Building the Organizational Knowledge Networks of SMEs in High-tech Industry

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Abstract

Prior research has primarily viewed firms as autonomous entities striving for competitive advantage from either external industry sources or from internal resources and capabilities. However, the networks of relationships in which firms are embedded profoundly influence their conduct and performance. This paper developed a comprehensive theoretical framework to explore knowledge management business practices among SMEs. Drawing on resources-based theories, the relational-based views, industry structure and ecosystem theories about sources of competitive advantage, this paper presents the organizational knowledge network of the SMEs in high-tech industry, and analyses the approaches through which SMEs can create competitive advantages on knowledge-based review (KBV).

Keywords: Knowledge networks, Knowledge management, SMEs, Competitive advantage

1. Introduction

There is increasing consensus among academic scholars, policy makers, and industry practitioners alike that the present and future secret of business survival and prosperity lies in strategic partnering and co-opeting successfully rather outright competition. In various countries, it can be seen that originally independent enterprises have merged to or cooperate in order to provide integrated products and services. This is particularly so in knowledge-intensive, highly complex, and dynamic environments such as all high technology industries (semiconductors, aerospace, software, telecommunications, etc.), where collaborating to compete in knowledge generation and exchange has become so pervasive it often hard to notice having become the standard modus operandi (from cross-licensing agreements to strategic complement in products and services). When knowledge is used as a medium of sharing and exchange as well as a tool for competition, it can create a positive-sum environment where firms are rewarded for coordinated and simultaneous cooperative and competitive relationships at multiple levels of the business environment.

Knowledge has certain characteristics that distinguish it from other media of exchange, such as financial capital or physical capital (eg. land). Knowledge can be transferred between firms or individuals, like other forms of currency. But unlike money or land, knowledge once transferred , is held by both the donor and the recipient. Hence, knowledge is not transferred in a formal, linear sense; it is shared and also transformed while being transferred, becoming more valuable through incorporating the lessons learned during, after, and possibly even in anticipation of the knowledge transfer process.The advent of internet-related information technology such as intranets, extranets, and intelligent agents has contributed significantly to the increased interest in knowledge management.

Interest in the area of knowledge management (KM) has grown dramatically over the last decade. In particular, KM has become the focal point for debates on mechanisms to facilitate firms acquiring greater competitive edge in the emerging global information economy. In these debates, a firm's competitive advantage is considered to result from its unique knowledge and how it manages that knowledge. It has argued that in the post-industrial global information economy it is "knowledge" that will replace natural resources, capital and labor as the basic resource from which to generate economic wealth. In studying KM, the dominant perspective adopted by writers from with the management and information system (IS) literature is referred to as knowledge based view (KBV). The KBV has itself been derived from the resource based view (RBV) on sources of competitive advantage developed within the strategic management literature. Both the KBV and RBV approaches have relied almost exclusively on research conducted on large organizations. The question of how firms, especially the SMEs achieve these co-opetitive values have received less attention, while it is important.

In this paper we try to provide a conceptual framework on how SMEs in high-technology build their organizational knowledge management network and get competitive advantage through it. This framework can be perceived in its totality as an organizational knowledge network with both real and virtual components at the individual, intra-, inter-organizational, industrial and ecosystem levels. The organizational knowledge management network in question relies both on knowledge and meta-knowledge, or knowledge about the knowledge within the network.

2. The Organizational knowledge (OK) network

Recognizing that some rivals may at times function as temporary allies in a competitive situation, Brandenburger and Nalebuff (1996) developped a framework which they called the ‘‘value net’’ for analyzing the structure of a firm’s market and competitive situation. The value net has two axes: one which represents the vertical flow of Porter’s value chain from suppliers through the firm to its customers; and one which represents the horizontal dimension of interaction between pure rivals competitors and rivals with whom a firm can form alliances for mutual gain termed complementors. Carayannis and Alexander (1999) proposed a framework that may help us better comprehend and manage this emerging form of organizations, called the ‘‘bull’s eye’’ model, which outlines an extended network of co-opetitive relationships linking the firm to its environment at the market, political, and ecosystem levels. It showed how a dynamic approach based on knowledge, learning and coopetition enables firms to adjust to complex changes at all these levels. Clarke and Turner (2004) highlight potential limitations to the RBV of KM and present a conceptual model that maybe deployed by SMEs, drawing on strategic management theories of relational and industry-based sources of competitive advantage.

Based on these works, we present the model of the networks to be used for SMEs in order to get competitive advantages. The set of intelligent that would constitute the backbone of the OK net lies in different levels of the network. In the firm-level, it is the enterprise’s valuable and unique resources knowledge-related that are costly to imitate, which have been studied by RBV and KBV. In the inter-firm level, it is the inter-firm linkages, which build between the competitors, the suppliers, the complementors, and the customers. These collaborations involve substantial knowledge exchanges and the combination of complementary resources or capabilities, which have been studied by relational-based view. In the industry level, it is the industry structure whose characters may include relative bargaining power, barriers to entry, lowering cost and tying in supplier and customers. The studies in this field are relative few. In the ecosystem level, it is the political and social capitals through enterprises could capture significantly larger private and social rates of return in an economically and enviromentally sustainable manner, which has been studied recently.

This model would comprise subscribing agents that would match individual competences and research interests with upcoming conferences, trade conventions, product announcements and other external events, scheduling agents that would match individual’s schedules to facilitate meeting either as residents or visitors, research enhancing agents that would inform researchers of announced request for proposals, publications, and conferences, Government-University-Industry partnerships agents that would enable collaborations across academia, government, and industry, etc. This model may help capture more fully and clearly the dynamics, nature, and potential of co-opetitive, knowledge-driven linkages among profit and not-for-profit, private and public, research, policy analysis and education-focused institutions. The OK net would be flexible and adaptive, endowed with the capacity to learn, learn how-to-learn, and learn to learn-how-to-learn from system users and stakeholders, team and organization customers, suppliers, complementors, and competitors in a co-opetitive manner through explicit and tacit, active and passive interactions (questionnaires, intelligent agent performance gauged, compared, and recorded, tracking of the evolutionary paths of user profiles and preferences, etc.).

3. Approaches to competitive advantage in-house

In order to develop and maintain a strong competitive position it is important for an organization to have adequate knowledge available. As Powell (1998) states: “ the core capabilities of organizations are based increasingly on knowledge-seeking and knowledge-creation”. Knowledge-based resources generally refer to ways in which more tangible input resources are manipulated and transformed to add value.

The high-technology industry is the representative of an example of knowledge-based industry with its main function being research and development and its primary asset being its intellectual property (IP). IP, in particular patents and trade secrets, has become a key element of competition in all high-technology industries. Its product-development process (from research activity to commercialization) is very long, research intensive and protracted. This situation demands a particular collection of resources and competencies (finance, knowledge assets, commercial skills) that usually isolate firms do not have completely. The Chinese high-tech industry is small by international standards. In this market, there are intrusive government officials, along with a lack of codified laws, well-developed rules, and commercial conventions, all of which add to the expenses for firms operating in China compared with the market in developed countries. The SMEs in this industry exhibit distinct characteristics that differentiate them from conventional SMEs. These characteristics include: (1) No or little resource poverty; (2) Highly specialized and skilled workforce aware of the important of IT/IP; (3) Tendency to have explicit strategies, with particular foci on the strategic management of IP. These business plans are frequently the only way that these start-up SMEs gain access to finance.

In terms of KM strategies, it is evident that a high-tech firm's scientific knowledge base forms a critical component of its competitive position. IP, especially the high level workers and the patents, have become a key element of competition in high –technology industries. High-tech firms are noted for their high level of intellectual work, the nature of the work is often cutting edge or a "fresh from the lab" approach. High-tech employees are highly educated, many with advanced degrees in science, engineering, or computers. SMEs in these industries have a large proportion of their assets tied up in intellectual human assets, ie., they often don't own much in the way of equipment or property.

Three characteristics stand out from work describing the high-tech workers: high level of education, a strong preference for independence, and a professional orientation rather than an organization focus. Zucker (1994) found that star scientists are the limiting factor in the founding of biotech enterprises near universities. The presence of highly educated people is common to high-technology industry.

Knowledge is a higher order concept than either data or information. People who are knowledgeable not only possess certain information itself but also the ability to integrate and frame the information at hand within the context of their experience, expertise, and judgment. Thus they can apply their knowledge in sophisticated fashion or even create new knowledge. Similar reasoning can be applied to organizational knowledge. At the same time, it stem from the people working in the organization.

The management of knowledge is complex because of the distinction between tacit and documented knowledge. When knowledge is documented, an individual can learn by studying procedure. With tacit knowledge, there is a need to learn as apprentice by imitating observed behavior of one or more masters in a community of practice. In small and medium firms, knowledge tends to remain tacit. This enables these firms to be flexible and to offer relatively high level of motivation. Small, but intensively cooperative firms, can, in this fashion, out perform larger, merged institutions.

Patents have become another key element of competition in high-technology industries because they are the most tangible IP resources available and provide the strongest legal protection. The use of patents can be extended beyond the initial intentions of preventing competitors from copying a firm's innovations. Knowledge-intensive industries are generating attractive revenue streams through licensing their technology patents. As with other organizational resources, it is increasingly common practice for firms to conduct audits, analysis and even patent mining. High-tech firms employ these techniques to ensure they have freedom to operate in the global markets, to identify patents from which the firm can obtain revenue, and to stimulate the development of new ideas. A firm's potential earnings and competitive prospects are often evaluated on the basis of its IP capabilities. Furthermore, small high-tech firms often rely on patent as evident of their expertise to attract research partners or investment.

The adoption of KBV and resource-based view (RBV) approaches, such as core competencies, offers much to high-tech SMEs in developing IP strategies. IP forms the core of a high-tech firms start-up. For many of these firms, as they have no product to market, their IP is the only way they are able to acquire finance. R&D priorities are determined by the strength of patents and high-tech business plans seek to optimize IP asset potential. The adoption of RBV approaches to manage IP assists high-tech SMEs in developing their strategic direction.

4. Approaches to competitive advantage inter-firms

Additionally, focusing on their core competencies, organizations seem to have grown more dependent on each other. In particular, they are dependent on each other's knowledge and capabilities. Because organizations are more knowledge intensive and dependent on each other, an important way to survive is through co-operation. The relational-based view developed in parallel with the RBV. The relational view refers to competitive advantage sourced through idiosyncratic inter-firm linkages, advantage which cannot be generated by either firm in isolation but only through collaboration. These collaborations involve substantial knowledge exchange and the combination of complementary resources or capabilities. This enables firms to create unique products, services and technologies and lower transaction cost compared to their competitors.

Much research has studied knowledge sharing and learning in alliances, focused on organizational and inter-organizational learning, especially from a strategic perspective. That means enterprises can build competitive advantages through inter-firm network by knowledge sharing and learning.

Industries intensive in technological knowledge usually are motivated to develop alliance with related agents. The need for rapid new product development often precludes internal development of critical technologies, evaluating the attractiveness of external technology acquisition by means of alliance among other methods. The high number of alliance and extent of industrial clustering occurs within the high-tech industry is evidence of prominence the competitive advantage inter-firms. High-tech industry is a complex and multidisciplinary process requiring new ventures to access a broad range of knowledge. Knowledge is accumulated both through internal development and

assimilation of external knowledge. Collaborative relationships help to access, survey and exploit emerging technological opportunities, because inter-firm cooperation accelerates the rate of technological innovation and firms can compete more effectively in high-speed learning races. So SMEs in high-tech industry usually keep close lies with universities, venture capitalists and end-users, building upstream and down stream linkages. Some scholars have demonstrated that a biotechnology firm's internal stock of knowledge as well as its ability to access new, external knowledge flows contribute equally to a firm's success.

Recent alliance research has highlighted the existence, and importance, of interpersonal relationships and trust in alliance or exchange situations. This work develop the notion of relational capital, which refers to the level of mutual trust, respect, and friendship that arises out of close interaction at the individual level between alliances partners. The relational capital can help companies successfully balance the acquisition of new capabilities with the protection of existing propriety assets in alliance situations. Relation capital, which is seen so important at the dyadic level in alliance, can be equally important in the context of alliance networks.

The utilization of the acquired knowledge requires the transfer of routines in addition to the codified knowledge. In this instance, it was seen that only collaboration in research was able to provide the access to the knowledge that could confer competitive advantage.

Alliances and inter-firm relationship are used to connect firms to both the information and capabilities necessary to support them through costly patents races and time-consuming product development and testing. Vertical alliances, more so than horizontal alliances, provide firms with access to scientific input and research knowledge. Alliances can assist firms in overcoming market-entry barriers. Furthermore, these external linkages may evolve into important sources of new product ideas.

Industry clustering is another example of relational view. A cluster is a group of firms from the same or related industries located geographically near to each other. Scholars predict that in the cluster should be more innovative than others at least two reasons. First, firms in the cluster benefit from agglomeration economies such as nearby suppliers attaining scale, direct observation of competitors, and ability to exploit collective knowledge. Second, firms in clusters benefit from network-based effects, especially benefit from social interaction. Clustering in high-tech industry is a trend occurring worldwide and assisting start-up in overcoming geographic isolation. These clusters include research geographic organizations, companies involved in development and application of high technology, companies providing specialized input, equipment and services, and supporting legal, financial, business services organizations. Powell (1998) found that in the biotechnology industry innovation was result of networks, not individual firms. Therefore, it was concluded that high-tech firms are competitive disadvantaged if they are unable to create or be positioned in these learning networks.

5. Approaches to competitive advantage through industry structure

Rather than conforming to the environments, high-technology SMEs in China have found they may need to develop and promote new explanations to what can be accepted within existing environments. This can entail aggressive promotions of business, its technology, or its procedures to regulatory bodies and policymakers, including its contribution to society in general. Many environments contain formal gatekeepers and institutions that limit access. Cultural legitimacy can be established in the selected environment if the enterprise enters a setting where the certification already possessed is seen as appropriated and validated.

Industry structure competitive advantage was the dominant view in 1980s and refers to the competitive advantage an organization acquires through its participation in an industry with favorable characteristics. Associated with the work of Porter (1998), characteristics may include relative bargaining power, barriers to entry, lowering cost and tying in suppliers and customers. The focus of this perspective has primarily been the favorable industry structure.

High-tech SMEs can adopt Porter's industry structure model strategies in varying forms. They maybe develop strong patent portfolios to use as bargaining power in cross-licensing agreements. A quality of portfolio is a powerful lever in negotiating required technology. Tying in customers and supplies is achieved through supply-chain linkages, in particular vertical linkages with upstream/downstream companies. Furthermore, these linkages can help lower costs. For example, upstream linkages are a way to acquire access to knowledge without having to hire a large and costly staff of scientists. Downstream linkages highlight ways to commercialize a product without having to invest in costly assets distribution networks, marketing departments or sales forces. However, the most dominant source of industry structure competitive advantage is creating barriers to entry through the formulation of patent blocks. Reid (2001) suggests that blocking rivals (barrier to entry), may be motivation for firms to enter into inter-firm alliances, a form of relational advantage.

A number of high-tech firms use their IP, especially patents, to create blocks to further R&D in specific areas. Although patenting is necessary to ensure that companies are able to recoup substantial research and development

expenditure, some trends in IP management are resulting in the creation of barriers to entry. Blocking patents arise where the excise of one patent would infringe the claims of another. Patent blocks further downstream. Given that most biotechnology firms are downstream companies, it is clear that blocking patents and stacking licenses could well be a barrier against entry to the high-tech industry. In Australia, this issue of patent blocking is a significant issue to SMEs, particularly as non- Australian companies and institutions hold most of the biotechnology patents granted in Australia (Clarke and Turner, 2004). It is suggested that patents held by foreign companies, are for blocking purposes and will lie dormant. In fact, a study by Cohen (2000) revealed that preventing rivals through patenting related inventions was the most pervasive motive for patenting after prevention of copying.

6. Approaches to competitive advantage through ecosystem

The shortcoming of traditional approaches to strategic management in high-technology industries can be seen through the study of government-university-industry strategic partnerships for research and technology development (GUISP RTDs), such partnerships include the Microelectronics Advanced Research Corporation in the United States, the Faraday Partnerships in the United Kingdom, the Joint Research Centre of the European Union, CANARIE in Canada, and the Storage Research Consortium in Japan. For firms engaged in knowledge-based competences, collaborations involving GUISP RTDs occupy a central role in developing new core competences in the firm, and in fostering better understanding about the management of complex, co-opetitive inter-organizational arrangements.

A comprehensive theory of strategic management must address not only the sources of a firm's existing competitive advantage, but also how firms change their position relative to their competitors. In the view of Teece et al.(1997), firms increase their competitiveness by deploying dynamic capabilities. "…The term capabilities emphasize the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirement of a changing environment". Therefore, a critical dynamic capability for any firms is its capacity to learn how to manage its relationships with other players and thus architect intelligent organizational interfaces across the spectrum of R&D performers, including government, university, and industry entities.

Conclusion

The high-technology industry is the representative of an example of knowledge-based industry. How can the SMEs in this industry capture the competitive advantages, especially like Chinese high-tech firms? By reconfigure the co-opetitive networks, this paper extend the research field on knowledge management. Drawing on adding the inter-firm level, the industry level, and the ecosystem level analysis, we propose that SMEs competitive advantages in high-tech industry can seek competitive advantage through its special knowledge-related resources such as the IP, high level of employee; through inter-firm collaboration, such strategic alliances and clustering; through industry structure, such as creating barriers to entry the market; through ecosystem, such as its political capitals and social capitals which match the requirement.

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