Managing Specialised Knowledge In Technopreneurial Firms: Evidence From Australian SMEs

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ABSTRACT:

This paper analyses particularities of the knowledge management process in technopreneurial firms with particular focus on knowledge identification, acquisition, utilisation and integration. Using a qualitative investigation from a sample of Australian SMEs, a number of key observations are derived which show the challenges of managing knowledge and how important knowledge management is as a management tool for R&D and innovation process in technology-oriented SMEs. Findings suggest that knowledge management and integration processes in these firms are very much project focused and mainly based on *ad hoc* and informal processes and not embedded within the overall organisational routines.

Keywords: *SMEs, Knowledge management practice, Knowledge utilisation, Knowledge sharing, Knowledge integration*

1. Introduction

The capacities of firms, industries and countries to develop and manage their knowledge assets are a major determinant of competitiveness and economic growth (OECD, 2004). Managing knowledge for innovation and organisational benefit has been extensively investigated in studies of large firms (Smith et al, 2005; Zucker, et al, 2007). To a large extent there is limited research into studies of small- and medium- sized technology-oriented entrepreneurial firms, i.e. *technopreneurial* firms. There are some investigations in knowledge management research on SMEs (see, Edvardsson, 2009; Massa & Testa, 2009; Sparrow, 2005; Beijerse, 2000), but the potential challenges for the integration of specialised knowledge for technopreneurial firms and the knowledge management strategies and practices in the development and application of technologies has been largely overlooked.

While these firms must have educated employees who can use technology and adapt to technological change, as a small organisation they have their own idiosyncratic requirements. Unlike larger organisations that often have in-house resources in place, smaller organisations may need to rely more on outsourcing and external experts. These organisations may obtain their knowledge from a range of sources, including their customers and suppliers, universities, and the Internet. The decision to rely on in-house versus external expertise, and formal versus informal experts, may reflect how quickly an organisation is able to respond to change, and may also impact the organisation's ability to innovate and use new technology in creative ways.

Focusing specifically on the Australian small entrepreneurial firms in high technology areas such as information technology, biotechnology and nanotechnology, this paper examines actual practices employed by these small technopreneurial businesses to manage and integrate their specialised knowledge. The research takes an exploratory approach to investigate the knowledge situation of technology-oriented firms. Consistent with the exploratory character of the study, the research question is: What processes and practices are used by small technology-oriented firms to transfer, create and capture knowledge for the organisation's benefit? Findings suggest lack of formal knowledge management and integration process within our sampled firms and that knowledge management and integration processes in these firms are very much project focused and mainly based on *ad hoc* and informal processes and not embedded within the overall organisational routines.

2. Knowledge Management In Technopreneurial SMEs

The term "technopreneur" is an extension of an entrepreneur, who is not only willing to own and operate and take the risk of operating any business but specifically makes use of technology to make a new invention and innovation and thereby exploits the invention in the market. What differentiates a technopreneur from any other businesses is the way a technopreneur operates his/her business (Milton-Smith, 2003; Verburg, et al, 2005), where technopreneurial business is generally marked with a high growth potential and high leverage of knowledge and intellectual property. Technopreneurs are technically conversant and able to spot opportunities in high tech or high value added products and processes. Like a typical high tech firm technopreneurs tend to emphasise invention and innovation in their business strategy, deploy a significant percentage of their financial resources to R&D, employ a relatively high percentage of scientists and engineers in their workforce, and compete in worldwide, short-life-cycle product markets (Milkovich, 1987). It is the technopreneurs who have successfully invented or commercialised many of the radical innovations in the market. Studies by Marvel & Lumpkin (2007), for example, shown that technology knowledge is a prerequisite for recognising opportunities with radical innovation outcomes and should be included in future knowledge frameworks in the context of technology entrepreneurship.

As discussed in the literature technopreneurial firms have unique characteristics that impact the activities that lead to organisational effectiveness (see, for example, Carrier & Raymond, 2004). One important activity is management and integration of their specialised knowledge. In fact ability to manage and integrate the specialised knowledge into new product or service development play invaluable role in product or process innovation. In particular each stage of the product development and firm's cycle may require that companies to emphasise different knowledge management practices. In order to understand why managing specialised knowledge effectively is an important source of competitive advantage for these

firms, we briefly review the relevant organisational knowledge literature. We define organisational knowledge as all the tacit and explicit knowledge that individuals possess about products, systems and processes. This includes explicit knowledge codified in manuals, databases and information systems as well as tacit knowledge that is shared collectively in the firm in the form of routines, culture and know-how.

If specialised knowledge is the key firm resource capable of creating a sustainable competitive advantage for technology firms, then it is important to examine how firms should manage knowledge processes. Technopreneurial firms must be intentional in order to manage their specialised knowledge strategically. Kogut & Zander (1992) suggest that the primary challenge of the firm is to create and transfer knowledge efficiently within the firm. We believe that this is more critical for a technology firm. Technopreneurs exploit their specialised knowledge by converting it into new products and services, which Kogut & Zander (1992) refer to as combinative capabilities. On the other hand literature suggests that organisational knowledge is subject to path dependencies. Once a particular technological path or learning path has been taken, it becomes more difficult to diverge from that path, with both psychological and financial commitments to that course of action. Path dependencies make it critically important for technology entrepreneurs to be intentional about managing their knowledge processes throughout the product or process development stages.

The knowledge-based view of the firm provides particularly a solid theoretical foundation in this respect (see, Boisot, 1998; Grant, 1996a; Teece, 1998). Recent empirical study by Palacios et al (2009) also provides a bridge from knowledge management activities to technological innovation and distinctive competencies. Technopreneurial firms may embody different knowledge and technologies in different organisation processes or products, and furthermore these firms must integrate this knowledge and technology into innovation activities to specialise their innovation efforts. Consequently intentionally managing and integrating both internal and external knowledge is critical to achieving competitive advantage for technopreneurial firms. Internal knowledge comes from R&D, reorganising, accidents, experiments, and inventiveness. External knowledge comes from new people, acquisitions, joint ventures and social networks.

Companies benefit from internalising external knowledge, and studies have shown that the benefits apply to both commercial and technological knowledge (Hargadon & Fanelli, 2002). The consequence of the increased interlinkages between the innovative activities of companies and external knowledge providers have already been analysed on an aggregate level. For example, Lane & Lubatkin (1998) have shown that the usage of external sources makes a difference as for the innovation and thus for the economic performance of companies. Given these effects of using external knowledge, the management of the processes to monitor and internalise external knowledge are crucial Thus a major objective for a small technology-oriented firm must be the usage of external knowledge for the innovation process. There are three key knowledge processes that are referred to in the literature in regard to integrating external knowledge. For instance, Kraaijenbrink et al (2007) examine the process for integration of external knowledge by looking at three stages of knowledge integration referred to as: identification, acquisition and utilisation. The investigation by Kraaijenbrink et al (2007) of these three stages of integration in high tech SMEs found a four-function model of external knowledge integration (see Kraaijenbrink et al, 2007).

In summary, in the case of technology firms, we must look at more practical consideration in managing and integrating specialised knowledge. In these firms intellectual capital can be too diverse, too complex and too heavily dependent on individuals and communities who may not behave rationally. Moreover technological know-how constitutes the competitive advantage of these high tech firms. Most firms wish to maintain control over how their know-how is used, and in this regard firms should efficiently control and manage their technology via an excellent KM system in which both internal and external sources of knowledge to be managed effectively. Given the importance of managing specialised knowledge the next section will develop a conceptual framework to base our theoretical foundation on knowledge management and integration within the context of a technopreneurial firm.

3. Conceptual Framework

Our review of the organisational knowledge literature suggests at least three categories of organisational resources impact knowledge creation and exploitation capability. First are stocks of individual knowledge in an organisation, which Hargadon & Fanelli (2002) referred to as latent knowledge. Second are social networks, or relational contacts, which facilitate knowledge flows between employees and stakeholders by creating access and motivation to exchange ideas and information (Hargadon & Fanelli, 2002; Nahapiet & Ghoshal, 1998). Finally, there are the organisational routines and processes that comprise a firm's climate that informally, and perhaps tacitly, define how the firm is to develop and use knowledge (Grant, 1996b). In fact several studies have emphasised the importance of these three categories. For example, Yli-Renko et al (2001) investigated roles of social capital and knowledge acquisition for young technology-based firms in building competitive advantage. Results show that social capital is associated with knowledge acquisition, and that knowledge acquisition from key customers mediates effects of social capital on competitive advantage. Their study thus provides empirical support to the links between social capital, knowledge acquisition, and knowledge exploitation.

This study builds on the previous literature and takes the process and activity view of KM as a starting point of departure (see among others Grover & Davenport, 2001; Probst et al, 2000; Lu et al, 2007). We suggest the process of managing and integrating specialised knowledge in technology firms comprised of various activities that are involved in the identification, acquisition, utilisation and integration of knowledge. These activities are needed to maintain a stream of products and services to the market. In fact, technopreneurs deal with all aspects of integrating technological issues into business decision making and new product development process. Furthermore, knowledge management is a multifunctional field, requiring inputs from both commercial and technical functions in the firm. Therefore effective knowledge management requires establishing appropriate knowledge flows between core business processes and between commercial and technological requirements in the firm.

Figure 1 clarifies our perspective on managing and integrating specialised knowledge in technology firms. At the heart of the conceptual framework is the technology and knowledge base of the firm, which represents the technological knowledge, competencies and capabilities that support the development and delivery of competitive products and services, and other organisational infrastructures including KM systems. Knowledge management activities and integration processes identified above including identification, selection, acquisition, development, exploitation and protection, operate on the technology and knowledge base, which combine to support the generation and exploitation of the firm's technology base. The basic knowledge and organisational determinants included in the framework that influence the knowledge base are as follows:

Path dependency: Path dependency is a process in which the pattern of behaviour of the firm is based on the earlier experiences and cumulative knowledge of the firm.

Mechanisms for linking technological and commercial knowledge: The framework emphasises the dynamic nature of the knowledge flows that must occur between the commercial and technological functions in the firm, linking to the strategy, innovation and operational processes, which might be emphasised at different stages of product development process.

Knowledge Context: The specific knowledge integration issues faced by firms depend on the characteristics of specialised knowledge and technology context of the firm. For instance, in some cases successful supplier or customer knowledge integration initiatives may result in a major change to the new product development process. Also technopreneurial firm may emphasis different knowledge integration activities at various stages of innovation cycle. For example, firms in the start-up phase may be more successful if emphasis technological knowledge, however as the firm enters the exploitation phase marketing and organisational knowledge may become more relevant.

Organisational Context: The organisational context (internal and external) refers to structure, systems, infrastructure, culture, and the particular business environment and challenges confronting the firm, which change over time.

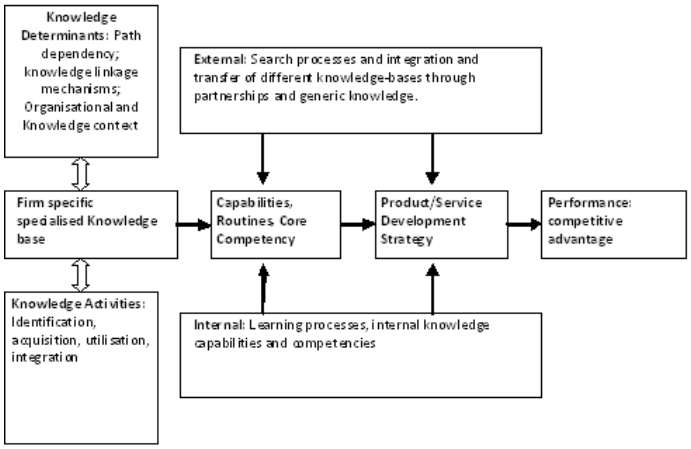

Figure 1: Technopreneurial Knowledge Management Framework

This framework is a strategic and systemic approach to managing knowledge and the emphasis is on integrating specialised knowledge throughout the product development process by including some internal and external factors in the process. The concept of organisational learning is also catered for in this framework. The focus should be on the importance of the employees of the organisation, and their contribution towards a successful knowledge management effort. The overall aim of the framework is to support understanding of how technological and commercial knowledge combine to support strategy, innovation and operational processes in the firm, in the context of both the internal and external environment. It should be noted that this is a high-level strategic framework that supports broad understanding of key aspects of knowledge management and integration. The many particular activities and aims that are associated with knowledge management practice in firms (for example, IT strategy, HR strategy, knowledge transfer, technology selection, R&D management and make *vs.* buy) depend on the particular context and objectives.

4. Methodology

The multiple case study method was employed for this study, since it would allow us to document in some depth the knowledge management experience of the technology firms. According to Eisenhardt (1989), Maxwell (1998) and Yin (1994), cases should be selected according to how well they represent the phenomenon under consideration. Multiple cases were used in a qualitative perspective. In such a perspective, one aims to portray the research object in order to know it better and provide a basis for further research (Yin, 1998; Maxwell, 1996; Robson, 1997). As emphasised by Bickman et al (1998), there is no question here of trying to determine causal links or to generalise. Having more than one case also allows one to

discover elements of convergence and divergence (Yin, 1998). Four technology firms from IT, biotechnology, nanotechnology and biochemistry industry were selected to represent different sectors of activity. All the cases were knowledge intensive technology firms where their specialised knowledge plays critical role in their competitiveness.

Semi-structured interviews with senior managers, company reports and web pages were used to collect case data, with an interview guide to ensure uniform coverage of the research themes. This interview guide was developed following development of the framework and a review of the methodologies and issues covered by similar studies in other countries and used some questions common to these studies. The questions were framed to gather data around knowledge management activity within the business, focusing on the identification, acquisition, utilization and integration of knowledge, but collecting a range of information about subject as well. The focus of the case studies was on the use of external and internal knowledge to support their knowledge intensive products and services.

5. Research Findings

The main findings are shown in four key areas as follows.

5.1. Identifying The Knowledge Gap

A strong participative style of company interaction was found to be important in the process. All case companies took a very informal approach to identifying the knowledge gap. However they took a very proactive approach to evaluating the required knowledge through more established routines or systems. Identifying knowledge gap and what knowledge the firm has internally is the first step in managing knowledge process. Several indirect processes have also been used to identify the knowledge gap within the firm such as performance appraisals, brainstorming, etc.

We found that even if employees had access to required technical and market information, there was still a need to have strong support systems in place. When these systems fail, information is lost along the innovation process and the integration of knowledge into product development process stalls. As expressed by one of the interviewees the systems and tools are important components of the knowledge management process:

In terms of running a company there are a lot of things you have to do, especially in a small technology based company, my experience is, this is probably my eighth start up technology company with no exception you always get caught out in terms of traceability and change control, so there are a lot of systems put in place that I have put in place, to ensure that you don't get caught out in those two areas, so that knowledge if you like is captured and controlled in a way, to ensure that mistakes don't happen, so it is not all just floating around in people's heads, there are systems and procedures as well in the important areas.

Overall, the specific nature and context of specialised knowledge appears to be different, depending on the stage of the innovation process. During the early stages, for example, there seems to be emphasis on tacit and technological knowledge. However, in the later commercialisation stages, the emphasis will be put on market and explicit knowledge that is more formal and administrative in nature. One of the interviewees commented on how his firm identifies what knowledge gap they have in various stages of product development:

…just by identifying that we don't have either a. the resources or b. the skills to complete what is happening, so it will generally come from a meeting where we discuss that we have these things coming up, how are we going to achieve them. That is where we start trying to identify gaps and holes.

It also appeared that although these small firms exercise indirect methods such as performance appraisal, brainstorming, management meetings or other similar processes, however they are not using more systematic and technical KM tools such as Knowledge audit, knowledge maps, knowledge topographies, knowledge assets, geographical information systems, knowledge source maps, knowledge matrices and intranet, which can all facilitate knowledge identification (Probst et al, 2000). We found none of theses methods were used in our case companies and mostly the firms relied on *ad hoc* and informal methods. Informal processes include working collaboratively to share and build knowledge. This has been emphasised by one of the interviewees:

Probably that is done more ad hoc if you like, we are not a particularly big team, we know who is well skilled in what. We do have, and again it is informal, but we do have practices in place where we will try to have you know, he should work with him because he is really skilled in this area, but we need to have more people skilled in this area.

As firms relied on their technical staff for identifying knowledge gap, the main system for managing this was through management meetings. The senior management in all case study firms had a significant role in identifying potential new areas for innovation and the decision to respond to these. All directors interviewed relied heavily on their personal networks to assess market trends, to confirm or test the results of formal market surveys or other sources of market data and to find people to deliver services when these were not available inside the firm.

5.2. Knowledge Acquisition And Development

Knowledge acquisition and development is the process by which knowledge from different sources is transferred and developed within the firm. The firm should make conscious efforts to sense, search, and define relevant knowledge and its sources. Because not all knowledge is relevant, identifying and acquiring relevant knowledge is a critical step. The firm may

have to develop special protocols, processes, and systems to acquire knowledge. Acquisition can take several forms, ranging from a document transfer to interactive cooperation. In terms of the methods of the acquisition, one of the interviewees expressed:

Well it could be in a number of different ways, it could well be that we decide somebody needs training … it could be as I said that we hire an external resource. It could be a contractor/specialist in that area, it could well be that we use documentation …, look up documentation of previous procedures, it could be a combination of those things and it may well be that we gain access to an external resource, get them to document what we need and then use that as a tool as well.

Comparing to knowledge identification, knowledge acquisition activities differ in number of ways. The main difference is the degree to which knowledge acquisition is considered an interactive process between sources and recipient. For example, in the case of hiring new staff knowledge is transferred by moving the carrier to the recipient without much interactivity. On the other hand, in the case of knowledge acquisition by cooperation, knowledge is acquired by much interaction between parties. Our cases indicated that they use both interactive and non-interactive method for acquisition:

We do collaborate with different universities, mainly in terms of ongoing research and development and in optimizing the product, so yes from that perspective if you look at the external we are actually, collaboration is the wrong word, but we are interacting very closely with several global companies in the US, China and Japan and Korea.

However in most cases knowledge acquisition occurred through hiring a new staff with required expertise or in house training:

In some instances when you bring something on new you employ someone who has got expertise in that area, or alternatively you might make a decision that your existing staff can be trained to utilize that, it depends how quickly you want to get to the end result I suppose.

We also observed that the amount of external knowledge a technology firm will obtain depends on a number of factors/ the factors include aspects of social capital in the relationship and level of social interaction between the firms, particularly the quality of the relationship in terms of goodwill trust and reciprocity, and the level of network ties created through the relationship. The importance of the networking and social interaction and quality of the relationships with customers has been emphasised by several interviewees, for example one interviewee commented that:

We are continually on the outlook working with our clients to say what more do they require and then we will feed that into the lab for them to then go about deciding how they are going to deliver on those methods required by the tests.

On the whole, the cases indicated that external knowledge sources are crucial to their innovation process. Even organisations that are in totally different industries can have fruitful sources of ideas and catalysts for innovation. Technology firms obtain knowledge on the external knowledge market, for example external experts, other firms, stakeholders and knowledge products. From the perspective of individual knowledge, companies have used recruiting employees on long-term commitments, or hired external experts and used their expertise for a short time.

5.3. Knowledge Utilisation And Sharing

It is clear that the utilisation of knowledge is also a knowledge activity that rests largely on the company culture. The utilisation of knowledge should chiefly be stimulated and motivated by the management. A crucial aspect within knowledge utilisation is sharing the available knowledge between employees mutually, between employees and managers, between departments, etc. It is important that the correct knowledge gets to the right person at the right time. Knowledge sharing is primarily a knowledge stream that is dependent on the culture of the organisation. One can share knowledge by making project or fact sheets, job rotation, internal secondment and lunchtime meetings. The importance of both formal and informal communication links is well documented in the literature. For example, Nonaka (1994) describes innovation as an information creation process that arises out of social interaction. Our study shows that the informal system is very important for these firms. As one manager commented:

We are quite keen to encourage activities outside of the workplace as well, I mean we have quite a few social evenings where we encourage the guys to do things together at lunchtime and we have our little lunch learning meetings, they are less formal environments, but they still allow the guys to talk about and share ideas.

It was evident from the responses of our interviewees that most technology firms realised strategic value of smooth and effective distribution of knowledge between all the relevant employees. However, they were not taking steps to alleviate the potential disruptive effects of dysfunctional communication systems. However one of the managers came up with a new initiative to ensure smooth and effective transfer of knowledge:

I've already started taking some initial steps to ensure that we do communicate properly, we have communication type meetings with all staff, we also regularly do research and development type meetings with all staff, so it is quite interesting in how you grow companies, you do it through these steps at different times, you've got goals where different types of approach are necessary and you will find that different types of people are necessary for different stages in the growth.

We further found that even if the firms had access to required technical and market information, there was still a need to have effective support systems for sharing knowledge. When these systems failed, information was lost along the process and the

integration and utilisation of knowledge in converting good ideas onto successful products stalls. Hence our findings indicated that effective sharing of knowledge has a large impact on the efficacy of commercialisation process. Another aspect of the commercialisation and management of specialised knowledge that has been emphasised by the managers was the effective management of intellectual property and protection of new knowledge. One of the participants point to the importance of the electronic management of IP assets:

In terms of the information that we have, we obviously have a significant amount of IP that we have developed over the years which is contained within our in-house methods and that is all maintained electronically.

In fact managing intellectual capital and intangible assets are one of the key activities in managing specialised knowledge in technology firms. There seemed to be a fine balance between the provision of a relatively flexible system to encourage the acquisition of knowledge to initiate creative thinking in the initial stages to a more rigid, defined and controlled group structure in the later stages where tacit knowledge was converted to more explicit knowledge which constitutes valuable intellectual property for the firm. The mismanagement of intellectual property is often the main hurdle for the successful implementation and exploitation of specialised knowledge.

5.4. Organisational Knowledge Integration

We found knowledge integration and capturing individual tacit knowledge and turn it into organisational knowledge was a big challenge for our case companies. One of the interviewees in this regard expressed his view:

We have IT systems, and quality systems that dictate how we manage the actual information, I guess the challenge for us is to identify and share knowledge that isn't necessarily task orientated if you like, because the documentation is all based around task and once you've done it, you lock it and put it away, it doesn't mean that everything got into that document. Some of the experience and knowledge you would have picked up doing that isn't necessarily you know required within the documentation. Documentation can often be a very clean and sterile process if you like so the requirements for this document are this, this and this, but it doesn't necessarily capture everything that you've done. That is probably the biggest challenge for us is to capture that experience if you like.

The research highlighted that although the knowledge integration process is not formally planned for these firms but these high technology firms make every effort to capture individual experience and knowledge and combine existing knowledge elements and to improve current technology, develop new skills, or adapt to environmental changes. This is emphasised in the literature as those firms that practice knowledge integration are more flexible and therefore better able to seize strategic opportunities (Zahra & George, 2002). For example, one of the companies commented that building industry knowledge and capturing knowledge of their competitors provide new opportunities for development of new products:

The build up of general industry knowledge and even the niche areas that we are in, and knowledge of our competitors, both big and small and the opportunities that they leave behind if you like, yeah they've got plenty of successes in what we've done already and opportunities everywhere.

Although it is highly important, knowledge integration in product development projects is difficult to achieve as such projects incorporate individuals whose knowledge is both specialised and differentiated. It appears that knowledge capture from a very specialised source is at the heart of the problem of knowledge integration. This view also described by one of the participants:

One of our engineers has been with the company since about 1995 or 1996, he is now a manager in the engineering division and he even though we do have processes and procedures together to capture as much as the information that we can into our systems, there is just so much that he has in his head, it would be very difficult to pick up quickly if something happened to him. So a guy like him, and there is hands on knowledge of applications of our products and that sort of thing, that our engineers build up over time that again it is a difficult thing to capture.

We found that there was growing recognition of importance of tacit knowledge which evolved in the absence of any technological system or procedure to convert it into explicit knowledge. Such knowledge developed through practice and experimentation. In this regard the importance of informal links for knowledge capture became evident. Also the need to combine knowledge with operation activities became increasingly important as different actors get involved in future development of innovative ideas. For example, new knowledge created sources from the research in several cases shared and integrated internally with both the manufacturing as well as the marking people. Hence, as emphasised by participants it is needed for knowledge to be integrated within different departments and facilitated by communication across organisational functions.

6. Discussions

The qualitative method used in this study provides practical insight into the knowledge management process within small number of Australian technology firms. The research also provides useful lessons which can be used by other firms in integrating the knowledge more effectively in the innovation process. The findings, therefore, would be helpful for other small technology firms that may be searching for a practical method for managing and integrating their specialised knowledge.

The resulting key statements derived from our findings are summarised in Table 1. While the key statements are not transferable to all technology-oriented firms in Australia, however, they provide initial indications of similar problem areas and solutions for other technopreneurial firms. Briefly summarising the findings, we can conclude that there is no explicit policy that is targeted at strategic knowledge management within the cases studied. Generally no goals are included in the company strategy with regard to direct monitoring of available and required knowledge, nor the development, acquisition, sharing, utilisation or evaluation of knowledge. We found that lack of knowledge management strategy and systems did impact firm's knowledge management capability, which, in turn, impacted how well these small technology firms manage their specialised knowledge.

The research also highlights that technopreneurial firms must be intentional in order to manage their specialised knowledge strategically. In particular there is the need to share and distribute knowledge effectively and communicate new information across the firm to gain wide support and form a wide base of knowledge. These knowledge sharing practices will align the employees involved in creative thinking more focused goals bringing not only technical aspects of products, but also the commercial aspects like financing and marketing. Employees can be encouraged to develop new techniques for sharing knowledge, and become familiar with new knowledge. Effective knowledge management is crucial for this purpose. The system can serve also for linking commercial knowledge and market needs with firm's knowledge base. Knowledge sharing is enhanced also by a culture where the role of knowledge, knowledge management, innovation and creative thinking is encouraged. Most knowledge management programs have a strong knowledge culture element through which an organisational culture of knowledge generation and sharing is emphasised. Knowledge sharing and creation benefits innovation programs and frames knowledge as resource, but it also provides a culture within which innovation, creativity and learning through mistakes are encouraged and valued.

We have found that gaining access to internal knowledge and integrating this knowledge into new product development process was important for these high technology firms; however equally important was gaining knowledge through external interaction. The case studies have shown that the extent to which a technology-based firm acquires external knowledge depends on the ability of the firm to recognise and assess the value of the knowledge and on the willingness of the firms to acquire information from external sources. By accepting socially constructed knowledge facilitated by social interaction, technology firms are not restricted to sources of knowledge being generated by technopreneurs alone but can obtain knowledge from all levels of the firms environment. We follow Nahapiet & Ghoshal (1998) in arguing that social capital facilitates knowledge acquisition and exploitation by affecting conditions necessary for the creation of value through the exchange and combination of existing intellectual resources. Central to the argument is that social capital influences the knowledge available for the technopreneurs through networks of relationships.

Table 1: Key Findings

Key Statement 1: *Managers are aware of the importance of knowledge management practices. In spite of this, with the exception of general use of IT systems, KM has only a low priority.*
Key Statement 2: *Building effective and adaptive IT systems to manage and share knowledge in the firm is one of the biggest challenges for technology-oriented small firms.*
Key Statement 3: *Knowledge transfer activities in technology-oriented SMEs are mainly based on soft personalisation mechanisms and focused on informal communication and interaction, and technology aspects are not adequately addressed.*
Key Statement 4: *Technopreneurs don't spend enough time strategically managing their specialised knowledge. They appreciate however the need to integrate this knowledge efficiently throughout the new product development stages.*
Key Statement 5: *A low-quality knowledge management system is problematic for technology firms. However experience, know-how, or the persuasiveness of people supporting and participating in the innovation process can compensate for a lack of KM system in the firm's technology or prospects for success.*
Key Statement 6: *Building internal and external networks is a key mechanism for sharing and acquiring knowledge from internal and external sources.*
Key Statement 7: *Technology-oriented SMEs do not have a designated position in their firm that specialises in knowledge management. They however may have IT experts among their staff.*
Key Statement 8: *Processes through which tacit knowledge is transferred, captured and integrated are not well embedded and understood within the organisational context and are based through face-to-face interface.*
Key Statement 9: T*here is little explicit strategy in small technology firms that is targeted at systematic knowledge management either at strategic or operational level.*
Key Statement 10: *Integration of specialised knowledge in technology firms is very much project focused and project specific.*

Our findings highlight that both technology and information processing techniques to manage knowledge are important. There seemed to be general acceptance in the literature and among the managers interviewed that technology is a concrete mechanism and tools that can be used for data analysis. However, there is a need to improve the general effectiveness of the systems in supporting the management of knowledge beyond simple use through databases. For example, high tech firms need not only to have effective information systems to manage customer information but to be able to synthesise by taking data, interrogating it, and turning it into information and then to knowledge. This process role of technology is influential and can act as a facilitator of human knowledge in the organisation. Our findings show that managers do have appreciation of the importance of technology in knowledge management and think that the technology should be used in much more creative way to support various business processes. However, such small specialised firms often do not have a designated position in their firm that specialises in knowledge management.

Finally we would like to follow the argument that integrating knowledge effectively requires a thorough understanding of the organisational knowledge processes. Knowledge integration capability may be necessary to successful innovation and commercialisation of new products, and may be a key dynamic capability of firms. This capability is dynamic as it requires

an ongoing process of combination and exchange leading to new knowledge. Technology firms that attempt to keep aligned with their environments may require attention to how they manage their specialised knowledge.

7. Concluding Remarks

This paper has focused on managing knowledge in small and young high tech firms. In our view, the organisational knowledge literature is a logical point of departure when explaining management of specialised knowledge in high technology firms. We have placed particular focus on analysing different knowledge management activities including knowledge identification, acquisition, utilisation and integration. We have developed a conceptual technopreneurial knowledge management framework for technology firms and made knowledge processes and determinants integral to the model. The determinants were related to the nature of knowledge, organisational context, and mechanism of the linkages between technological and commercial knowledge.

In general, the study supports recent literature on knowledge integration, such as Kraaijenbrink et al (2007) or Enberg et al (2006), since our case studies demonstrated importance of micro-level organisational context in integrating knowledge within small firms. Empirical findings also support the argument that firms seems to utilise increasingly more external networks to acquire knowledge and this partly enables SMEs with limited resources to learn and get to the market sooner.

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