Knowledge management, Organizational capabilities and Performance in High Tech SMEs[1]

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Abstract

Research into small and medium sized firms (SMEs) has become increasingly important as these firms are seen as contributing significantly to many commercial applications of technological innovation. They also provide support to many large high tech corporations and are therefore important agents of industrial regeneration. Previous research has examined the impact of organizational capabilities and/or strategy on performance, the relationship between entrepreneurs' background and the performance of SMEs, the key skills and capabilities affecting the performance of high tech SMEs, and so forth. Much of this research focuses on the notion of fit between capabilities, the environment and a variety of organizational variables. Recognizing the critical role these firms play in creating knowledge, we frame the discussion within the context of knowledge management and develop a conceptual framework to explain the relationship between organizational resources/capabilities of high tech SMEs and their performance. We believe this conceptual framework will shed further light on how the innovative activities of SMEs can play a more meaningful role in knowledge-creation process.

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Introduction

In the light of contemporary debates about the role of knowledge in firm performance (e.g. Bogner and Bansal, 2007; Hatch and Dyer, 2004; Nickerson and Zenger, 2004), this paper argues that the processes of innovation and entrepreneurialism have an important bearing on the challenges of knowledge-creation. We argue that SME entrepreneurial activity might usefully be framed in terms of its contribution to knowledge-creation and the challenges of appropriating knowledge, and suggest that concerns about performance are ultimately about the organization's ability to generate and appropriate knowledge, hence echoing the challenge of sharing and diffusing knowledge (e.g. Watson and Hewett, 2006).

By a similar token, we argue that the critical role played by entrepreneurs and employees in creating knowledge through research and development and new product development needs to be acknowledged even as attention focuses on organizational capabilities. We contend that SMEs' strategic initiatives to appropriate knowledge must take into account the agency and subjectivity of such employees (Bowman and Swart, 2007), who may find their claims to knowledge particularly for career advancement and remuneration, at odds with those of an SME seeking a strategic 'fit'. To the extent that SMEs are by definition small, the role of key performers is not only potentially highly visible but also potentially supportive or disruptive of SME activity. Given the above differences between SMEs and other types of organizations, the strategic activities that embrace innovation and entrepreneurship within SMEs need to be reconfigured as part of a broader context of creating knowledge, particularly where high-profile performers are concerned. Thus, by bringing together the organization's quest to create and disseminate knowledge through its innovative and entrepreneurial

activities, and the individual's role in these processes potential raises the prospect of a contested context for further research.

This paper recognizes that both resource based view (RBV) and capability perspective propose that a firm's performance is determined by its efficient use of unique resources and capabilities that the firm possesses and/or acquires. Whether or not this assertion is applied to SMEs in the context of high tech industries depends on further empirical evidence. We contend that the RBV and capability perspective cannot fully explain how high tech SMEs develop and enhance performance. There are other factors that should be taken into account, such as environmental factors, high tech entrepreneurs' competence, organizational strategies, as well as the power/political context within which relations between employees and business owners are shaped.

Much of the extant research on SMEs focuses on the performance and development of such firms in various contexts (e.g. Miller & Toulouse 1986; Sandberg & Hofer 1987; Covin et al 1990; Dowling & McGee 1994; Stuart & Abetti 1990; Chandler & Hanks 1994a; 1994b; McDougall et al 1994; Li & Atuahene-Gima 2001; Covin & Slevin 1990; Zahra 1996; Zahra & Bogner 1999; Randolph et al 1991; McGee et al 1995; Jo & Lee 1996; Chrisman et al 1998; Man et al 2002).

Among them, studies with particular reference to high tech industries are becoming increasingly more important though SMEs might not be as financially strong as big corporations in their R & D investment. The main reason is that high tech SMEs contribute significantly to many commercial applications of technological innovation. They also provide support to many large high tech corporations and therefore hold

particularly promising potential as agents of industrial regeneration (Romijn & Albaladejo 2002). However, most of these past studies focus only on identifying and analysing one to two single variables that affect the ventures' performance. For example, Parnell, et al (2000) examined the impact of strategy on ventures' performance. Studies by Dowling & McGee (1994) and Zahra (1996) are to identify the relationship between business and technology strategy, and venture performance. Jo & Lee (1996) investigate the relationship between entrepreneur's background and the performance of new ventures. Other studies extend to explore the moderating effect of contextual variables on their relationship (Zahra & Bogner 1999; Li & Atuahene-Gima 2001). The RBV and the capability perspective propose that a firm's performance is determined by the efficient use of a firm's unique capabilities in creating a sustainable performance differential within industries. For example, Powell (1993) emphasizes the importance of firm-specific skills and resources, rather than industry and strategic group structures, in explaining the profitability variance of the firms. In the context of high tech SMEs, some specific firm resources might be of particular relevance. This study is intended to identify some relevant skills and capabilities that affect the performance of high tech SMEs and to develop a conceptual model of the above variables for reference of empirical studies.

Defining SMEs in the High Tech Context

In entrepreneurship literature, a new venture is defined as the end result of the process of creating and organizing a new business that develops, produces, and markets products or services to satisfy unmet market needs for the purposes of profit and growth (Gartner 1985; Normann 1977; Sandberg 1986). Some studies, however, specifically target on entrepreneurial start up, which is on the early stage of

development of a new venture (e.g. Lynskey 2004; Bruton & Rubanik 2002; Van de Ven et al 1984) but a new venture might not fall exactly on the category of start-up as both types can be positioned along a spectrum of new firm development process. The growth stage theories cannot offer a conclusive explanation on the precise moment in time when it is called a new venture, or an incubator, or at the start up stage, or at the embryonic stage, as it depends largely on its industry, resources, strategy, etc. (Greiner 1972; Kazanjian 1988; Churchill & Lewis 1983; Kazanjian & Drazin 1990; Dodge et al 1994).

Another term often used in entrepreneurship studies is small and medium size enterprise, i.e. SME, which is differentiated from entrepreneurial ventures (Begley & Boyd 1987a; 1987b; Carland et al 1984; Romijn & Albaladejo 2002; Oakey 2003; McGee & Sawyerr 2003; Randolph et al 1991; Covin et al 1990; Crick & Spence 2004; Man et al 2002). One distinction, for example, is the difference in goal, in which entrepreneurial ventures strive for growth while small business aims at profit and remains survival for a long time. Since SMEs cover a wider range of business scope and if the study focuses only on the performance of new venture at the early stage of development, the period would be too short to be valid, particularly in the high tech context. We therefore define our target study on SMEs' performance in the high tech sector. Apparently, there is no single agreed definition of high-tech SMEs, they are generally characterized as SMEs operating in high tech oriented sectors (Oakey, 2003; McGee & Sawyerr, 2003). More specifically, the following criteria are usually applied: a) the firms are founded recently; b) they employ a large proportion of scientists, engineers and technologies, educated workforce; c) they have an unusually high percentage of R&D; d) they have the potential for extremely rapid growth; e) they have

strong innovative ability to produce new products/services (Crick & Spence 2004; Von Glinow & Mohrman 1990; Chang et al 2003). Moreover, as there is no specific boundary on which industry should be categorized as high tech industry, our study will be applied to those industries with advanced knowledge and capabilities in technologies, emerging and new technologies and also those SMEs that fulfil the above criteria. Some examples of this kind would be SMEs in the biotechnology, semiconductor, material science, electronic, computer software, multimedia, and telecommunication industries (Bell & McNamara 1991).

Organizational Capabilities and Performance of SMEs

The resource-based view (RBV) proposes that a firm's performance is determined by the efficient use of a firm's unique capabilities in creating a sustainable performance differential within industries. In general, organization resources refer to both tangible and intangible assets that an organization controls or seeks to control (Wernerfelt 1984; Barney 1991; Dierickx & Cool 1989; Hall 1992). Researchers have further indicated that intangible resources, such as networks (Dubini & Aldrich 1991), favourable location (Cooper 1979), functional know-how, patents, and reputation (Hall 1992), technological capabilities (McGrath 1994), knowledge capabilities (Gold et al 2001; Lee & Choi 2003) and innovation capabilities (Romijn & Albaladejo 2002), are critically important in forming a firm's competitive advantages leading to the profitability of the firm, not just the survival (Chrisman et al 1999). In the high tech environment, Powell (1993) emphasizes the importance of firm-specific skills and resources, rather than industry and strategic group structures, in explaining the profitability variance of the firms. He stated that "in such an environment, deliberate strategic positioning is less important than the capacity to manage change, to formulate

and implement a complex, dynamic, and flexible vision, and to adapt continuously in the face of technological and competitive revolution".

In the high tech context, we specifically focus on three major types of firm skills and resources that are significant to SMEs' performance. In addition, their relevance and validity on SMEs' performance are supported by past studies in the literature.

Technology Capability

First, the firm's technology capability could enable a firm to reshape its skills and structures, and form the foundation for continuous learning, improving innovative ability and enhancing competitive advantage (Lynskey 2004; Lall 1992). A firm's technology strategy is also supported by its technology capability so the successful implementation of technology strategy to achieve superior performance relies greatly on the quality of its technology capability. Romijn & Albaladejo (2002) found that ongoing in-house technological efforts contributed significantly to innovation performance, particularly in capturing the incidence of product innovation and its scientific content. Researchers also argue that technology strategy, among various types of strategy, is one of the most important aspects in forming a firm's strategic posture under the dynamic environments that the high tech industries are in (McGrath 1994; Zahra & Bogner 1999; Zahra 1996). In general, a company can use technology to develop a competitive advantage by creating barriers that deter the entry of rivals, introducing novel products or processes that attract new customers, or changing the rules of competition in the industry (Golder & Tellis 1993; Zahra, et al 1995). Specifically, the study by Zahra & Bogner (1999) revealed that a new venture's technology strategy has significant impact on its performance, measured by NPV.

Innovation Capability

Secondly, innovation capability is considered to be another equally important intangible organizational resource that leads to good performance of high tech SMEs. It is generally defined as the skills and knowledge needed to effectively absorb, master, and improve existing technologies, and to create new ones (Lall 1992). The more innovative the firm and its products, the more the firm grows (Bruton & Rubanik 2002). The theory of first mover advantage requires the firm to have the ability to develop new products and bring them to market fast enough that it will give the firm early cash flows, greater financial independence, external visibility and legitimacy, and by doing so, the firm can gain early market share and increase the likelihood of survival at the early stage of development (Schoonhoven et al 1990; Deeds et al 1998). Since strong innovation capability of a firm will lead to a higher rate of new product development while the study on biotechnology firms by Deeds et al (1998) confirms that the rate of new product development is positively related to firm performance with great significance, it can be argued that strong innovation capability of SMEs in the high tech sector will contribute to the firms' performance. The same study by Deeds et al (1998) also supports indirectly the above relationship as they found that the firm's internal effort on R&D intensity, which is one of the factors affecting a firm's innovation capability, is positively related to the market value added to high tech SMEs.

Knowledge Capability

Knowledge capability is regarded as the third major factor affecting the performance of SMEs in the high tech sector. In principle, knowledge capability is drawn from

strategic management literature with regards to dynamic capabilities (Eisenhardt and Martin 2000; Teece et al 1997) and absorptive capabilities (Cohen and Levinthal 1990). They help SMEs develop competitive advantages in situations of rapid and unpredictable change (Teece et al 1997). It is claimed that SMEs would be able to use dynamic capabilities to integrate, recombine and leverage their resources in order to create new competitive strategies (Eisenhardt & Martin 2000). On the other hand, absorptive capabilities are firm-specific assets which perform supporting role in enhancing the transfer and reuse of knowledge. Specifically, high tech SMEs usually have scarce resource and spend limited fund on R and D to generate breakthrough technology. They tend to accumulate knowledge, particularly tacit knowledge so as to increase their future ability to assimilate information. As a result, their prior related experience will become their knowledge base and shape their ability to recognize the value of new information, and to utilize that information effectively. Both types of capabilities are the key elements in developing knowledge capabilities in seizing strategic opportunities (Teece, 2000). Although it is obvious that knowledge capabilities are conceptually argued to have direct bearing on the firms' organizational performance, the empirical evidence on their direct relationship is quite limited due to large number of exogenous factors to be taken into account in the validation process (Bharadwaj 2000). One suggested framework by Yu et al (2007) is to try to link knowledge management drivers, indicating the firms' knowledge capabilities, to the performance of knowledge management and ultimately to organizational performance. According to their proposed model, knowledge management drivers, including cultural dimension, technical dimension and management dimension are assumed to influence knowledge management performance, e.g. knowledge quality and user knowledge satisfaction. Furthermore, the empirical study by Yu et al (2007) concluded that

learning orientation, knowledge management reward and the quality of knowledge management system have positive impact on knowledge management performance. Despite that most of the past studies are not conducted with relevance to the high tech SME context, we argue that knowledge capabilities specifically applied to SMEs in the high tech sector would be even more significant than the general context. If knowledge management drivers are built strongly, they would certainly enhance the firms' knowledge capabilities. And a higher level of knowledge capabilities would strengthen the competitive position in technology development and innovative activities. As a result, other measures on organizational efficiency and effectiveness would be improved, including such examples as ability to innovate, rapid commercialization of new products, responsiveness to market change or exceptional surprise (Detert & Schroeder 2000; Ostroff & Schmitt 1993).

Institutional Environment: External Support, Location and Internationalization

Past studies indicate that the positive impact of a firm's technological capability, innovation capability and knowledge capability on its performance will be strengthened if the firm obtains the benefits from external support, e.g. government and other private agents. For example, geographic location of high tech SMEs is one of the critical factors affecting their performance because it is argued that the higher the extent in grouping the similar firms in a close geographic proximity like the science park, the better it would be on a) knowledge spill-over; b) cooperation with universities/research institutes on scientific/research activities (Lynskey 2004). In addition, a firm that locates in a geographic area with a high concentration of similar firms, e.g. the science park, will have better access to information, personnel, technical know-how and supporting infrastructure. Such increased access to resources will

enhance the firm's performance. Deeds et al (1998) confirmed the hypothesis that the concentration of biotechnology firms located in a geographic area will have a positive relationship with the wealth created by the firm as it will enjoy benefits from its proximity with other firms in the same industry. The cluster effect, agglomeration effect and externalities generated from high tech firms concentrated in the same geographic location have been widely researched and documented in past studies of science park literature (Maillat 1995; Phillimore 1999; Westhead et al. 2000; Smilor 1987; Hisrich and Smilor 1988; Harwit 2002; Jou and Chen 2001; Aydalot and Keeble 1988; Pouder & St John 1996). Therefore, there is strong evidence that institutional support will benefit the development of high tech SMEs and contribute to its performance eventually.

Internationalization of SMEs has become a trend in recent years. Many SMEs have started their internationalization process at the early stage, with an aim to gaining and accumulating knowledge of both market and institutions abroad (Bilkey and Tesar 1977; Cavusgil 1980; Chang 1995). Such experiential knowledge is acquired through learning by doing and informally transmitted to others within the organization (Kogut and Zander 1996; Nonaka 1994) and will be integrated with firm knowledge. It also forms the basis for the firm to absorb other types of knowledge during the internationalization process. Moreover, it is also argued that SMEs that operate in an international environment will enjoy a learning advantage as the knowledge that these entrepreneurs gain about foreign markets, institutions and cultures makes them more aware and alerted of international opportunities as well as reducing their uncertainty about operating in such an environment (Oviatt and McDougall 2005). Although internationalization of SMEs is invariably supported by past studies, it is not without

problem. According to resource scarcity theory, international SMEs are usually required to bear high costs in internationalization process, which would pose great demand on their scarce resources and reduce their performance subsequently. Another challenge is the high risk of going into unfamiliar market and operation location at the early stage, which might not be promising for SMEs. In sum, it is argued that internationalization will present either positive or negative impact on SMEs' performance. Hence, we believe the relationship between skills/capabilities and high tech SMEs' performance is moderated by institutional factors, including i) external support/facilitation/barrier, ii) geographical location, iii) internationalization.

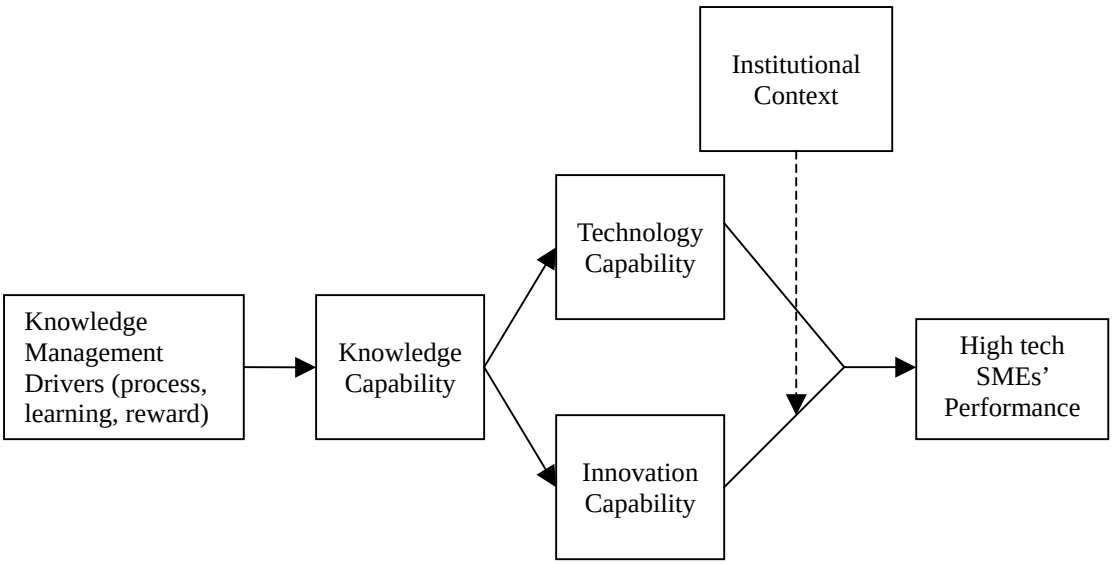
Other factors related to firm level characteristics were suggested to have the impact on high tech SMEs' performance but they were either not supported empirically or arguably inconclusive due to inconsistent results. Two typical examples of these factors that fail to explain any direct bearing on high tech SMEs' performance are: a) age of the firm (Lynskey 2004); and b) size of the firm. In developing our conceptual model, both factors will be treated as control variables.

A Conceptual Model of Organizational Capabilities and SMEs' Performance

With the support of past studies as reviewed above, we believe strongly some specific factors, among many others as proposed in the areas of strategic management and entrepreneurship, are more relevant in the high tech sector for SMEs. In the process of developing our model, we find both similarities and differences between the determinants of new ventures performance and SMEs' performance. From the perspectives of RBV and organizational capabilities, capabilities are equally important in explaining the performance of new ventures and high tech SMEs. The striking

differences are the types of capabilities that lead to lasting competitive advantages for both. Three major categories are identified for high tech SMEs as essential in contributing to their outstanding performance: technology capability, innovation capability and knowledge capability. However, the past literature suggests there is a logical sequential link between the three types of organizational capabilities. It is argued that an effective knowledge management system, for example, is a necessary condition for enhancing knowledge capability of the firm. Other drivers of knowledge management such as learning orientation and knowledge management rewards are also empirically confirmed to have positive effect on the performance of knowledge management and contribute ultimately to the firms' ability to innovate, and to develop and commercialize new products rapidly in the market (Yu et al 2007). In brief, the relationship of the above variables is presented below to conceptually summarize the past studies.

Organizational Skills/Capabilities and High Tech SMEs' Performance



Conclusion

Models on the study of determinants of new venture performance have been researched and developed based on the extant strategic management literature. We argue in this paper their applicability in the high tech sector might require some modifications due to the unique nature of industry structure. In view of the rich studies recently in such context and the increasing importance of high tech SMEs development worldwide, it is necessary to have a comprehensive and systematic review of existing knowledge, integrate bits and pieces of fragmented research results and develop a conceptual framework to guide our future research direction.

Future studies of high tech SMEs performance can follow this framework and the effect of organization capabilities on firms' performance can be tested with confirmatory research. One interesting issue we need to address is to find out the effect of knowledge capability on SMEs' performance as it seems that the presence of organization capabilities with regard to only technology and innovation might present a great difficulty for the long term success of SMEs in the high tech sector if knowledge management is not well taken. In the process of reviewing past studies, we find that many research findings have important implications for the processes of creating and appropriating knowledge. The effects of technology capability and innovation capability on performance are indicative of the potential scope for realizing innovative gains that are consistent with knowledge management and appropriation. As our brief review on relevant studies demonstrates, product innovation including product upgrades intensity and radicality is critical to SME performance. For our purposes, this has implications for organizations' ability to harness the creative energies of their human resources through product development as well as their ability to foster such creativity through investment in technology. Both these elements are

central to the processes of creating and appropriating knowledge, in particular in high-tech SMEs whose raison d'etre is defined by their ability to remain innovative. In sum, we hope that this conceptual study will generate further research not only on the effectiveness of organizational capabilities and performance but also how this impacts SMEs' ability to create and appropriate knowledge. For example, how are the outcomes of product development conceived as a form of knowledge in SMEs, how do these firms seek to appropriate such knowledge from high-profile performers and what are the power and political dimensions at play in relations amongst team members and between high-performers and the organization particularly when it comes to tacit knowledge which may pose greater appropriation challenges for the organization?

In addition, an exploratory study can be conducted to investigate the process of how each variable will lead to SMEs performance. Statistical association between the variables in the model might not provide a necessary link on their causal effect so it is suggested that using case study or longitudinal research will provide a hint on the reasons why technology strategy, for example, are more important to SMEs' performance. Lastly, we argue environmental variables, i.e. institutional context such as external support/barrier, location economies and internationalization, play an equally important quasi moderator role in affecting SMEs' performance as compared to the general model of new ventures performance and therefore, it would be worthwhile to expend effort in exploring how the model is applied in various environmental settings. For example, many high tech SMEs has been developing in China and other similar transition economies in Eastern Europe. It is quite certain with the early evidence from recent studies that their institutional impact on SMEs' performance is unique and different. Without doubt, our model is developed with

extant knowledge on the high tech context so it needs more research effort to fill the gap in the future.

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