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'Open Innovation Thinking as a Mechanism for Strategic Development of Knowledge Intensive Ventures

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Abstract

This paper serves to analyse how the strategies for development pursued by knowledge intensive (KIE) ventures are influenced by Open Innovation thinking. This is done through the development of a conceptual framework for analysing this relationship, and the application of this framework empirically through six in-depth case studies of KIE ventures. It is found that there is a very high degree of similarities between the KIE strategies and Open Innovation thinking. In particular the exchange, development, and application of knowledge generated externally to the KIE ventures is a strikingly similar feature.

OPEN INNOVATION THINKING AS A MECHANISM FOR STRATEGIC DEVELOPMENT OF KNOWLEDGE INTENSIVE VENTURES

1 INTRODUCTION

Understanding the process of wealth creation is a central objective in research throughout organizational sciences (Hitt et al. 2002) - each research area taking its own approach to this goal. For example, strategic management focuses on how competitive positioning can create advantages for firms, whilst entrepreneurship focuses on wealth creation through identification of new and emerging opportunities (Shane and Venkataraman, 2000). Although the respective foci of these areas suggest a clear demarcation between strategic management and entrepreneurship, the reality of organizational behaviour is often much more complex, and managers must handle challenges presented by both strategic objectives and entrepreneurship.

Scholars have long recognized the need for firms to focus on both aspects of strategic management and entrepreneurship (e.g. Burgelman, 1983) in order to be continuously innovative. In order to integrate both aspects, contemporary literature on innovation emphasizes the importance of the ability to utilize external knowledge sources in innovation activities (Cohen et al., 2002; Cockburn and Henderson, 1998; Chesbrough, 2003; von Hippel, 1988). For example according to Chesbrough (2003), openness to using external sources of information and ideas in the firm's innovation processes, as well as interaction among different partners is of high importance when creating value through innovation activities.

Entrepreneurship specifically takes on new importance in a knowledge economy because it serves as a key mechanism by which knowledge created in one organization becomes commercialized in a new venture. In particular knowledge intensive new venture firms are often regarded as an important source of innovation, due to fluid structures, low levels of hierarchy, few bindings to existing customers and markets, yet based on highly specialized knowledge (Tushman and Anderson, 1986; Christensen, 1997). Scholars have defined new ventures as firms that are less than 8 years old (e.g., Zahra, Ireland and Hitt, 2000), although this parameter varies somewhat across studies.

Despite the significant number of studies conducted in the general area of entrepreneurship and management, little attempt has been made to systematically gather evidence on the innovation strategies pursued specifically by new knowledge intensive ventures, and how open innovation may influence the development of such ventures. This create a lack in our understanding of the mechanisms affecting knowledge-intensive entrepreneurship, its relation to open innovation and the outcome hereof, as well as the understanding of the linkages between the concept of open innovation and entrepreneurship. Relevant questions on the specificities hereof remain unanswered. This is the starting point of the current research study.

In order to research the identified gap in knowledge, we address the following research question in this paper.

How do strategic considerations unfold in the context of knowledge intensive venture creation, in relation to the recognition and development of innovative opportunities?

2 CONCEPTUAL FRAMEWORK

According to Oviatt and McDougall (1994), new ventures do not need to own the resources in order to grow and to outsmart their rivals. Instead they compete through resourcefulness achieved through developing unique intangible assets, which include network relationships among other elements, such as organizational culture, innovative abilities, entrepreneur-related conditions (founder's cognitions and prior experiences). However, shifting the focus from ownership to the concept of openness requires a reconsideration of the processes that underlie value creation and value capture. The notion of openness we apply follows Chesbrough and Appleyard (2007) who define it as "the pooling of knowledge for innovative purposes where the contributors have access to the inputs of others and cannot exert exclusive rights over the resultant innovation".

In this section we first characterize KIE in order to be able to identify traits of such organizations which may favour certain strategies. Secondly, we apply the EO construct as an overall research frame to understanding the development of innovation. The concept of entrepreneurial orientation was introduced by Covin and Slevin (1991) and includes the dimensions of innovativeness, risk-taking, pro-activeness, competitive aggressiveness and autonomy (Lumpkin and Dess 1996). The central conviction of the EO construct is that the presence of such orientation leads to innovative performance (Stopford and Baden-Fuller, 1994; Lassen et al., 2006). The EO construct is considered appropriate as it focuses in particular on identifying the behavior of entrepreneurial organizations which leads to innovation, and hence gives a strong starting point for identifying and discussing how KIEs engage in open innovation.

The strengths of this approach is that it allows us to make detailed comparison of the empirical data in the study, and thus create specific answers to the question of how KIE ventures use open innovation as part of their strategic development.

2.1 Characteristics of KIE ventures

McMahon et al. (1993) referred to the intent of defining the small venture as a characterized by "vexing and enduring difficulty" and went on to indicate that "small enterprises are easier to describe than to define in precise terms. In other words, you will know one when you see one. What small enterprises in fact have in common, and which sets them apart from large enterprises, are other less tangible attributes that are more difficult or even impossible to measure" (p.9). McMahon et al. (1993) have summarized a common view that small firms are best identified by their inherent characteristics. As such, this section (2.1) provides an overview of these characteristic to develop a base for understanding the key elements the KIE venture and how these influence the ability to innovate.

2.1.1 Resources

The organizational configuration refers to the formal and informal structure of the small firm. Little theory has been developed on the structure of small firms because of its apparent simplicity and less formalized nature. However, a number of studies have respectively addressed a number of characteristics, which will be outlined here.

Human capital

Researchers and other interested parties have used specific criteria to operationalize the small firms as a construct; value added, value of assets, annual sales, and number of employees (Osteryoung and Newman, 1992; Holmes and Gibson, 2001). The latter two are most often used to delimit the category. E.g. the OECD SME and Entrepreneurship Outlook (2005) defines company size according to numbers of employees, and categorizes the small firm as having less than 50 employees.

The low staff number is of course a striking feature of new ventures, and describes the limited human resources of such firms. However, as pointed out by e.g. Curran and Stanworth (1986) it is not without problems to define company size purely according to number of employees, as this is a measure which is relative to e.g. the market size and the structure of the industry in which the firm is located.

In a practical sense, an employment based proxy however has a number of advantages over financial measures of size, specifically; number of employees is easily understood and readily visualized, and it maintains status quo and is the current measure used by public institutions and databases, hence providing a comparable measure.

With the problematic issues in mind we proceed by applying the OECD definition of small ventures having less than 50 employees. This will be seen in connection to several other characteristics.

Financial capital

Innovation often represents a large financial risk. Due to the limited size, the small venture will experience this as a serious challenge as this creates an inability to spread risk across several projects or units.

This is further emphasized by the fact that with a limited number of employees the value of time spent by each person on not immediately value-adding activities is very high and may have direct impact on the day-to-day operations performed in the firm.

In this connection, the ability to attract external capital may also be a challenge for small ventures, as business angles and corporate venture capital is highly oriented towards start-up companies with high-growth potential rather than the already established firm, which has remained small. Hence, the cost of external capital, through loans, may turn out to be relatively high for the small venture.

Social capital

One of the ways in which small ventures try to counterbalance the lack of human and financial resources is through the characteristic use of multi-functionality of staff. This means that the individual employee is often in charge of more than one process/task in the organization. This provides key role players with extraordinary opportunity to influence operations and activities directly. To this dynamics of the firm, formal qualifications in relevant disciplines are remarkably unimportant. Few precise definitions of rights and obligations, duties and responsibilities exist, and informal relationships govern the distribution of tasks to a much higher extent than education and/or technical qualifications (Jennings and Beaver, 1997).

The key skill of the staff is, therefore, not only knowing how to create an appropriate product to fit the needs of particular client, but also the capability of staff to select appropriate clients and appropriate directions of activity. This ability is highly dependent on their ability to create and use

social capital rather than relying on market intelligence and formal agreements with external partners.

Employing multi-skilled staff creates a large degree of flexibility and coherence between departments, which is often found to be more difficult to achieve in larger organizations. However, an obvious challenge in relation to relying on the multi-functionality of staff members is that a number of functions, duties and roles must be fulfilled if the organization is to succeed, and a lack of attention to any one of such activities and tasks will lead to sub-optimal performance.

2.1.2 Organizational design

One of the most distinct differences between large and small ventures is found along the structural dimensions, such as formalization and centralization. Organizational structure is also closely linked to the innovativeness of firms and, hence, important to consider in this research.

Structure

Research on small ventures has suggested that such firms commonly adopt an organic structure as it increases their ability to adapt to the demands of the market. Hage (1986) has argued, for example, that organic structures are likely to be found where environments are turbulent, technology advanced and changes occur rapidly.

The adaptability of a structure is achieved by increasing or decreasing the numbers of operating teams. The capacity to draw in more staff from outside the organization, to use sub-contract workers, and to move people around within the organization itself, in order to create better operating teams, is essential for increasing the scale of operations, and for changing and diversifying the scale of operations.

The capacity of small ventures to do so is sometimes made explicit and referred to as a desirable feature of small organization. Smallness is highly functional, indeed it is sometimes held to be essential that operating teams should not grow too large, and that firms themselves should not grow above the core of a few operating teams.

Organizational boundaries

In line with the high internal flexibility, the boundaries of small ventures are often found to be extremely porous, and high degrees of collaboration take place based on informality and person specificity. Formal arrangements on the other hand between individuals or groups ostensibly outside the organization and individuals inside the boundaries are more uncommon.

This fluid perspective on the integrated use of both internal and external resources is often highly beneficial for the small venture, as it significantly reduces the fixed cost connected with relying only on developing in-house competences. However, such an approach also creates a dependency between the individual small venture and external partners, which is particularly risky in times of economic turbulence in the marketplace.

2.1.3 Collaboration

The task environment is composed of the way of addressing and interacting with customers, suppliers, competitors and regulatory bodies (d'Amboise and Muldowney, 1988). The small venture is in general more vulnerable to the effects of the environment, and given its limited financial and human resources, it spends more time adjusting to turbulence than predicting or controlling it.

External network - affiliation and alliances

Accounts of dynamic small ventures have stressed the importance of networks and networking to competitive success (Ackroyd, 1995; Bryson, 1997; Hendry *et al.*, 1995). The essential point seems to be that the informal and formal linkages that exist between firms can exercise an important influence on the ultimate viability of the enterprise. This appears to be particularly pronounced in small knowledge intensive firms. Given the vulnerability of such small ventures to the changes in the environment, which were pointed out above, survival depends to a large extent on how well it interacts. Informal affiliations between individuals and organizations of similar size are ubiquitous and extremely important activities for creating interaction with the task environment. These might be called "informal strategic affiliations" to distinguish them from those formal arrangements widely discussed in the literature (Ram, 1999).

Market orientation

In small ventures, resources for market intelligence generation are scarce, and there is no room for a marketing specialist. In fact, market intelligence is based mostly on secondary data (from trade journals, sector research, conferences, and professional magazines) or on personal contacts (with suppliers, customers, or bank employees) (Smeltzer, Fann, and Nikolaisen 1988).

However, the products and services developed and implemented by small ventures are often in the process of constant adaptation and change. Rather, the lack of resources for quantitative market intelligence generates a need for an organizational culture which efficiently creates superior value for the customers based on other methods. Such methods include close collaboration and relationships with customers, and a willingness to adapt products to customized demands.

2.1.4 Managerial characteristics

Amongst others, Jennings and Beaver (1997) argue that the management process in the small venture is unique, and bear little or no resemblance to management processes in larger firms, which have been subject of substantial academic research. Managerial characteristics involve the motivations, goals, objectives and actions of the management.

Management and ownership

It is now widely accepted that the particular characteristics of small ventures require a different appreciation of management understanding. In small organizations the owner-manager role is often centered on the same individual (Holmes and Gibson, 2001), and the importance of this structure is highly central, as his/her comprehension of the organization will guide and directly influence the business decisions. Although small ventures are often generally characterized by high degrees of flexibility, fluid structures, informality and team-work, certain elements of hierarchy are highly

noticeable. The omnipresent influence of the owner-manager creates a centralized and fast acting top management decision process. Understanding the influence of power, capability and influence is of vital importance for understanding the development of the small venture, as it may be an influential explanatory factor of why certain small ventures strive for performance whilst others do not.

Strategy

In larger organizations competitive advantage is often created deliberately as a result of the pursuit of explicit policies and procedures. Consequently, strategic management becomes a predictive process (Faulkner and Johnson, 1992). In contrast, competitive advantage in the small venture often arises accidentally as a result of particular operating circumstances surrounding the enterprise. Here the strategic management becomes primarily an adaptive process concerned with manipulating a limited amount of resources. As such, the efforts are not concentrated on predicting or controlling the operating environment, but on adapting as quickly as possible to the changing demands of this environment (Jennings and Beaver, 1997). This management process is often characterized by highly personalized preferences, prejudices, and capabilities of the owner/manager and the key staff, and thus the organizational strategy develops as a consequence hereof. This approach has the distinct advantage of being adaptive, fast responding and closely related the contemporary developments on the market. However, it should also be emphasized that such strategy is very vulnerable to discontinuity of management and key staff, and is very exposed to serious implications of unopposed misapprehensions of management.

2.2 Sum-up

We have above identified and discussed a number of variables associated with KIE ventures. This will enable us to identify traits of such organizations which may favour certain strategies. In table 1 below these traits are listed for the sake of overview.

Tabel 1: Traits of KIE ventures

Resources	<i>Human capital</i>
	<i>Financial capital</i>
	<i>Social capital</i>
Organizational design	<i>Structure</i>
	<i>Organizational boundaries</i>
Collaboration	<i>External network</i>
	<i>Market orientation</i>
Managerial characteristic	<i>Management and ownership</i>
	<i>Organization strategy</i>

2.3 Development of innovation in KIEs

In this section we turn focus to identifying how to understand the approaches to innovation applied by KIE ventures. We do so by operationalizing the elements of the EO construct into specific aspects applicable in the discussion.

2.3.1 Innovativeness

Innovativeness is referred to as a firm's tendency to engage in and support new ideas, novelty, experimentation, and creative processes that may result in new products, services, or technological processes.

Degree of radicality

It is recognized that innovativeness can vary in degree of radicalism, but essentially it refers to a willingness to depart from existing technologies or practices and venture beyond the current state of the art (Kimberly, 1981). Evaluating the novelty continuum of innovation it becomes clear that a division can be made between innovation based on exploitation logic of improving the existing and innovation based on exploration logic of creating something new.

Growth / Development

The measure of growth and development is central to innovation, as implicitly stated through the definition of radical innovation in terms of the impact created. Intuitively this suggests that the more radical the innovation the greater the impact. However, the measure of impact is not without its difficulties. One of the most commonly used measures is the size of a company relative over time. Amongst others Whetten (1987) suggests that organizational size proves valuable when seeking to identify appropriate concepts of organizational growth.

Additionally, Weinzimmer et al. (1998) showed that 83% of studies used sales (or revenues) as a concept of growth and nearly 3/4 of these studies used sales as their only measure of growth. This in spite of the fact that already in 1972 Child contended that organizational growth cannot be measured by simply considering sales, and urged that multiple concepts be considered. Other common concepts used to measure growth include employees and assets.

2.3.2 Risk-taking

Risk taking is a quality that is often used to describe entrepreneurship. It can have various meanings, depending on the context in which it is applied. In this paper, risk is seen in the context of strategy, which according to Baird and Thomas (1985:231-232) can take three forms; (a) venturing into the unknown; (b) committing a relatively large portion of assets; and (c) borrowing heavily.

An informal, open, and inquiring environment that values experimentation, with leaders promoting innovation by creating a shared belief that team members are safe to take interpersonal risks will facilitate radical innovation. However, as described by Leifer et al. (2000): "*Attempts at radical innovation produce more failures than successes, and the magnitude and timing of results are highly unpredictable. Faced with the double-barreled negatives, it is not surprising that executives*

feel more comfortable in other approaches to future growth; sticking to their knitting, gaining access to innovative technologies through acquisitions, or being a fast followers, as new concepts enter the competitive arena.”

Venturing into the unknown

Venturing into the unknown involves a psychological risk in the sense of uncertainty and unfamiliarity that may apply generally to different types of risk. The willingness to take psychological risk involves making moves for which the outcomes and probabilities may be only partially known and where hard-to-define goals may not be met. This is often a prerequisite for engaging in the development of radical innovation.

Committing a relatively large portion of assets

Financial risk refers to the risk-return trade-off, and was used by Miller and Friesen (1978) when they defined risk taking as *“the degree to which managers are willing to make large and risky resource commitments – i.e., those which have a reasonable chance of costly failures”*. The commitment of resources may be in terms of financial as well as human/social capital.

Borrowing heavily

Borrowing finances is a particular type of risk often associated with entrepreneurship. This most often refers to bank loans and to a lesser degree equity financing. This type of risk is often influenced by a tendency for entrepreneurs to be unrealistically optimistic and have an exaggerated perception of control (de Meza and Southey, 1996), and only moderated by the willingness of credit institutions to provide loans.

2.3.3 Pro-activeness

Pro-activeness is related to the act of initiative in the entrepreneurial process, and to acting in anticipation of future problems, needs, or changes.

Anticipation

For example Lieberman and Montgomery (1988) emphasized the importance of first-mover advantage as the best strategy for capitalizing on a market opportunity. Thus, pro-activeness by anticipating and pursuing new opportunities and by participating in emerging markets has become associated with entrepreneurship. The pro-activeness dimension of entrepreneurial orientation therefore most closely resembles the ideas suggested by Miles and Snow (1978) of a prospector type, about which they stated: *“the Prospector's prime capability is that of finding and exploiting new products and market opportunities... Prospectors are frequently the creators of change in their respective industries. Change is one of the major tools used by the Prospector to gain an edge over competitors.*

2.3.4 Competitive aggressiveness

Competitive aggressiveness refers to a firm's predisposition to directly and intensely challenge its competitors to achieve entry into a new market or improve the present position in an existing market; that is, a strong focus on outperforming competitors. According to Lumpkin and Dess (1996) competitive aggressiveness is characterized by responsiveness, and a willingness to be unconventional rather than rely on traditional methods of competing. The propensity of the firms to analyze and target a competitor's weaknesses (Macmillan and Jones, 1984), as well as tendency to be first-to-market with new product offerings on a frequent basis (Porter, 1985), are also considered elements of competitive aggressiveness.

External perspective

Innovation through competitive aggressiveness requires the ability to harvest ideas and competencies from a wide array of sources. It is the process of identifying, understanding and acting on external emerging patterns in the environment that is the essence of radical innovation

2.3.5 Autonomy

Autonomy is an essential element of EO, and is traditionally seen through the formation of new and independent ventures. However, in an organizational context autonomy refers to the independent actions of an individual or a team in bringing forth an idea or a vision and carrying it through to completion (Lumpkin and Dess, 1996). As such, their actions are taken free of rigid restrictions and where the individual or team throughout the process remains free to act independently, to make key decisions, and to proceed. Fostering autonomy in an organizational context may involve flattening hierarchies and delegating authority to operating units, and draws on the idea of or example Burns and Stalker's organic management systems, promoting decentralization, low formalization, dynamic behavior, learning and flexibility in structures and processes of the organization (Burns and Stalker, 1961; Nonaka, 1991; Senge, 1994).

Freedom

Freedom to explore is widely recognized as a prerequisite for innovation. Freedom, in the innovation context, refers to deciding what to do or how to do accomplish the task, as sense of control over one's own work and ideas. The most important freedom is operational autonomy; it means the freedom in the day-to-day conduct of one's work, freedom in deciding how to achieve the overall goal of a mission.

Abetti (2003) argues that over-management can be as much an inhibitor to radical innovation as under-management. Management of radical innovations requires balancing the natural desire of control with the realization of insufficient technical and market knowledge in order to guide and assist, rather than interfere with and control the innovators.

Managerial characteristic	Management and ownership								
	Organization strategy								

In the following, we will describe the methodology used to test the conceptual framework in an empirical setting.

3 METHODOLOGY

Given the exploratory nature of this research, qualitative case studies are chosen as the appropriate research method to apply (Yin, 1989). Six case studies are conducted to illustrate and explain the process and effect of strategic considerations in the context of knowledge intensive new venture creation.

3.1 Data selection

We deliberately selected the case-organizations to provide information-rich cases. The criteria for selection were that:

- The organizations were smaller than 50 employees (OECD definition of ‘small firm’)
- The organizations had existed less than 8 years (in the new venture creation phase)
- The organizations were knowledge-intensive
- The organizations were engaged in innovation project(s)

An overview of the case organizations is presented in Table 2.

Table 4: Overview of organizations and innovation projects

Organization pseudonym	# of empl.	Age	Areas of activity
Fuel cells Inc.	35	5	Leading manufacturer of fuel cell stack modules featuring HTPEM (High Temperature Polymer Electrolyte Membrane) technology
Software Inc.	12	7	Artificial intelligence technology offering a flexible method to represent complex and uncertain decision problems.
Green Inc.	20	6	NH ₄ ⁺ Slurry Acidification Systems which convert ammonia content to a stable chemical state, thereby virtually eliminating evaporation.
Sensor Inc.	10	6	Development of a low-power, wireless CO ₂ sensor, which reduces dependence of infrared source stability by 50 times or more. The idea originates in the area of indoor air quality control, where CO ₂ is an important variable to measure for air conditioning and optimization of energy use.
Space Inc.	8	3	Operational Cubesat platform, being used in different satellite projects. The

			technology is based on COTS components. This has resulted in large flexibility in the individual subsystems making them easier to integrate with a payload into an operational satellite.
Surveillance Inc.	6	3	Advanced remote controlled Unmanned Aerial Vehicles, providing data suitable for e.g. detailed map making of remote areas.

3.2 Data collection

The 5 dimensions of entrepreneurial orientation (Covin and Slevin, 1991; Lumpkin and Dess, 1996) are used to form the analytical basis for the empirical research, as these are widely recognized as representative of innovative and entrepreneurial behaviour.

The concept of entrepreneurial orientation was introduced by Covin and Slevin (1991) and includes the dimensions of innovativeness, risk-taking, pro-activeness, competitive aggressiveness and autonomy (Lumpkin and Dess 1996). The central conviction of the EO construct is that the presence of such orientation leads to innovative performance (Stopford and Baden-Fuller, 1994; Lassen et al., 2006).

Through the development of an interview protocol based on the dimensions, interviews are conducted with the owners/CEO's the firms. The data collection is carried out following a similar interview protocol in all cases in order to create replication logic between the cases (Yin, 1989).

A minimum of four hours of interviews are carried out in each organization, and in three of the cases up to twenty hours of interviews. All interviews are completely or partially transcribed allowing for clustering of emerging themes.

4 RESULTS AND DISCUSSION

In the following, we have used the conceptual framework to evaluate the knowledge created through the six case studies. The analysis is conducted by evaluating how each KIE characteristics affects the ability to conduct innovation.

The analysis of the six case studies shows that competitive advantage in the knowledge-intensive new ventures often arises a result of particular operating circumstances surrounding the enterprise. Here the strategies followed become primarily adaptive processes concerned with manipulating a limited amount of resources. As such, the efforts are not concentrated on predicting or controlling the operating environment, but on adapting as quickly as possible to the changing demands of this environment. The highly personalized and flexible organizational strategy has the distinct advantage of being adaptive, fast responding and closely related the contemporary developments on the market. This is a process greatly similar to the processes described as open innovation. The innovativeness activities are also striking in these case studies. By this, we mean the processes by which the KIE ventures identify a market opportunity, defines (configures) its value chain, and identifies unique ways to reach potential customers is also characteristic of the cases studied.

Table 5: KIE ventures' use of open innovation to strategic development

Characteristics of innovation KIE characteristics		Innovativeness		Risk-taking			Proactiveness	Comp. aggressiveness.	Autonomy
		Degree of radicality	Growth	Venturing	Committing assets	Borrowing heavily	Anticipation	External perspective	Freedom
Resources	Human capital	X	X	X			X	X	X
	Financial capital		X	X	X		X		
	Social capital	X	X	X				X	X
Organizational design	Structure	X	X						
	Organizational boundaries	X	X	X			X	X	X
Collaboration	External network	X	X	X			X	X	X
	Market orientation		X				X	X	X
Managerial characteristic	Management and ownership								
	Organization strategy	X	X	X			X	X	

4.1.1 Resources

In all six cases, the primary driver is first of all the access to new knowledge, either complementary technological knowledge or market knowledge. The KIE ventures view themselves as part of an extended knowledge network, where the synergies create advantages for all players, in step with the joint development and expansion of the markets they operate in.

In addition to technological, scientific and market knowledge, several of the KIE ventures also express how social capital is an important factor in their strategy to stay innovative. Social capital is according to the respondents a ticket to be part of future interesting activities, developments and deals. In the case study of Space Inc., it nurtures close relationships with NASA, due to their influential position in relation to the funding decisions made by the Space Grant Consortium and the National Science Foundation.

Financial capital is of course also a concern for KIE ventures as they possess only scarce resources, and are often forced to prioritize their activities. But, financial resources are in this connection not only sought through sales. They have other channels for funding. Academic funding programs, CVC, and other capital investors are often of interests to the KIE ventures, and their innovation efforts are affected by this interest. Innovation can be seen as a necessary trait in order to qualify for certain investors, and moreover, innovation can expand the access to potential funding programs. Additionally, the extensive use of networks by the KIEs is also considered as a way to bootstrap

resources, in the sense that expenses are shared amongst several partners, thereby minimizing the expense for the individual KIE venture.

In all cases the aspect of access to human capital is a prevalent consideration in relation to innovation. The respondents acknowledge that in order to be in the forefront of the knowledge developments in their respective areas, it is necessary to be attractive and visible in the markets where the most highly skilled people are located. They all agree that the access to suitable human resources is a serious challenge for a recently started venture, and they need to be creative in their pursuit of such people. Thus, it is not only a matter of marketing of the company and attracting highly skilled personnel to work in the home country of the KIE ventures. The ventures must do more. The companies often collaborate with people located outside of their home country, and they initiate international activities to make the most of such collaborations. In the case of Sensor Inc., they initiated their activities on the German market due to the fact that a number of people with specialized knowledge on infra red sensors were located in Germany.

4.1.2 Organizational design

As highlighted in the development of the conceptual framework, theory often points to organizational structures and boundaries as a defining factor for the ability of firms to be innovative. The analysis of the empirical setting also shows that their structures and boundaries do have significant influence on their ability to innovate. It is however important to mention that none of the studied KIE ventures seem to pay specific attention to developing and maintaining such favourable structures and or boundaries. Rather, it seems this is an inherent trait of the KIE ventures, which they exploit through a variety of activities and types of collaboration. E.g. the research at hand demonstrates how fluid structures and loosely defined organizational boundaries generate social capital for new ventures and better equip them for accessing resources and overcoming the liabilities of newness.

4.1.3 Collaboration

One of the most striking features identified through the analysis of the case studies, is the extensive use of network and external knowledge sources as the primary driver of strategic development strategies applied by knowledge intensive ventures. Inter-organizational networks link the KIE ventures with different external assets and competencies in response to or in anticipation of new market opportunities. One of the main reasons to team up with other firms is technological complexity and high market uncertainty. The need for external resources is often used as an explanation of the involvement of new ventures in networks. Networks are also as an important characteristic feature of these types of firms. The existing literature (e.g. Johanson and Vahlne, 2009) recognizes the importance of networks for new ventures and identifies the influences of network ties on the growth process of new ventures. Chesbrough (2003, p. 53) argues that *“The cascade of knowledge flowing from biotechnology...is far too complex for any one company to handle alone...so companies have to identify and build connections to excellent science in other labs”*.

4.1.4 Managerial characteristics

As in many entrepreneurial companies, the managerial characteristics in the six KIE ventures are dominated by the technical competences behind the founding concept. The knowledge traits of the management/owner team are often a requirement for the level of innovation conducted in the KIE venture. However, all the cases point to the organizational strategy being the defining characteristics of how KIE ventures stay innovative. Such, organizational strategies establish clear linkages to the continuous pursuit of collaboration with external partners on several different levels.

5 CONCLUSION

In conclusion, we return to the point of departure of the present article; how the innovation strategies pursued specifically by new knowledge intensive ventures are influenced by open innovation principles and how linkages exist between the concept of open innovation and entrepreneurship.

We have been able to establish that there are vast similarities between the innovation strategies pursued by KIE ventures and the concept of open innovation. The six cases studied have provided insight into the most defining drivers of such similarities. In Table 4 it is illustrated how the access to knowledge and different sets of resources are primary driving mechanisms behind the open innovation strategies of the KIE ventures.

Table 6: Strategic output of open innovation approach in KIE ventures

<i>Primary driving mechanisms</i>	<i>Software Inc.</i>	<i>Fuell Cells Inc.</i>	<i>Green Inc.</i>	<i>Sensor Inc.</i>	<i>Space Inc.</i>	<i>Surveillance Inc.</i>
Access to knowledge	X	X	X	X	X	X
Social capital		X	X		X	X
Financial capital				X	X	X
Human capital	X	X	X	X	X	X

In particular, due to the level of knowledge applied in the products of the six case companies, the access to further knowledge is for all the ventures the absolute most important feature. It is imperative for the ventures to stay in the very forefront of the market, and in several instances drive the actual development of the market. And the only way for them to do so, is by continually exchanging, developing, and integrating the latest knowledge within each of their fields. Also, regarding the resources sought through open collaboration, especially the resources connected to knowledge (social and human) are highlighted as important. This further underlines the linkages between open innovation and the entrepreneurial strategies pursued by KIE ventures.

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