors coming from social structure. That is a kind of opinion of network structure, and it thinks that resources are not flowing in the network system equally or randomly, and network members differently occupy scarce resources and distribute these resources according to connection nodes. The nodes of technical innovation network occupy different positions in the network, and present different characters in the network structure. And the network position of enterprise will largely influence actors' behaviors and performances.

#### *4.2 Theory of network structure*

Ronald Burt created the theory of "structure hole" in his article of "structure hole" in 1992. The so-called "structure hole" means the non-redundant relationship between two nodes. For example, A respectively keeps direct touch with B and C, but B and C have not direct association, i.e. B and C establish the indirect relationship by the agency of A, thus the relationship vacancy will be formed between B and C, and this is a "structure hole" (Burt R, 1992, P.231-235). The enterprise occupying the network structure hole will occupy the position information of other enterprises in the network and their information of information flow, and possess the information resources containing less redundant connections, saving network costs and approaching particularity. The enterprises with thus position will have many advantages in the network, and core enterprises could utilize their position to successfully select future cooperative fellows and new technologies (Freeman, 1977, Knoke & Kuklinski, 1982, Wasserman & Faust, 1994). Furthermore, the enterprises in the central position could build themselves as a cooperative fellow with skillful technology and abundant knowledge, and possess more ability to attract enterprises in the network (Powell, Koput et al, 1996 & Brass, Butterfield et al, 1998).

The node enterprise occupying special position in the technical innovation network have more rights to acquire more resources and more quickly contact resources, and more bargaining opportunities, and accordingly control resources and outputs and the prior acquirement rights of work chances. The people or actor in the position of agency in the cooperation network will always build the bridge among organizations, and operate the resource flow of at least one even two sub-groups, and make them highly depend on his activities.

#### *4.3 Representation of network structure character of core enterprises*

Freeman (2001) firstly put forward the concept of "centrality" in the complex network, and he called the individual occupying important position in the network structure as centrality, and thought that these centralities had important function for the network, and largely influenced the growth of network (Freeman, 1991, P.499-514). Chuang et al (2006) studied the influencing factors forming the core state in the technical innovation network, and they thought that when enterprises more approached the network center or their agency character was stronger, the information they contacted would more, and the innovation character of enterprises would be stronger. That will gradually enhance the network state of enterprises, and make them finally turn into the core enterprises in the technical innovation network (Cheng-Min Chuang, 2006). Burt thought that nodes are in the key position in the network, and they can enjoy the information advantage and the control advantage. The information advantage means that the individual occupying the structure hole could acquire non-repeated information from many aspects and forms the distribution center of information (Burt R, 1992, P.231-235). The centrality can be used to evaluate the importance of one person in the social network, and measure the superiority or privilege of his state and his social reputation (Luo, Jiade, 2005). In the network, the nodes with centrality are those people with most powers and most important state in the organizational behavior theory, and they are "key nodes" in the network.

As viewed from the network structure of core enterprises, first, core enterprises more easily approach the resources of other enterprises in the network, such as technology and management method. Second, because core enterprises are at the intersection point of various connections, so they can more early acquire information than other enterprises (Rogers, 1995). Third, higher centrality means higher state and power (Wasserman & Faust, 1994), because the roles containing many connections are always regarded as those persons with higher reputation (Brass & Burkhardt, 1992). Therefore, the enterprises in the hub have more and better resources and opportunities (Gulati, Nohria et al, 2000), and could acquire asymmetric useful resources in the asymmetric network states.

The important representation of core enterprise network structure in the technical innovation network is the central position in the network. The hub position of core enterprises in the technical innovation network are mainly embodied in two aspects, i.e. the centrality of degree and the centrality of agency. The centrality of agency could measure the ability of core enterprises as the medium, because core enterprises always occupy the position of bridge, and become into the nodes with important position among other nodes, and if other enterprises refuse this medium, the divided nodes may not be communicated. Core enterprises generally are at the position of structure hole, which can first acquire the information and knowledge of other networks, even screen or control the nodes in the network.

## 5. Conclusions and Revelations

In this article, the structure hole theory in the complex network organization is mainly utilized to analyze the network structure character of core enterprises in the technical innovation network organization, and the result shows that because core enterprises occupy the structure centrality of network, obvious relationship advantage and higher state and reputation, they have more opportunities to acquire more benefit returns, and very advantaged state in the network cooperation.

The technical innovation network is a representative self-organizational system, and the adjustment is completed by the enterprise itself, not the exterior environment. Enterprises should confirm their states in the strategic alliance according to their cognitions about the technical innovation network, and plan the strategic position and the implementation method what they want to achieve. The relative researches in the article indicate that the enterprises must find and strive for the advantaged position by analyzing and managing the relationship between them and other enterprises in the cooperation to enhance the competitive ability and grow to core enterprises in the network. In the strategic arrangement, these enterprises should adjust them on the central position, and extensively associate with other network nodes to acquire advantages of information and control.

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