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**Absorptive Capacity and Knowledge Transfer:
An Exploratory Model for University-led Research
Institutes (RIs) and Small and Medium Enterprises (SMEs)**

A 152.800 thesis presented in partial fulfilment of the requirements of the

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Abstract

'Absorptive capacity' is a construct used to define an organisation's ability to exploit knowledge that is available internally and externally. The construct is very popular within management research and has been used to describe the absorptive capacity of a range of strategic Multinational Corporation partners through to whole regions of countries.

SMEs account for over 95% of businesses throughout the world. They provide innovation, productivity and economic growth, but because of their size and resources cannot afford to carry out costly Research and Development (R&D). They therefore need to be able to harness the intellectual property from universities through University-led Research Institutes.

This thesis uses the construct of absorptive capacity to propose a theoretical model to analyse the knowledge transfer from a University-led Research Institute (RI) to an SME, when the SME is commercialising a product or process the RI has developed. The application of absorptive capacity in this context would allow SME researchers and managers to develop understanding of how this knowledge transfer is affected by internal and external factors. The importance of continued government funding to ensure the collaboration between SMEs and RIs is highlighted.

This research design is highly exploratory resulting in a range of future research suggestions for future hypothesis generation. Most important of these are suggestions for determining, defining and developing the organisational determinants of absorptive capacity. This will allow a prescriptive analysis of how knowledge transfer occurs between the SME and RI and how managers can foster organisational absorptive capacity for successful knowledge transfer. Additionally, the temporal aspect of the SME and RI relationship could be explored, such as the impact of the initial experience on the ease and length of future knowledge transfer relationships. Also, researchers could study the change in the SME's knowledge requirements from the RI as the SME's organisational structure grows.

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Chapter 1

Introduction

In the 1990s, the rapid internationalisation of businesses meant that many companies could access global markets and reap the financial rewards from developing larger customer bases. However, businesses found that this easier access into larger global markets was tempered by the increase in competitors vying for the same consumer dollar. Businesses had to rethink their organisational strategies to reap the benefits from an increasingly competitive market and demanding customers (Prahalad & Hamel, 1990). These organisational strategies included forging strategic alliances with competitors and these types of new strategies signalled the change of emphasis for large businesses. The focus shifted away from creating 'core products' that encouraged product loyalty to creating 'core competencies' that arose out of innovative organisational processes (Hamel, Doz, & Prahalad, 1989).

Now, managers within these organisations were able to see "knowledge [*and knowledge processes*] as a strategic asset" (Bou-Llusar & Segarra-Ciprs, 2006, p. 101). At the same time, researchers started seeing organisations from a 'resource-based view' (Lane, Koka, & Pathak, 2006). This was important because it meant that companies could create competitive advantage by utilising resources within the organisation. Additionally, an organisation's *capabilities* in utilising these resources in a novel and inimitable way could also create *sustainable* competitive advantage.

Therefore, organisations (and their managers) that can manage their knowledge processes skilfully can create competencies that generate sustainable competitive advantage. For example, organisations can develop knowledge bases that capture valuable expertise gained from developing specific new products or processes. This expertise can then be used in the development of other products and processes or even in completely new and novel situations (Watson, 2002). Capturing expertise and applying it to other situations is a source of innovative thinking (Adams, Bessant, & Phelps, 2006; Cohen & Levinthal, 1990). Large businesses recognise that to be inimitable and compete successfully, they also need to be innovative in their products and processes.

Large businesses are able to develop innovative products and processes through internal Research & Development activities (R&D). However, R&D in new areas is costly in terms of time and money. It can be difficult for large companies to respond quickly and efficiently to changes in the market. In order to deal with this problem, large businesses enter into strategic R&D alliances with competitors, some of which are small, unknown companies developed by entrepreneurs (Rothaermel & Deeds, 2004; Wheelen & Hunger, 2004). The size and organisational form of small businesses allows innovative processes to occur more easily than in a larger organisation, which suffers from bureaucracy and more complicated knowledge networks (Thorpe, Holt, Macpherson, & Pittaway, 2005).

Due to their characteristics, these small businesses are important sources of innovation (OECD, 2005). Although a lot of the focus of governmental policies and business research on innovation has been given to large businesses such as Multi-National Corporations

(MNCs), governments have realised that helping small business is also vital to fostering economic productivity (OECD, 2005).

Small and Medium Enterprises (SMEs) account for over 95% of businesses around the world (OECD, 2005). Therefore it is important to address the role they play in the economy. The OECD recognises that SMEs “are responsible for most net job creation in OECD countries and make important contributions to innovation, productivity and economic growth” (OECD, 2005, p.16).

Policy makers and researchers have pointed out that there is no official New Zealand definition of what constitutes an SME (OECD, 2006; Massey, 2008). The New Zealand Government’s Ministry of Economic Development (MED) define SMES as businesses that employ 19 people or less. The New Zealand Centre for SME Research defines SMEs as employing less than 100 Full Time Equivalent (FTEs) in order to be consistent with international definitions (Massey, 2008). For the context of this thesis, this definition will be used as it allows SMEs to be categorised as micro, small or medium enterprises.

The New Zealand Government agrees with the Organisation for Economic Co-operation and Development (OECD) and recognises the importance of SMEs’ contribution to innovation, productivity and economic growth. In 2002, the New Zealand Government launched the Growth and Innovation Framework to guide national development, in which the importance of small business, innovation and R&D were highlighted. In 2006, this framework was developed into the present Economic Transformation Agenda. This agenda outlines the Government’s push to create an innovative and creative knowledge-based market economy.

On a more practical level, the New Zealand Government has an SME Minister and Government agencies such as New Zealand Trade and Enterprise (NZTE) that are dedicated to helping small business survive and prosper. The New Zealand Government realises that one of the primary problems for small business is to finance the costly R&D of new products and processes (MED, 2006b). One of the key concerns outlined by Governmental papers is the low-level of collaboration between businesses and research organisations, such as universities and associated Research Institutes (RIs). The Government believes better collaboration “can help overcome scale problems in New Zealand firms and assists transfer of ideas and knowledge through the economy” (Mallard, 2006, p. 5).

While the effective transfer of knowledge is one aspect of this collaboration, the New Zealand Government also believes that SMEs are important for the application and development of intellectual capital developed by the RIs (MED, 2006a). SMEs can harness this intellectual capital from RIs by commercialising a new product or process the RI has developed. However, the level of knowledge transfer that occurs between the SME and RI affects the success of commercialising the new innovative product or idea (Agrawal, 2001). This level of knowledge transfer is influenced by the SME’s ability to recognise and use the new knowledge. This can be represented by the SME’s level of ‘Absorptive capacity’.

Absorptive capacity is defined by Cohen and Levinthal (1990, p. 128) as “the ability of a firm to recognise the value of new, external information, assimilate it, and apply it to commercial ends”. An understanding of absorptive capacity of an organisation is useful because it identifies how well that organisation can create competencies in recognising and exploiting information. It also links an organisation’s internal R&D efforts to developing this capability.

Most absorptive capacity research has focused on large organisations that carry out costly R&D efforts in house, and it has not addressed SMEs (Agrawal, 2001). A firm's level of absorptive capacity helps to explain why some companies fail and others succeed – information that could be particularly advantageous to an SME. If an SME is able to effectively recognise the usefulness of an RI's knowledge and assimilate it into a practical application, it could result in long-term competitive advantage. Additionally, although absorptive capacity recognises that RIs are sources of new, external knowledge, there is limited research on the knowledge transfer relationship between an SME and RI.

Another issue surrounding the use of absorptive capacity is that despite its popularity in journal articles in many disciplines, it is being applied in a negatively reified manner. In other words, most articles simply use it as a keyword and do not define or explain the underlying assumptions behind the construct. In such cases any conclusions drawn from the research could be fundamentally flawed and unusable. As with most constructs, there is a need to understand the underlying assumptions in order to understand the limitations of their results (Cockburn & Henderson, 1998; Lim, 2006).

This thesis explores the use of absorptive capacity in transfer of knowledge between SMEs and RIs. The context for this knowledge transfer is when an SME is commercialising a new product or process the RI has developed through its own R&D efforts.

Research Question and Objectives

The aim of this thesis is to examine the knowledge transfer between an SME and an RI using the construct of absorptive capacity. The approach taken is theoretical as it complements the exploratory nature of this thesis and the lack of hard data in this particular research field.

The specific research question is “How can the construct of absorptive capacity be applied to explain the knowledge transfer between an SME and an RI?”

The research objectives to address the research question are:

- To identify the unique characteristics of an SME business;
- To examine the role that RIs play in transferring knowledge to business;
- To examine the construct absorptive capacity;
- To explore the application of the absorptive capacity construct for the transfer of knowledge from an RI to an SME; and,
- To identify future research on the relationship between the RIs and SMEs.

Structure of the Report

This short introductory chapter is a brief overview of why the thesis focuses on SMEs, their relationship with university-led Research Institutes (RIs) and the construct of absorptive capacity. The following chapters are organised on the basis of describing the construct, addressing concerns about its reification and then applying it to the specific RI-to-SME knowledge transfer process, that is, applying a theory in a new setting.

Chapter Two focuses on the background and history of the construct, via an analysis of Cohen & Levinthal's (1989, 1990, 1994) three articles, rendering an understanding of its assumptions and limitations. It also outlines the journal articles that have extended and refined the construct. This chapter outlines briefly the possible reification of the construct.

Chapter Three discusses the literature surrounding SMEs and RIs. The first part of the chapter outlines the definition of an SME, its salient characteristics and why SMEs are important in the New Zealand economy. The second part of the chapter focuses on RIs and the role they play in fostering economic development. Last, gaps in the SME and RI knowledge transfer research are considered.

Chapter Four represents my contribution to the absorptive capacity literature stream, and presents a model that uses the construct to describe the knowledge transfer relationship between an RI and an SME. The model represents a specific situation, that is, an RI transferring knowledge to an SME. The model is developed with pertinent research conclusions and its advantages and disadvantages are discussed.

The final chapter concludes with a review of what is previously covered in the thesis and a discussion of future research directions. Although there are many areas of research within the model to pursue in future research, the area of organisational determinants is specifically noted for the research into partner specificity of SMEs and RIs and relative absorptive capacity.

Chapter 2

Absorptive Capacity

2.1 Absorptive Capacity as a Construct

Absorptive capacity is a concept that has been developed to explain an organisation's ability to explore and exploit knowledge. Cohen and Levinthal (1989) first introduced the concept and its role in the context of organisational learning and further develop the construct in subsequent articles. They started by building on prior research that studied the impact of an organisations' R&D spending on organisational learning. Their research affirmed the concept that in-house R&D increases an organisation's technical capabilities, which in turn allows the organisation to take advantage of technologies created elsewhere. They argued that an organisation's ability (created through R&D) to exploit these technologies leads to competitive advantage.

The first introduction to absorptive capacity set the ground work for subsequent extensions and refinement. An important point made in this early work was that Cohen and Levinthal challenged the long-held economic belief that knowledge spillovers in an industry are a public good. Economists believed corporations could adopt this knowledge at a low cost but adopting this knowledge would not lead to competitive advantage. Knowledge spillovers in this context are

described as any “original, valuable knowledge generated in the research process which becomes publicly accessible” (Cohen & Levinthal, 1989, p. 571). However, Cohen and Levinthal argued that this low cost was actually indicative of an organisation’s ability to recognise and exploit knowledge spillovers (the organisation’s absorptive capacity) and that this ability was developed by the organisation’s internal R&D processes. Conducting R&D was therefore seen as integral to achieving future competitive advantage. These arguments are supported by economic theory and mathematics.

The authors then extend and refine the construct by adding ‘socio-cognitive’ explanations and assign absorptive capacity as the central construct of organisational learning (as opposed to R&D)(Cohen & Levinthal, 1990). Their theory suggests absorptive capacity has an important role in increasing profitability and that it exists not only within organisations but also within the organisation’s employees. More importantly, absorptive capacity is cumulative, so that companies must initially invest in R&D if they want to be able to cope with competence-destroying innovations such as radical new technologies that occur in their industry. This concept leads to their last extension of the construct (Cohen & Levinthal, 1994) suggesting that absorptive capacity is not developed passively and that it allows corporations to ‘update’ and forecast future industry shifts. Updating is the organisation’s ability to explore new areas and determine whether they are profitable and therefore worth pursuing. The ability to update can be developed by making sure new technologies and processes are more easily accessible to organisations through governments

strengthening industry to academic ties, such as between private businesses and publicly-funded research institutions.

The use of the construct of absorptive capacity became very popular due to its timeliness as emerging research focused on strategic alliances and developing competitive advantage through organisational learning. Subsequently, the construct has been used in a variety of settings, including regions (Tallman, Jenkins, Henry, & Pinch, 2004), countries (Davenport & Bibby, 1999) and in strategic alliances between Multinational Corporations (Mowery, Oxley, & Silverman, 1996). Absorptive capacity is an important construct in the field of organisational learning and knowledge management with over 1800 citations of the original paper. However an examination of articles that use absorptive capacity as a keyword reveals that most articles do not explain the underlying assumptions nor do they include a definition of the construct. It is disconcerting how limited the collective understanding of the construct is but its popularity hints to its usefulness.

Absorptive Capacity as a Component of Organisational Learning

Organisations have long realised the need to develop inimitable processes, rather than easily copied products, in order to cope with increased competition and unstable business environments (Grant, 1996; Prahalad & Hamel, 1990).

With this came an increased interest in how organisations learn, defined as how they perceive their experience gathered directly from their own activities and from others. Researchers were interested also in how this was affected by

competitors learning and a changing industrial environment (Levitt & March, 1988). Organisations learn by “encoding inferences from history into routines that guide behaviour” (Levitt & March, 1988, p. 320). That is, people within organisations take their perception of their experiences and turn them into organisational processes, such as formal rules and procedures and even informal work cultures. Organisational learning can be seen from a number of viewpoints, but the most popular are at the firm-level and inter-firm level.

At the firm-level, researchers are interested in whether the type of knowledge an organisation chooses to learn affects its overall strategic direction, and more importantly long term sustainability. This knowledge can either be explorative or exploitative (Levinthal & March, 1993). Explorative knowledge is developed by research into new and novel areas. Exploitative knowledge focuses on leveraging further advantages from existing competencies. Most research on how organisations learn centres on how this can be turned into or guide long term profitability or survivability. In this way, competitive advantage is seen as stemming from an organisation’s ability to combine their resources and capabilities or ‘dynamic capabilities’ (Teece, Pisano, & Shuen, 1997). This is important, as organisations are seen to hold not only bases of information but also stores of knowledge and ways of processing and using that knowledge.

The quality of an organisation’s capability is also important. Organisations must make sure their capabilities are ‘core competencies’. Core competencies are described by Prahalad & Hamel (1990) as being inimitable, providing potential

access to a wide variety of markets and making significant contributions to perceived customer benefits of the end product. These core competencies can be seen as the knowledge held within the organisation and can be developed by managing knowledge flows within the organisation (similar to absorptive capacity). This knowledge not only resides in organisational processes but also within the people and information systems of the organisation (Blackler, 1995).

Parallel to the development of frameworks for understanding organisational learning at the firm level, researchers also examined it at the inter-firm level. The focus at this level reflected the fact that alliances had become a popular form of business venturing and further knowledge was needed on how this might operate successfully. Studies on inter-organisational learning developed particularly in relation to changing industrial environments such as mature industries undergoing restructuring because of radical technological breakthroughs, for example, the impact of biotechnology on the R&D intensive pharmaceutical industry (Powell, Koput, & Smith-Doerr, 1996). Companies that entered into strategic alliances were able to use their complementary capabilities to develop new products and processes that other competitors would find hard to imitate.

In this vein, researchers were interested in how organisations could benefit the most from engaging in strategic alliances. Similar to looking at the flow of knowledge within an organisation, they looked at the flow of knowledge from one organisation to another, or knowledge transfer. The strategic alliances that

developed could be categorised as either learning alliances (where the partners hope to learn new processes or techniques from one another) or business alliances (where the partners hope to use their complementary capabilities to generate profit) (Koza & Lewin, 1998). Knowledge transfer is straightforward in a learning alliance, but in a business alliance there will still be asymmetric knowledge between partners that has to be addressed. Once the mechanisms of knowledge transfer were identified, researchers began to see other situations where knowledge transfer was occurring, such as between organisations and research institutions.

Organisational learning, therefore, can occur at a firm-level from knowledge gathered internally within organisations but also externally from other sources such as partners in strategic alliances and public research institutions (Cohen & Levinthal, 1989). In the area of knowledge transfer, absorptive capacity has been used mainly in strategic alliance research consisting of large companies who share the cost of R&D but is only recently linked to SMEs (Agrawal, 2001; Lane et al., 2006; Liao, Welsch, & Stoica, 2003). However, it is useful to use absorptive capacity to understand the knowledge transfer that occurs between organisations that are not in a strategic alliance such as between academia and industry or between SMEs and RIs. To properly use the construct it is important to understand its underlying assumptions and so it is useful to briefly outline how Cohen & Levinthal (1989, 1990, 1994) developed absorptive capacity.

2.2 The Development of Absorptive Capacity by Cohen and Levinthal

Cohen and Levinthal are the authors responsible for the key development of the absorptive capacity construct. This section follows the advances they made with each subsequent journal article.

First Paper - 1989: "Innovation and learning: The Two faces of R&D"

As mentioned, the starting point of absorptive capacity was the importance of conducting internal R&D for organisational learning. In this first article R&D was the central focus; absorptive capacity was developed in order to describe the advantages of conducting R&D. The advantages were twofold - one face of R&D was the ability to develop innovations and the second face was the ability to appropriate external knowledge. The ability to develop innovations was linked to technological knowledge. Incentives for learning this technological knowledge are driven by how easy it is to learn, such as its technological and scientific basis. The ability to appropriate external knowledge is driven by how much R&D the organisation engages in. The true cost of appropriation is hidden because R&D spending is long-term, cumulative and path-dependent, and therefore substantial.

They conclude with a simple theoretical model of a firm's generation of technical knowledge, highlighting the role of the firm's own R&D, knowledge which originates with its competitors' R&D spillovers and knowledge that

originates outside of the industry. The outcome of this model is to ascertain the organisation's knowledge base. The model assumes that external knowledge is only available as knowledge spillovers and that it can not be passively assimilated. The organisation must therefore invest in R&D in the first place. Cohen and Levinthal identify the methods and limitations of the model. These in brief are:

- The measure used in the model was the impact of technological opportunity and appropriability on R&D intensity. This was used because Cohen and Levinthal could not find a direct measure of 'ease of learning' or its determinants because of the survey data they used.
- Two samples were used; a larger sample that included both R&D performing and non-performing business units and a small sample that only included R&D performers. The data is limited by the fact the R&D performers were larger and tended to be operated by parent companies and the companies were in the manufacturing sector.
- Technological opportunity: Here Cohen and Levinthal asked respondents to assess the relevance of science to the industry's R&D. Science was roughly categorised as basic sciences (such as mathematics and chemistry) and applied sciences (such as applied mathematics/operations research and computer science). Respondents were also asked to assess the importance of five external sources of knowledge that affected the businesses'

technical progress, where the sources included the supplier, customers, government agencies and research laboratories and universities.

- **Appropriability:** Cohen and Levinthal discuss how appropriability conditions, such as the level of intra-industry knowledge spillovers might affect an organisation's R&D spending (and therefore the development of absorptive capacity). This is limited as the measure used is drawn from their survey data (gathered from a previous paper on industrial R&D).
- **Other determinants:** Cohen and Levinthal control for other determinants of R&D intensity, such as industry maturity and demand. A limiting nature of controlling for demand is that elastic demand would encourage process R&D but inelastic demand would encourage product R&D.

Empirical testing of their model yielded four key findings. First, Cohen and Levinthal found that their hypotheses were generally confirmed by their results. The 'ease of learning' (new knowledge) was affected by differences in the type of knowledge. On the whole, an increase in technological opportunity in the basic science field impacts more on R&D spending as opposed to the applied science field. There were some exceptions, like computer science, but this was attributed to the rapid pace of its advancement.

Second, the difference between Government agencies and research laboratories and Universities were not significant. Customers were viewed as important extra-industry sources of knowledge due to demand conditions and bias towards products that relied on product differentiation for competitive advantage. They further suggest that external basic science complements internal R&D but external applied science is used as a substitute for internal R&D.

Third, Cohen and Levinthal found that in some cases, the positive effects of spillovers *did* outweigh the negative effects of spillovers. The implication of this finding is that companies should not avoid investing in industries that have a lot of spillovers. Finally, they acknowledged that technological opportunity did not distinguish between process and product innovation which could result in a measurement error. Since the survey data was in the manufacturing industry, it was expected that respondents would have mainly referred to product R&D. However, this bias was ignored as it would add more errors to other parts of the model and it “scarcely changes the qualitative results of interest” (Cohen & Levinthal, 1989, p.592).

The article concluded with a discussion on how their research may increase understanding of the welfare effects of patents and similar policies. From an economic standpoint, the stronger the appropriability mechanisms firms have in place, the more society loses out on the beneficial efficiency effects of these spillovers. This is important in the context of certain industries, such as medical

science. If spillovers do indeed have a positive effect, then governmental policies can be implemented to encourage knowledge spillovers for the betterment of society as a whole. In summary, this paper was important to the development of absorptive capacity because it supported the construct with economic theory, outlined some of its determinants and stressed the impact of knowledge types on organisational learning (Lane et al., 2006). A logical progression of ACAP from here was to extend the construct using socio-cognitive explanations.

Second Paper – 1990: “A New Perspective on Learning and Innovation”

In their 1990 article, Cohen and Levinthal concentrate on absorptive capacity as the central construct and describe how an individual’s ACAP is linked to organisational ACAP. This is done by extending the construct past economic theory to management theory by taking the idea that learning is cumulative. This idea was from research on individuals’ cognitive structures and problem solving abilities and applying it to organisations (Koza & Lewin, 1998; Lane et al., 2006; Lane & Lubatkin, 1998).

The key development of this paper is three-fold. First, the definition of absorptive capacity is refined to “the ability of a firm to recognise the value of new, external information, assimilate it, and apply it to commercial ends” (Cohen & Levinthal, 1990, p. 128). Rather than just exploiting information, the organisation must be able to recognise the value of new information and turn it into something meaningful like profit. Also, absorptive capacity is cumulative

and path-dependent, and is controlled by the level of communication and knowledge sharing within the organisation. Second, they accentuate the importance of prior knowledge. Prior knowledge includes “basic skills of even a shared language [and] may also include knowledge of the most recent scientific or technological developments in a given field” (Cohen & Levinthal, 1990, p. 128). Lastly, they suggest that absorptive capacity is not only developed through R&D efforts but can also be developed through other means such as sending employees to advanced technical training. This was important as this means developing absorptive capacity is not simply equated to carrying out R&D.

Cognitive Structures

Cohen and Levinthal (1990) apply cognitive and behavioural sciences to the construct of absorptive capacity. Important points made are that accumulated prior knowledge increases the ability to acquire and recall knowledge. The ability to acquire knowledge is also self-reinforcing, if you learn to acquire knowledge in the first place this leads to a better understanding of how to use it in new settings. In this way, learning is associative. Learning new ideas and linking them to old ideas needs a context to understand it within, thus forming a knowledge base to fully utilise the new knowledge and apply it later. Learning can be seen as either the assimilation of new knowledge or creation of new knowledge. Additionally, the intensity of effort and the diversity of knowledge are important.

New knowledge needs to be deeply processed and practised as individuals need to gain true contextual understanding. The Japanese tradition of rotating personnel through departments for years rather than months is a prime example of how to encourage true contextual understanding (Cohen & Levinthal, 1990; Collinson, 2001). Additionally, when understanding new areas of research, a diverse knowledge base yields better understanding and also can lead to new innovative ideas as individuals make lateral intuitive leaps. After discussing individual's cognition and behaviour, Cohen and Levinthal then develop absorptive capacity in an organisational setting.

Organisational Absorptive Capacity

Cohen and Levinthal (1990) considered that an organisation's absorptive capacity is dependent on the individuals within the organisation (and their absorptive capacity). Organisational absorptive capacity is also dependent on prior investment and is also cumulative. The addition of these two ideas precludes the important point of organisational structure affecting internal knowledge flows. This in turn affects the assimilation of external knowledge and ultimately the organisation's absorptive capacity. The addition of these two points is important because it highlights the change of focus from industrial R&D and economic theory to organisational learning and management strategy theory.

The article also goes beyond discussing the flow and transfer of knowledge between the external environment and the organisation to the flow of

knowledge that occurs within the organisation itself. This is important as it recognises that work specialisation within large organisations creates 'gate keepers' of knowledge and this impacts on the organisation's ability to see changes in the external industrial environment. Additionally, communication within the organisation can be about sharing knowledge internally or absorbing external knowledge. Cohen and Levinthal (1990) warn there must be a balance between the two, or dysfunctional situations can result, such as the Not Invented Here (NIH) syndrome. Cohen and Levinthal (1990) also conclude that absorptive capacity can not be simply bought as it is dependent on prior knowledge that is cumulative and path dependent.

Path Dependence and Absorptive Capacity

Further discussion into the role of prior knowledge in developing absorptive capacity is worthy as it explains the important points of cumulativeness and expectation formation. Cumulativeness is when an organisation's absorptive capacity allows further accumulation of critical knowledge. This means that prior knowledge is history or path-dependent. Expectation formation refers to the organisation being able to take advantage of this accumulated critical knowledge and use it to accurately analyse and take advantage of rapid technological changes in the external environment. These two points are used to explain the problematic situation of 'lockout'.

Lockout describes what happens when an organisation does not initially develop absorptive capacity in a particular field and is "locked out of

subsequent technological developments” (Cohen & Levinthal, 1990, p. 136). This lack of initial investment results in the loss of the positive outcomes of cumulativeness and expectation formation. The organisation can not see the critical knowledge, take advantage of it, and even if it could, it becomes a disincentive to invest as it is too costly an exercise. NIH is an example of lockout in that if the organisation does not invest in ACAP and undertake the relevant R&D themselves, they lose the benefit of future developments.

Absorptive Capacity and R&D Investment

Harking back to their 1989 article, Cohen and Levinthal (1990) reiterate that investment in R&D still plays an important role in generating new knowledge and developing absorptive capacity. They present a graphical model of the mathematical model outlined in the 1989 article (Figure 1) and add a model depicting the organisational sources of technological knowledge (Figure 2).

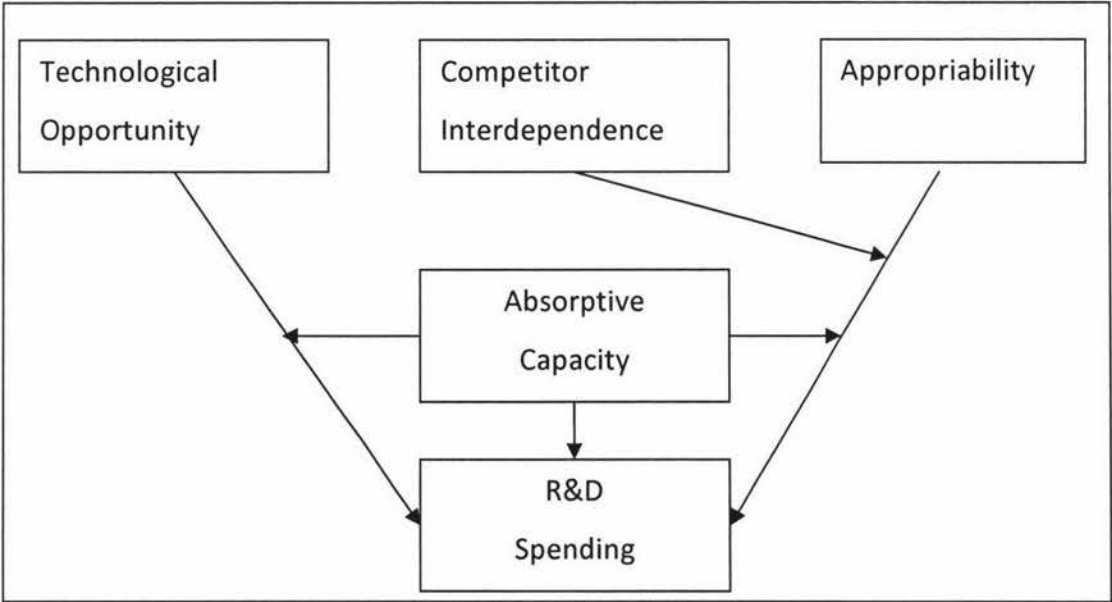


Figure 1. Cohen and Levinthal (1990) Model of Absorptive Capacity and R&D Spending

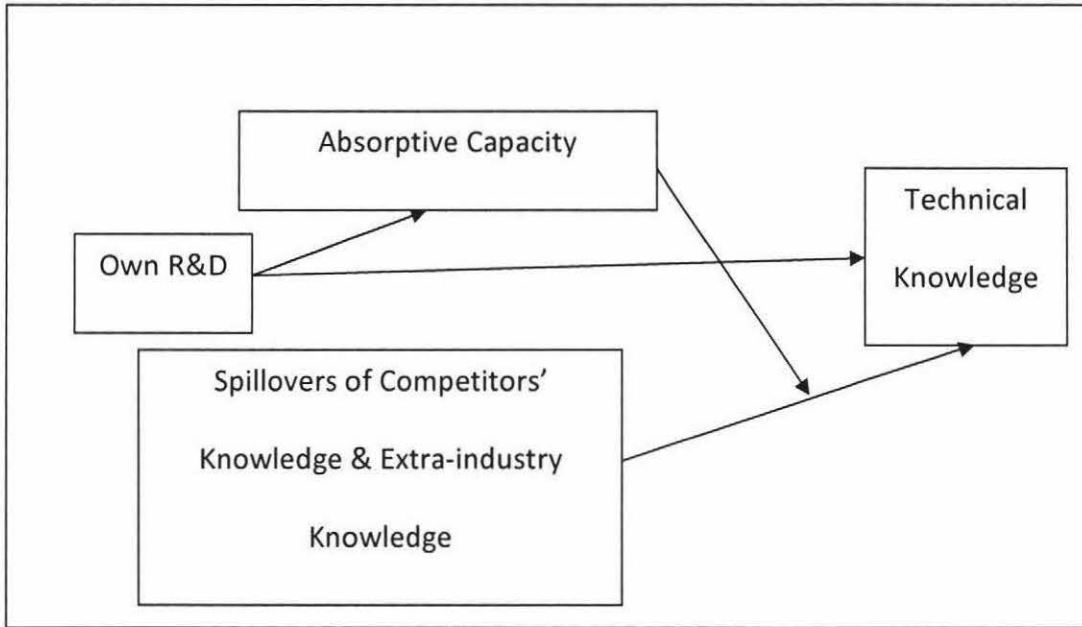


Figure 2. Cohen and Levinthal (1990) Model of Sources of a Firm's Technological Knowledge

As it is based on the 1989 article, the main focus of the first graphical model is on R&D spending. The first model shows how technological opportunities and appropriability are mediated by absorptive capacity. Further, competition interdependence controls appropriability, which is the “extent to which a rival’s technical advances diminish the firm’s profits” (Cohen & Levinthal, 1990, p. 139). The important change in the second graphical model is that the focus is on absorptive capacity. Here the model reiterates that R&D develops absorptive capacity and also generates new knowledge. Further, absorptive capacity controls whether the organisation can use spillovers of competitors’ knowledge and extra-industry knowledge as sources of technological knowledge.

At this stage, the absorptive capacity construct is a descriptive analysis of organisational learning and of its impact on organisational performance. Cohen and Levinthal suggest that the next progression should lead to prescriptive analyses that would answer questions such as “when is a firm most likely to under-invest in absorptive capacity to its own long-term detriment?” (1990, p. 149). Other researchers do not pick up on this call for further research. So, Cohen and Levinthal were left to refine absorptive capacity in their next paper, published in 1994.

Third Paper – 1994: “Fortune Favours the Prepared Firm”

The next development by the authors adds the concept of forecasting industry trends. Absorptive capacity allows an organisation to accurately predict the nature of future technological advances, that is, the ability to forecast trends and therefore opportunities (Cohen & Levinthal, 1994). They revert back to economic theory to describe how the cumulativeness and expectation formation functions of absorptive capacity are offset by the effects of uncertainty in the external environment. First, uncertainty encourages the development of ACAP as it allows organisations to forecast and second, firms are risk-adverse and so uncertainty discourages initial investment in ACAP.

The social welfare implications of market competition are another extension of the absorptive capacity construct. In their model, there are situations where competition leads to underinvestment in absorptive capacity, such as when an organisation’s primary function of their absorptive capacity capabilities is

updating. University - industry cooperatives are useful vehicles for interpreting and generating technological and market signals (of change). In these situations, Government policies can then encourage such cooperative relationships and support the commercialisation of new technologies borne out of university research.

There is, however, one important limiting assumption of the results in that their conclusions are based on “explicit, rational calculations on the part of the firms” (Cohen & Levinthal, 1994, p. 245). In other words, they assume that firms actually value absorptive capacity in the first place. They posit that failure to value the development of absorptive capacity would most likely lead to organisational death.

In conclusion, Cohen and Levinthal (1989; 1990; 1994) build on their own previous research and experience to develop a construct based on economic theory, mathematics and organisational learning theories. The construct is supported with empirical research and covers a variety of situations. However, its popular use belies the fact that most articles do not discuss its underlying assumptions (and therefore limitations). The construct therefore, has been used in a negatively reified manner. In order to use the construct myself, it is important to address the issue of the reification of absorptive capacity.

2.3 Reification of Absorptive Capacity

Frequent citations in a broad range of fields are evidence that absorptive capacity is an important construct. However, there are some researchers who are concerned at the lack of collective understanding of the construct (Joglekar, Bohl, & Hamburg, 1997; Lane et al., 2006; Matusik & Heeley, 2005; Zahra & George, 2002). This is not to say that the absorptive capacity construct is unusable, simply that it is not cohesive as a research stream and steps must be taken to make sure it is not used in a negatively reified manner. Although reification is important for learning an increasingly sophisticated concept (Latour, 1987), it is still imperative to understand the limitations of the concept for the validity of subsequent results and findings. Additionally, it is important to understand what has been collectively accomplished by the research stream in order to guide future research towards knowledge gaps.

Reification is the process of forgetting who developed the ideas and theories, and objectifying them (turning them into things), and then forgetting we have done so (Jay, 2008). A negative outcome of reification is that successive authors can adapt the construct to their needs and the original meaning of the construct becomes clouded. This can be problematic as the validity of the construct becomes threatened when all differing views (and limitations) of the construct are used as one. If in turn this is used in future research, the validity of that research is also threatened. However steps can be taken to avoid negative reification by understanding the limiting assumptions of the construct used.

Zahra and George (2002) first expressed concern that absorptive capacity as a construct had become negatively reified. They discussed how past literature had widely differing variations of the definition of the construct but attempted to reverse this by reconceptualising it using a number of journal articles they deemed influential. This is further developed by Lane et al. (2006) who use bibliometric analysis to assess what journal articles do to extend or refine the construct and whether they are influential within the research stream. They then conducted a thematic and citation analysis of a sample of absorptive capacity management papers and produced five reasons why the construct may have become negatively reified. These were the assumptions that competitive advantage was based on scarcity of knowledge, that absorptive capacity was only developed if knowledge spillovers exist, that it only resides within an organisation and that it is dependent on R&D and relevant prior knowledge (Lane et al., 2006).

The Use of Absorptive Capacity in the Literature

A large number of papers use the absorptive capacity construct. As of November 2008, a Web of Science cited reference search of Cohen and Levinthal's 1990 paper shows over 2300 papers. However, in a sample of 289 papers published between July 1991 and June 2002 that cite this article, only 22% make more than a minor use of the construct, and of these, only four articles actually extend or refine the construct (Lane et al., 2006). They do so through its application to specific situations or by reviewing past literature.

These papers are Lane & Lubatkin (1998), Dyer & Singh (1998), Van den Bosch, Volberda & De Boer (1999) and Zahra & George (2002). A further three papers concentrate on using absorptive capacity within management theory (Koza & Lewin, 1998; Mowery et al., 1996; Szulanski, 1996). As there are so few papers that extend or refine the construct and only 18% of the articles use Cohen and Levinthal's seminal articles as citations, it can be concluded that the absorptive capacity research stream is not tightly linked (Lane et al., 2006). This gives support to the idea that absorptive capacity as a construct has indeed become negatively reified. A summary of the key contributions of these papers is shown in Table 1 and the rest of this section will examine the development of the ACAP construct.

Lane and Lubatkin's (1998) paper is one of the key papers in the absorptive capacity literature. The most interesting development of the construct they make is the addition of a learning dyad view, that is, the relationship between a teacher and student firm and their problems with partner specificity. Lane and Lubatkin (1998) argue that there is not enough analysis on who to ally with in strategic alliance research. They also criticise the use of Cohen and Levinthal's (1990) R&D expense as a measure of absorptive capacity due to its limitations. Additionally they develop empirical evidence to show that their own measures explain more variance than the popular measure of R&D expense.

Table 1.
Summary of the Development of Absorptive Capacity through the Seminal Papers

Year	Author	Title	Addition to literature
1989	Cohen & Levinthal	Innovation and Learning: The two faces of R&D	<ul style="list-style-type: none"> • Introduction of absorptive capacity construct. • Economics and mathematics based model. • Argument that firms must invest in absorptive capacity in order to utilise external knowledge spillovers. • Absorptive capacity is linked to R&D efforts.
1990	Cohen & Levinthal	Absorptive Capacity – A new perspective on learning and innovation.	<ul style="list-style-type: none"> • Refinement of absorptive capacity as the central construct. • Use of socio-behavioural theories to develop the construct in area of organisational learning. • Change in the definition of ACAP that includes the ability to recognise new external knowledge and also apply it to commercial ends.
1994	Cohen & Levinthal	Fortune Favours the Prepared Firm	<ul style="list-style-type: none"> • Ability of forecasting added to definition of absorptive capacity. • Economic theory and mathematics to support arguments for governments developing university to industry linkages.
1989	Lane & Lubatkin	Relative Absorptive Capacity and Inter-organisational learning	<ul style="list-style-type: none"> • Extends the construct to two organisations with a dyadic relationship. • One of the few articles that attempts to operationalise the construct using empirical data. • Try to take absorptive capacity out of the R&D context and into inter-organisational learning.
1999	Van den Bosch, Volberda & de Boer	Co-evolution of Firm Absorptive Capacity and Knowledge Environment: Organisational forms and combinative capabilities	<ul style="list-style-type: none"> • Examines the internal organisational drivers of absorptive capacity (operationalisation) and how the external environment affects investment incentives.

2002	Zahra & George	Absorptive Capacity: A review, reconceptualisation, and extension	<ul style="list-style-type: none"> • One of the first to see that the construct needed reconceptualising due to possible negative reification. • Refocuses the construct as a multi-dimensional <i>dynamic</i> capability. • Concludes that organisations should invest in both explorative and exploitative learning processes. • Splits ACAP into Potential ACAP (PACAP) and Realised ACAP (RACAP).
2005	Jansen, Van den Bosch & Volberda	Managing Potential and Realised Absorptive Capacity: How do organisational antecedent's matter?	<ul style="list-style-type: none"> • Critically analyses and refines Van den Bosch et al.'s model (1999). • Further researches the operationalisation of the construct. • Used by Todorova & Durisin (2007) as to why ACAP need not be split into PACAP and RACAP.
2006	Lane, Koka & Pathak	The Reification of Absorptive Capacity: A critical review and rejuvenation of the construct.	<ul style="list-style-type: none"> • Applied the only comprehensive analysis on the reification of absorptive capacity, specifically analysed important articles on absorptive capacity using bibliometric analysis. • Remodelled the construct based on Cohen & Levinthal's three articles and other key articles.
2007	Todorova & Durisin	Absorptive Capacity: Valuing a reconceptualisation	<ul style="list-style-type: none"> • Critically analyses and refines Zahra & George's model (2002).

Lane and Lubatkin (1998) posit that relative absorptive capacity can explain the differences in teacher and student firms, that is, why some learning relationships work and others do not. The use of relative absorptive capacity also shows that knowledge transfer is affected not just by the firm itself but also by external influences. Their definition of the construct in the learning dyad relationship builds on Cohen and Levinthal's (1990) definition but adds that it is dependent on the type of knowledge given by the teacher, the similarity between the teacher's and student's organisational determinants and how familiar the student is with the teacher's organisational problems (Lane & Lubatkin, 1998).

Lane and Lubatkin (1998) then outline three ways an organisation may learn: passively, actively and interactively. Passive learning is described as knowledge that is articulable and comes from sources such as consultants and seminars. Active learning is a more strategic view of competitors' capabilities, for example, benchmarking. These types of learning are observable and can be easily imitated, however good competitive advantage is based on competencies that are unobservable. Interactive learning concerns embedded tacit knowledge competencies which are transferred through inter-organisational learning processes.

Additionally, this paper discusses extending individual cognitive learning theory to the organisational level, similar to Cohen and Levinthal (1990). They argue that the level of similarity and dissimilarity in the teacher's and student's knowledge bases would impact on organisational learning. The authors proposed, and found empirical support for, a positive influence on absorptive capacity when the teacher and student firms share basic science knowledge bases. Interestingly, they did not find empirical support for the negative

influence of similarity of specialised knowledge. Lane and Lubatkin (1998) also proposed that student firms must be knowledgeable about the teacher firms' particular ways of achieving their objectives, that is, their dominant logic. They argue that the more similar the dominant logic of the teacher and student, the easier the inter-organisational learning process.

Overall, this article plays an important part in extending the construct. The use of relative absorptive capacity allows further discussion into knowledge transfer between two parties, particularly a one-way learning dyad (that is, teacher to student). This type of relationship can be used to map the relationship between an SME (student) and RI (teacher).

Van den Bosch et al.'s (1999) article further extends the absorptive capacity construct. Their article looks at organisational determinants of the construct, specifically organisational forms and combinative capabilities. Van den Bosch et al. (1999) also look at how the construct influences and is affected by its knowledge environment and how it can be developed through managerial actions. The important contribution that this article makes to the absorptive capacity literature stream is the operationalisation of the construct through the analysis of the relationship between organisational forms and knowledge absorption. Using three conventional organisational forms, that is, functional, divisional and matrix, they categorise their effect on three dimensions of knowledge absorption, which are efficiency, scope and flexibility. They then look at how combinative capabilities affect these three dimensions. The combinative capabilities are categorised as system, coordination and socialisation capabilities.

Van den Bosch et al. (1999) also describe micro- and macro-evolutionary effects that exist within the firm, that is, cumulativeness of absorptive capacity and how a firm's absorptive capacity can affect the industrial environment. Their results show that most of their propositions are supported, for example, the two organisational determinants did affect absorptive capacity, but also that some surprisingly did not, such as, systems capabilities did not negatively affect absorptive capacity development. The use of longitudinal data provides validity to their findings.

Zahra and George's (2002) article attempts to reconceptualise the construct as they realised the literature stream was not cohesive. They also extended the construct as a multi-dimensional dynamic capability and created their own model. Defining the construct as a dynamic capability, Zahra and George (2002) believe, enables companies to change their absorptive capacity abilities, for example, managerial actions could be taken to develop absorptive capacity and, therefore, competitive advantage.

They also redefine the construct into four dimensions: acquisition, assimilation, transformation and exploitation. Their antecedents to absorptive capacity are similar to Cohen and Levinthal's with the addition of knowledge complementarity, that is, similarities and differences in knowledge. Outcomes are also similar with the addition of (strategic) flexibility and an overall label of competitive advantage. Regimes of appropriability are shifted from Cohen and Levinthal's (1990) impact on antecedents to outcomes as it affects commercial exploitation of products and processes. They add two factors, activation triggers and social integration mechanisms, examples of these are mergers and organisational culture, respectively.

Using their four dimensions, Zahra and George (2002) also attempted to bundle these into two new dimensions: potential and realised absorptive capacity. Potential absorptive capacity (PACAP) incorporates the acquisition and assimilation dimensions and Relative absorptive capacity (RACAP) holds transformation and exploitation. They believed splitting absorptive capacity into two factors would allow analysis of why some firms have a lot of exploitable knowledge and processes but fail to convert it into competitive advantage.

Zahra and George (2002) imply that RACAP is more important than PACAP.

Jansen et al.'s (2005) article extends Van den Bosch et al.'s (1999) article and critiques Zahra and George's (2002) distinction between PACAP and RACAP. In their article, they re-examine the difference between PACAP and RACAP focusing on the manner in which Van den Bosch et al.'s (1999) concept of combinative capabilities affects them. They acknowledge that these capabilities tend to be emergent and idiosyncratic but argue that they still exhibit common features (Jansen et al., 2005). Overall, their article helps to further extend the research on the operationalisation of the absorptive capacity construct.

The next paper is a recent article by Lane et al. (2006), in which they revisit the issue of the possible negative reification of absorptive capacity within its research stream using bibliometric analysis. Cohen and Levinthal (1989; 1990; 1994) did not give a clear graphical representation of absorptive capacity and its relationships. Therefore, in order to understand the original context of the construct, Lane et al. (2006) critically review their three articles. This allowed them to understand and highlight the relationships Cohen and Levinthal discuss and put them into a clear graphical form (See Figure 3).

In their figure, Lane et al. (2006) identify absorptive capacity as the central construct and the important end product. Furthermore, they highlight the important relationship between R&D spending and the development of absorptive capacity. Industry demand, scope of technological opportunities and propensity for knowledge spillovers directly impact on an organisation's R&D spending. The propensity for spillovers is controlled by ease of learning external knowledge, competitiveness and price elasticity. Scope of technological opportunities is also controlled by ease of learning.

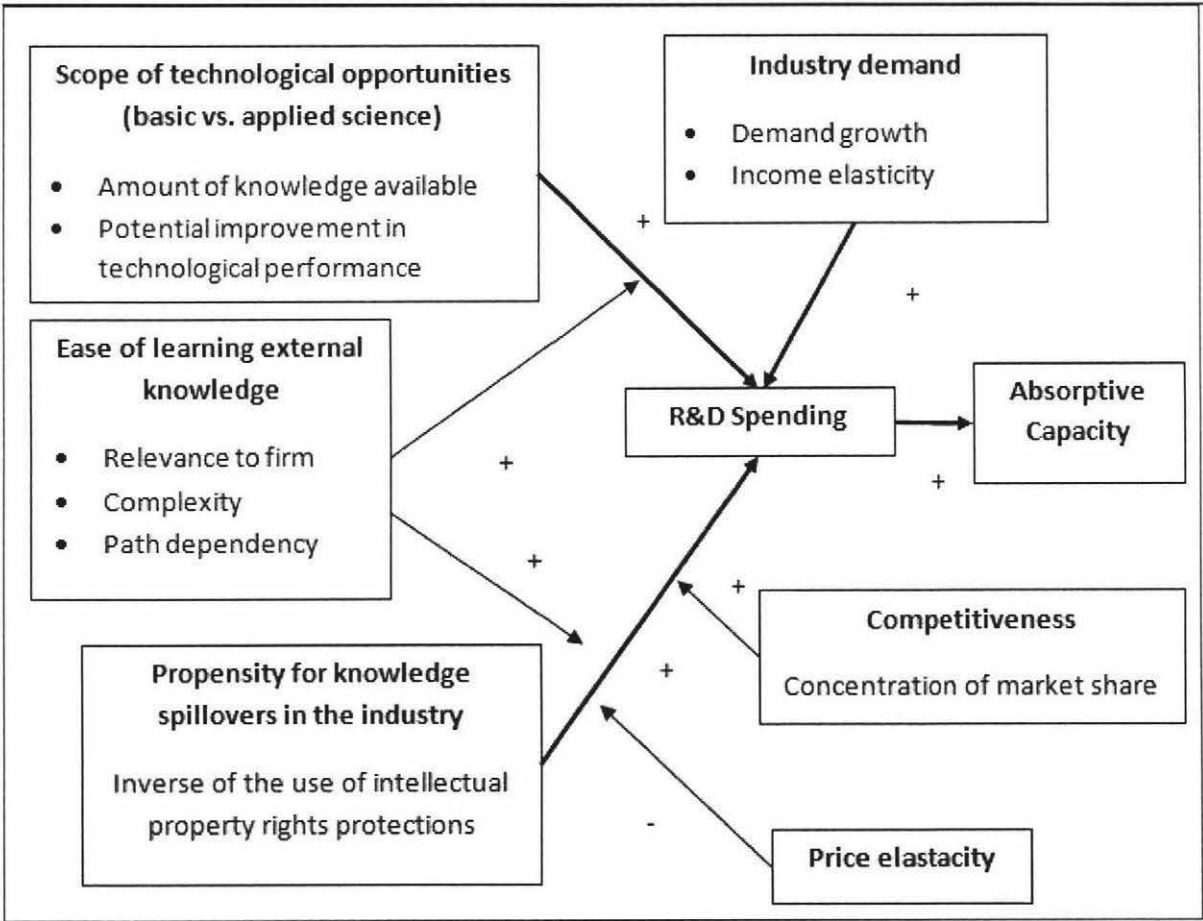


Figure 3 Cohen and Levinthal's (1989, 1990) Implied Model of 'Absorptive Capacity'

Source: Lane et al., (2006)

Lane et al. (2006) also concluded that most of the other absorptive capacity literature equated the construct to the level of prior knowledge within the organisation (its knowledge base) and is operationalised in the R&D context. They criticised this as the use of R&D proxies contrasted with empirical evidence. Additionally, within the research stream, there was a lack of empirical evidence and lack of focus on the influence of knowledge types. This is disappointing given the in-depth discussion Cohen and Levinthal gave to the impact of knowledge types on the ease of learning. Cohen and Levinthal also consider in-depth the impact of organisational structure and diversity of knowledge on ACAP but again this theme lacks discussion and empirical evidence in more recent literature.

Inter-organisational learning is, however, one theme that was well developed in the literature with most of the central articles providing empirical evidence. The reason for this may be a research focus on acquiring knowledge in inter-organisational relationships (Lane et al., 2006). The research was also split into two forms of relationships - dyadic (a teacher-student relationship) or network relationships (multiple relationships). These researchers concluded that although new innovative ideas may result from two companies sharing their different capabilities, this new idea can only be communicated or developed if the two companies have the same background knowledge.

However, the translation of this research on inter-organisational relationships into the development of absorptive capacity in an organisation is not well established. One difference between more recent research and that carried out by Cohen and Levinthal could be the emphasis placed by the latter authors on challenging the idea that knowledge spillovers are a public good. This concept does not seem to have been considered important

by recent researchers, particularly those who study the development of absorptive capacity through inter-organisational networks and geographic locations.

Other themes in these articles concentrate on the identification and assimilation of new knowledge for the development of absorptive capacity. However one theme related to innovation concentrates on the utilisation of this knowledge. Innovation is measured by the formation of new patents and products that arise from the firm's knowledge base (Lane et al., 2006) and in this context is also incremental and exploitative. There is little focus on exploratory or 'radical' innovation. However, Lane et al.,'s (2006) thematic analysis suggests that these researchers believe that incremental innovation occurs more frequently and quickly as a result of absorptive capacity.

The themes of organisational structure, scope and types of knowledge are defined as static themes while organisational learning, inter-organisational learning and innovation are defined as dynamic process themes, all of which Lane et al. (2006) linked to the central theme of definitions and operationalisations. Static themes have evolved independently, whereas the dynamic process themes had not, primarily due to the fact that the dynamic processes themes revolved around knowledge creation (Lane et al., 2006). There appears to be little research on the impact of the types of knowledge and organisational structure on organisational learning and innovation.

From the thematic analysis, Lane et al., (2006, pp. 851-854) detail the five limiting assumptions of absorptive capacity:

1. Absorptive capacity is relevant only to R&D-related activities;
2. Firms develop absorptive capacity in response to the existence of valuable external knowledge;
3. Relevant prior knowledge equals absorptive capacity;
4. A firm's competitive advantage is based on Ricardian rents (that is, a firm's competitive advantage is based on the scarcity of their knowledge) rather than efficiency rents; and ,
5. Absorptive capacity resides in the firm alone.

They further proposed a more comprehensive definition of absorptive capacity (2006, p. 856):

"Absorptive capacity is a firm's ability to utilise externally held knowledge through three sequential processes:

- (1) Recognising and understanding potentially valuable new knowledge outside the firm through exploratory learning;
- (2) Assimilating valuable new knowledge through transformative learning; and
- (3) Using the assimilated knowledge to create new knowledge and commercial outputs through exploitative learning."

Their definition of absorptive capacity was couched in a learning-process model that included drivers and outcomes to address the problems they found through their prior analysis (see Figure 4). Their definition sits in the middle of their model, with drivers left and

centre and outcomes to the right. Drivers that are deemed partially or completely external to the firm sit left and the internal drivers sit above and below.

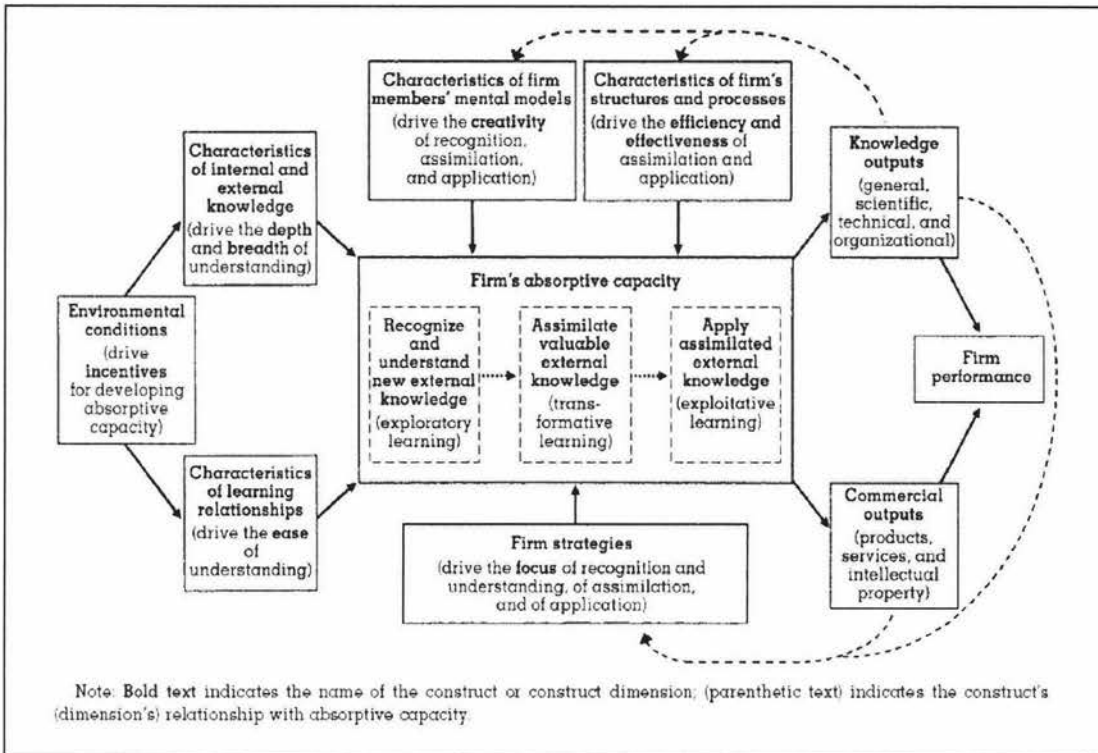


Figure 4 Lane et al.'s (2006, p. 856) Process Model of 'Absorptive Capacity'

These authors put particular emphasis on the impact of individuals' absorptive capacity on the firm's overall absorptive capacity; something that has been under-researched regardless of the Cohen & Levinthal's focus on this aspect in their 1990 article. They call this internal driver the characteristics of firm member's mental models. The neighbouring internal driver, characteristics of firm's structure and processes is included by Lane et al. (2006) to stress the need for the construct to be seen as a dynamic capability.

Another under-researched area is included as the final internal driver – firm strategies. Lane et al. (2006) point out that a firm's strategy not only shapes what knowledge they gather and how they apply it but also how this strategy is shaped by the firm's organisational

structure. Research in this area will help in the development of practical recommendations for managers to guide some development of 'absorptive capacity'.

Following Cohen and Levinthal (1989; 1990; 1994), Lane et al. (2006) also separate the three absorptive capacity dimensions as they believe that each dimension needs different processes; recognising new knowledge needs exploratory learning, assimilating that knowledge needs transformative learning, and applying it needs the use of exploitative learning.

Lane et al. (2006) emphasise that the outcomes of absorptive capacity should include knowledge outputs, such as scientific and organisational outputs to complement the commercial outputs, such as intellectual property. They believe both types of outputs affect future absorptive capacity, for example, commercial outputs affect the future direction of research and knowledge outputs affect the organisational structure.

Lane et al. (2006) end by acknowledging that future research does not have to follow the relationships they specified in their model to avoid reification, but must follow a base set of rules. They ask that researchers see absorptive capacity as a capability, understand its underlying assumptions and build on its theory using empirical tests in areas other than R&D. Following the view of the construct as a capability, they encourage the use of longitudinal studies to understand its process aspects.

The most recent paper is Todorova and Durisin's (2007) article which addresses their concerns with Zahra and George's (2002) conclusions and improves on Zahra and George's

(2002) model. Their main criticisms are the breaking up of absorptive capacity into the two factors of PACAP and RACAP, because empirically it is better to operationalise the construct using the four original factors of acquire, assimilate, transform and exploit. They argue that the transformation dimension is too closely linked to the assimilation dimension to be neatly divided into potential (PACAP) and realised absorptive capacity (RACAP).

Contingent factors are also discussed by Todorova and Durisin (2007). These authors use Zahra and George's (2002) social integration mechanism, however they argue that this factor should affect all relationships between the components as the original authors have conceptualised all components as social interactions. Additionally, they disagree with Zahra and George's assertion that only strong relationships lead to knowledge generation; believing instead that it is contingent on the type of knowledge and knowledge processes.

Todorova and Durisin (2007) criticise Zahra and George's position of regimes of appropriability and argue that it affects both antecedents and outcomes. They also add that further research is required in this area. Todorova and Durisin (2007) also add their own original factor of power relationships, which affects the exploit dimension and antecedents of absorptive capacity. Finally, they add a feedback loop to diagram the path-dependency feature of the construct.

Todorova and Durisin's (2007) model of absorptive capacity represents the present state of the construct (Figure 5). Their model uses the background and assumptions similar to Lane et al.'s (2006) analyses of the construct. It also extends the construct past Zahra and George's (2002) and Lane et al.'s (2006) re-conceptualisations (and models) of absorptive

capacity. In Todorova and Durisin's (2007) model, a clear relationship between external knowledge sources and organisational absorptive capacity is given. Here, external knowledge sources and prior knowledge affects organisational absorptive capacity, which in turn affect competitive advantage. The relationship between the inputs and outputs of absorptive capacity is regulated by regimes of appropriability (appropriation practices such as patenting), power relationships (intra-organisationally and inter-organisationally), social integration mechanisms (such as organisational culture) and activation triggers (such as organisational crises). Their model will be used as a starting point for the development of an absorptive capacity model in the specific situation of an RI transferring knowledge to an SME. The articles discussed in this section will be used in later chapters to apply absorptive capacity to the development of an SME to RI knowledge transfer model.

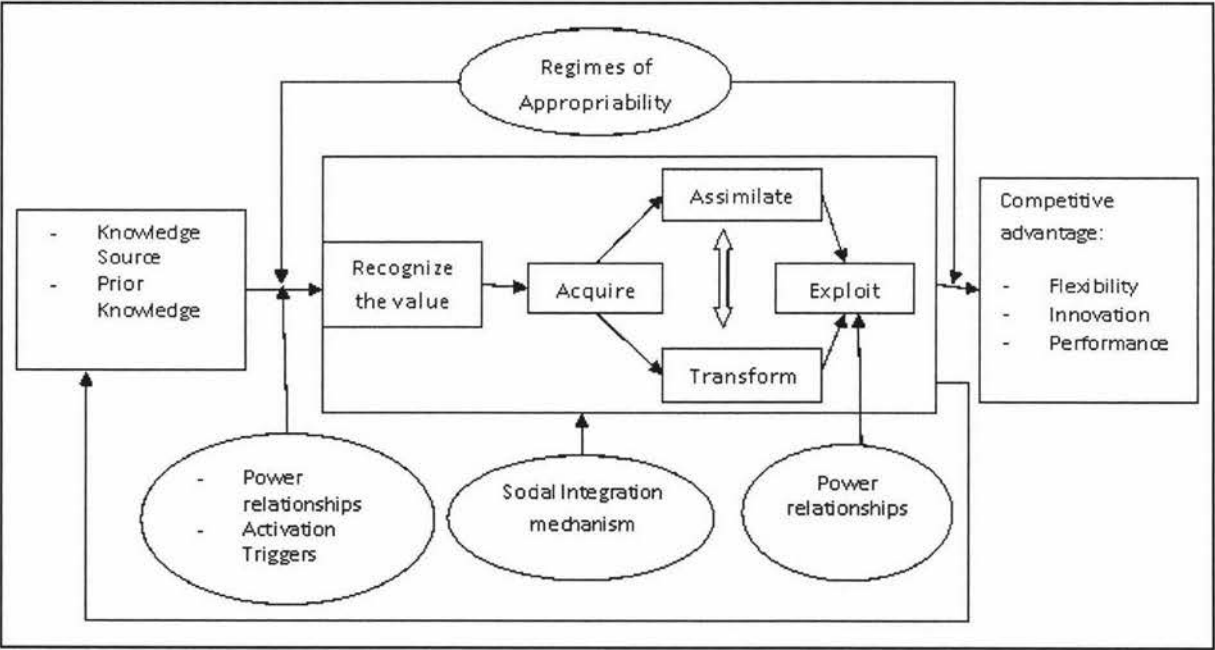


Figure 5 Todorova & Durisin's (2007, p.776) Refined Model of Absorptive Capacity

Chapter Three

Small to Medium Enterprises and Research Institutions

In order to discuss the knowledge transfer that can occur between an SME and University-led Research Institute, it is essential to understand exactly what constitutes an SME and RI in New Zealand. It is also important to discuss the importance of SMEs and RIs to the New Zealand economy from the views of the New Zealand Government and academia. The first part of this chapter focuses on SMEs, how are they defined and their importance to economic performance and the development of an innovative, knowledge-driven economy. This helps to understand why it is necessary to increase collaboration between private industry and academia. It is also important to highlight the gaps in the research of SMEs and RI relations. The second part focuses on RIs, how they are defined around the world and specifically in New Zealand and the importance they play in developing New Zealand's knowledge economy.

3.1 The Definition of a SME

An SME, rather like absorptive capacity, is one of those concepts people think they understand and assume they have a common definition for. The OECD, in their analysis of SMEs throughout their member countries, identified numerous definitions of what constitutes an SME, as each definition is country specific (OECD, 2005). The European Union, for example, defines SMEs in terms of number of staff, financial turnover thresholds and their operation as independent businesses. Ireland (which has a similar population to New

Zealand) defines SMEs as “those [*that*] employ fewer than 50 people and whose total annual turnover and/or annual balance sheet total does not exceed €10 million” (MED, 2007, p. 40). In contrast, the New Zealand Government defines SMEs as businesses employing fewer than 20 people. The New Zealand Government also identifies specific characteristics of SMEs, including personal ownership and management and the lack of specialist managerial staff (OECD, 2005).

The Ministry of Economic Development (MED) further categorises SMEs by their characteristics (as a legal identity) and the number of employees. The employee count is the number of salary and wage earners the enterprise employs and is gathered from taxation data (MED, 2007). This differs from the previously used FTEs, which included working proprietors who did not receive a salary or wage (MED, 2007). It is important to note this difference as any comparisons made from these differing statistics can be qualified for future research.

The Small Business Advisory Group (SBAG) reports to the Minister for Small Business on the issues facing small business in New Zealand. They also define SMEs as businesses that employ 19 people or less but they also list a number of qualitative characteristics in their inaugural report. These characteristics outline how SMEs differ from large businesses. The full list is included in Appendix A, but an important factor is that they are usually being led by independent-minded owner/managers who are multi-skilled. These owner/managers also tend to create a family-like workplace culture eschewing formal management strategies. Additionally, the owner/managers are time-poor and have all their personal assets as committed security for their business.

However, the New Zealand Centre for SME Research (NZCSMER) uses a differing definition for their research purposes. The NZCSMER is a Massey University Academic Research Centre with the primary aim of creating, disseminating, applying and conserving knowledge on New Zealand SMEs (NZCSMER, 2008). The Centre defines SMEs using the number of people employed by the firm. In line with international definitions, they add that they make “allowance for the fact that large firms in New Zealand are smaller than large firms in other countries” (NZCSMER, 2008). The NZCSMER define SMEs in three categories. Fewer than 5 FTEs constitute a micro enterprise, 6 to 49 FTEs constitute a small firm and 50 to 99 FTEs represents medium firms (NZCSMER, 2008).

For the purposes of this thesis, I will use the definition used by the NZCSMER because it is more in line with international definitions which will align this research with future research. Further, it differentiates between the three types of enterprises that the acronym SME consists of (that is, micro, small, medium). It is useful to differentiate between these because in future research it may be found that they have different competencies and therefore ACAP would be operationalised differently. It also allows for the incorporation of a temporal aspect as the relationship changes between the SME and RI as the SME grows. The growth of the SME can be described as transitioning from the one category to the next one, for example, growing from a micro enterprise to a small business and perhaps ultimately a medium business.

3.2 Operational differences of SMEs

The characteristics of SMEs outlined above and the implications of being of limited size in a business environment pose some specific problems for SMEs. SMEs tend to have issues with survival rates, and reaching the impetus to enable them to transition into larger enterprises (Macpherson & Holt, 2007; Zahra, 2005). Regulatory and administration requirements can also become burdens for the small business (SBAG, 2008), and a failure to adopt ICT and to actively use it to expand business operations can be detrimental and tight resource constraints limit long term planning of a strategic approach for the growth of the SME (SBAG, 2004). Decisions regarding the future of the business are tactical and usually for a short time frame only.

The final characteristic of SMEs that is of particular significance in the context of this research is that SMEs rarely have the resources to undertake their own R&D. The MED suggests that the proportion of SMEs undertaking their own research is only 7% (MED, 2008). Inability to conduct R&D means that the SME is essentially limited to the pathway or products it began with. The SME therefore needs to acquire this R&D through other sources. The New Zealand Government notes the importance of collaboration between industry and Research Institutes to make up for the inability of SMEs to conduct independent research (MED, 2008), but does not identify an implementation plan to facilitate this.

In this context, there are three characteristics of SMEs that may affect the transfer of knowledge between an SME and another source. First, SME behaviour is tactical because of tight resource constraints. This affects long term planning of the growth of the SME by the

owner/manager and lack of funding for R&D activities (SBAG, 2004). Second, the characteristics of an owner of an SME (such as the likelihood of seeking advice and support) can affect how the business operates (Lewis, Claire, Ashby, Coetzer, & Harris, 2005; Massey et al., 2004). Lastly, some SMEs are not static; they will grow and can change organisational shape. How they grow is affected not only by the characteristics of the owner/manager (internal organisational capabilities) but also by events out of the owner/manager's control, such as industry and economic downturns (Massey et al., 2004).

3.3 The Role of SMEs

SMEs are important to the economy for two key reasons. First, SMEs are drivers for innovation, productivity and economic growth (Hoffman, Parejo, Bessant, & Perren, 1998). SMEs are also key sources of “dynamism, innovation and flexibility” (OECD, 2005, p. 15). Their organisational structure can allow them to exploit opportunities for rapid change or development in business environments. Second, SMEs play a significant role in the economy. The importance the OECD gives to SMEs and the role they play can be seen with the creation of the OECD Centre for Entrepreneurship, SMEs and Local Development (OECD, 2008).

Within New Zealand, 97% of enterprises are SMEs, employing 31% of the workforce and contribute to 37% (value added) of the economic output (MED, 2008). SMEs have a particularly large impact on the New Zealand business environment, accounting for a higher proportion of employment than other OECD countries (SBAG, 2004, p. 3). The New Zealand Government has set up a number of initiatives aimed at helping small business, operating

through New Zealand Trade and Enterprise (NZTE) and the SBAG. The MED, in conjunction with Statistics New Zealand, releases an annual report on the state and trends of SMEs. It is obvious to researchers and policy analysts that SMEs are a key sector in New Zealand (Perry, Cardow, Massey, & Tweed, 2006).

An important issue in the context of New Zealand is that most agricultural and horticultural businesses, including farms, orchards and wineries, are SMEs. There has been some concern in the past that these have not been targeted by SME statistics, although this has recently been rectified by the inclusion of agriculture as an industry sector in a new set of business demography statistics (MED, 2008). Other countries have varying levels of importance given to agricultural SMEs. The United States, for example, places importance on the diffusion of agricultural technology through an extensive network to farmers, in areas such as biotechnology and sustainable development (OECD, 2005). Smaller countries however, implement simpler policies, such as Denmark which is making it easier for farmers to develop their farming operations (OECD, 2005).

SMEs also have a significant role in the adoption of new and innovative ideas and technology (Branzei & Vertinsky, 2006). SMEs are able to internationalise and commercialise new products and processes faster than larger organisations. However, without internal R&D, SMEs are dependent on R&D from other organisations to fully harness this capacity. Again, this reinforces the need for the SME to have an efficient and effective system for recognising and responding to new information.

3.4 Research on SMEs

Given the importance of SMEs, and particularly the importance of SMEs in developing innovative products, there would seem to be incongruence in the level on research undertaken on SMEs. In the context of transferring and adopting knowledge, there are clear gaps in the following areas.

There is no research stream on how the specific characteristics of an entire SME affect its ability to gather and implement knowledge from a general outside source. The use of SMEs in research is multidisciplinary; SMEs are studied in terms of entrepreneurship (or creating new ventures), industry to academic relationships, and in particular industries such as manufacturing and biotechnology (Agrawal, 2001; Dangayach & Deshmukh, 2001; Qian & Li, 2003; Schildt, Zahra, & Sillanpaa, 2006). The main research on SMEs in entrepreneurship is on entrepreneurial strategies (such as internationalisation of the SME for growth) and the entrepreneur themselves (such as their psychological characteristics and what makes them so successful in creating new businesses)(Lu & Beamish, 2001; Schildt et al., 2006). There is a focus on the entrepreneur itself and a clear gap at conceptualising how the whole SME plays a part in business activities.

SMEs are also considered in terms of their role in academia-to-industry relations. They are recognised as being an important part of industry, although most research in this area centres on issues for the university, such as licensing strategies and problems with intellectual property (Agrawal, 2001, 2006; Kodama, 2008). The main focus of the characteristics of SMEs in this relationship is what industry they are in, for example, high

growth companies in the manufacturing or biotechnology industries (Branzei & Vertinsky, 2006; Qian & Li, 2003; Thorpe et al., 2005).

3.5 Research Institutes

In the academic literature, there is no clear conceptual definition of what constitutes a Research Institute. Examination of this literature suggests that the only universally agreed position is that RIs are organisations that undertake R&D. These organisations are either funded privately by corporate businesses or publicly by governments or universities (who are in turn partially government funded). Unlike corporate-funded RIs, publicly funded RIs have the additional goal of researching for the public good. Universities and their research institutes are expected to create linkages with industry for a country's economic development rather than for pure profit (Beise & Stahl, 1999; Geiger, 2004). This idea traditionally originated from governments dealing with 'market failure' in a free-market economy. In these situations, businesses sometimes do not cover the social good in their activities and these must be provided for by government policies (Salter & Martin, 2001). This simplistic view has since been expanded upon and more complex views discussed by economists and researchers, but the key issue remains - public science is still a driving force for economic growth (Narin, Hamilton, & Olivastro, 1997; Salter & Martin, 2001).

The transfer of knowledge from universities and their RIs (academia) to industry (SMEs) is important (Mueller, 2006). Universities are key sources of new knowledge and the application of new knowledge is a primary driver for economic growth (Agrawal, 2001; Azagra-Caro, Archontakis, Gutierrez-Gracia, & Fernandez-de-Lucio, 2006). Additionally, RIs

can be the “starting and/or diffusion point for locally relevant knowledge, especially [for] SMEs” (Diez, 2000, p. 452). SMEs have limited capacity to carry out R&D and therefore universities and their research institutes are good potential sources of R&D activity. The benefits however are offset by constraints, such as universities having to compete for funding and the tension of carrying out research for the public good while still being fiscally competitive (OECD, 2007).

Regardless of their general purpose, RIs can differ in nature due to external influences, such as the country which it is operating in and its governmental policies. In the United States, collaboration between academia and industry is typified by large businesses and universities that are encouraged to act like businesses themselves (Matkin, 1994). Governmental policies centre on technology diffusion to the industry through intellectual property processes, such as patenting (Geiger, 2004; Harvey & McMeekin, 2007; Matkin, 1994). In Britain, universities are seen less as profit-generating institutions and more as organisations that educate for the public good (Owen-Smith, Riccaboni, Pammolli, & Powell, 2002).

In New Zealand, most RIs are funded through government initiatives (OECD, 2007). The RIs are Crown Research Institutes (CRIs), universities, some research associations and non-commercial private research institutions (OECD, 2007). CRIs were formed out of Government Research Institutes in the 1990s in an effort to turn them into commercially competitive organisations. However, they are still government-led and are therefore expected to pursue research for the public good. This can be seen through the mission statements of CRIs, for example AgResearch states that part of its mission is to transfer intellectual property to businesses for the benefit of the New Zealand economy

(AgResearch, 2008). R&D undertaken by the public sector can enhance national competitiveness and public RIs become a vital source of knowledge (Yusuf, 2008). Recently the OECD (2007) has raised questions about whether having a large number of funding instruments and competitive funding for projects was conducive to increasing R&D activities. The report found that in New Zealand, Universities are funded largely by Government instruments, such as the Marsden Fund and the Performance-Based Research Fund. There is some private funding that originates from organisations buying research. The report concluded that further steps could be taken to ensure the transfer of knowledge (R&D) from academia to industry is effective and efficient.

It is important to look at RIs, as they are part of the organisations that help transfer knowledge from academia to industry and therefore drive economic growth (Mueller, 2006). They are part of the broader picture of the Government's push to develop New Zealand into a knowledge economy (MED, 2008).

3.6 RIs and SMEs

The relationship between SMEs and RIs is not covered extensively in the literature. The discussion that is evident tends to see the unit of analysis as either the RI or the SME. Also discussion centres on developing governmental policies to raise the chance of academia collaborating with industry but does not focus on the specific way SMEs and RIs *interact*. Researchers do discuss SMEs and their role in academic-to-industry linkages but they fail to detail exactly *how* knowledge transfer operates between SMEs and RIs. There is little consideration of the interactions and relationships that can occur between SMEs and RIs and how these can impact on the knowledge transfer between the two. There is a need,

therefore, to extend the literature to examine the broader field of academic-to-industry linkages. Most literature in this area focuses on specific topics such as the development of academics as entrepreneurs, diffusion of knowledge and geographic networks (Tallman et al., 2004; Zahra, Van de Velde, & Larraneta, 2007).

It also examines how universities can commercialise their R&D through intellectual property instruments and more recently, issues concerned with academic entrepreneurs starting spin-off companies (Vohora, Wright, & Lockett, 2004). Research on the diffusion of knowledge that occurs through from academia to industry is centred on the transference of a specific *product technology*. Any transference of process knowledge is focused solely on the manufacturing industry and uptake of better businesses processes (such as ICT) (Kodama, 2008; Rothaermel & Deeds, 2004; Rothwell, 1991). From the SME literature, there is research on geographic networks, including, for example, how the geographic distance from universities and their research institutes raises the economic performance of a region or the success rate of start-up companies (Phan, Siegel, & Wright, 2005; Powell et al., 1996). There is little research on how the characteristics of an SME and a RI (together, not in isolation) impact on the knowledge transfer between the RI to the SME.

It has long been established that conducting R&D in-house can lead to new innovative processes and products and therefore most likely competitive advantage (Cohen & Levinthal, 1989). This is because the actual process of conducting R&D leads to expertise in not only refining existing processes and products but also searching for new knowledge and the ability to forecast industry changes (Cohen & Levinthal, 1994). However, what happens with when R&D is carried out in another location by another organisation, such as a RI? The

implication of this is particularly important to SMEs, organisations that have problems with funding their own business growth, let alone R&D (MED, 2008). RIs present a good source of publicly funded R&D skills and knowledge, but if a SME can not carry out their own R&D, can they still develop the ability to recognise and adopt new knowledge and adapt to industrial changes? It is important to analyse the mechanism of the knowledge transfer rather than just investigating the presence of it (Jaffe, Trajtenberg, & Henderson, 1993). As discussed in the previous chapter, absorptive capacity is one concept that has been used to describe an organisation's ability to recognise and seek out external knowledge and harness it for its own use. In the next section, therefore, I apply the concept of absorptive capacity to discuss the transfer of knowledge that can occur from RIs to SMEs.

Chapter Four

The Exploratory Model

4.1 Introduction

In Chapter Two, I looked at the development of absorptive capacity in its literature stream and outlined how its development culminated in a model by Todorova and Durisin (2007). This model shows the current state of the construct. In Chapter Three, I looked at what an SME and an RI are and why it is necessary to increase collaboration between private industry and academia. In this chapter, I build an exploratory model that incorporates absorptive capacity to facilitate knowledge transfer between an SME and an RI. There are particular issues that arise out of the use of the absorptive capacity construct, such as addressing its limiting assumptions, and the SME and RI knowledge transfer relationship, such as the dyadic situation that can arise in learning partnerships. First however, it is appropriate to discuss why absorptive capacity is useful for describing the knowledge transfer process between a SME and a RI. Then, I will develop a theoretical model for the use of absorptive capacity as a tool for knowledge transfer. Lastly, I will look at the advantages and disadvantages of the model.

The model looks at RIs and SMEs because RIs (as university-led or crown research institutes) are known centres for knowledge and this knowledge, when commercialised through SMEs, serves as a driver for economic growth (Agrawal, 2001; Mueller, 2006). It is useful, therefore, to understand how knowledge can be transferred from RIs to SMEs and what steps can be taken to make this knowledge transfer successful. Cohen and Levinthal's early

work on incentives for R&D spending, and later absorptive capacity, noted that universities and their research institutes are sources for knowledge spillovers and play an important part in the updating process of technologies. However, as discussed in Chapter 3, academia (RI) to industry (SME) knowledge transfer research focuses on either the characteristics of universities or businesses, rather than the two as a learning partnership. Channels of knowledge transfer concentrate on areas such as intellectual property policies, like patenting and consulting, and the management of academic entrepreneurs. It is important to understand the alliance between universities and industry as a *relationship*, as these alliances potentially accelerate the rate and quality of knowledge transfer.

It is also useful to discuss this knowledge transfer in terms of SMEs, as receivers of the knowledge from university-led research institutes and as vehicles for the commercialisation of the knowledge transferred (that is, the end outcome of increased economic performance). In New Zealand, SMEs play an important part in the economy, but as discussed, they rarely have the resources to undertake their own R&D. This is unfortunate as SMEs are able to internationalise and commercialise new products and processes quicker than larger organisations. The New Zealand Government understands that collaborations between SMEs and RIs can offset this inability to conduct internal R&D. However, most SME research focuses on the entrepreneur itself, there is a clear gap when conceptualising a whole SME as a part of a business activity.

4.2 Advantages of using ACAP

The transfer of knowledge between a SME and a RI is a specialised form of organisational learning not specifically studied in the literature. The processes that are discussed include strategic alliances (Koza & Lewin, 1998), research partnerships (Hagedoorn, Link, & Vonortas, 2000) and acquisitions and mergers (Ranft & Lord, 2002).

Strategic alliances usually occur so that organisations can either learn from each other or take advantage of each others' complementary assets to create competitive advantage (Koza & Lewin, 1998). Most strategic alliances fall into the second category, as organisations tend to utilise the exploitative learning approach rather than the explorative (Levinthal & March, 1993). This is a major limitation of applying strategic alliance research in the context of the knowledge transfer between an SME and RI. This is because SMEs have both exploitative and explorative aspects to learning in their relationship with RIs. The explorative approach is taking on the new knowledge from the RI, while the exploitative is utilising their best competencies to increase economic performance. Absorptive capacity incorporates both of these approaches in tandem and is therefore more appropriate.

Research partnerships between organisations usually involve significant effort in R&D (Hagedoorn et al., 2000). Most of the research in this area focuses on public/private partnerships. This is because of the direct government intervention and investment in these linkages between industry and academia. There are a number of different theories to view the advantages and disadvantages of engaging in research partnerships (be they private/private or private/public) for the organisations involved and also society (through

increased social welfare or determining areas for subsidisation)(Scott, 2003). Again, this is a limitation as the research will consider one set of research partnerships at a time and does not take an integrated approach. Absorptive capacity, however, was developed using not only economics and mathematics but also organisational learning theories, and it covers the all the relevant ways of looking at research partnerships. It highlights why industry-to-academia links should be encouraged (through economics, knowledge spillovers in an industry are not a disincentive to invest) and it looks at how learning processes occur at an individual and firm level (that organisational learning is not only depends on organisational knowledge processes but also the individuals within). Absorptive capacity represents a relatively well-rounded construct that can be used to make sense of the complicated issues that arise out of a SME and RI knowledge transfer relationship, such as being able to define and categorise issues related to knowledge transfer.

Another way that an organisation can get new knowledge is either by merging with or acquiring another organisation. In these types of organisations, it can advantageous to simply buy new knowledge or important competencies to avoid being left behind in a rapidly changing business environment (Ranft & Lord, 2002). However, Cohen and Levinthal (1990) argue that new external knowledge can not be simply bought. This is because product and process innovation can only occur if individuals within the organisation understand not only the new innovation but also the critical complementary organisational knowledge that comes with it. Using absorptive capacity, the SME can understand that valuable complementary organisational knowledge is developed through experience. It simply not enough to hold the instruction manual (the tacit knowledge) for the new knowledge but also understand the background knowledge (the implicit knowledge) needed

to deeply process it. This realisation can enable SMEs and RIs to handle their knowledge transfer interactions more proficiently.

While there are a number of advantages for using absorptive capacity in the SME-to-RI knowledge transfer relationship there are also some limitations which must be taken into consideration.

4.3 The Five Limiting Assumptions of the Construct

There are five limiting assumptions of absorptive capacity (Lane et al., 2006) which were outlined in Section 2.3. They are considered here in the context of the knowledge transfer relationship between SMEs and RIs. The first limiting assumption is that the construct is only used in the R&D context. Using absorptive capacity in a situation of knowledge transfer from an RI partly addresses this limiting assumption because the relationship is about R&D and external sources of knowledge. The model does not focus on investment in R&D as a direct measure of absorptive capacity. Rather, the focus is on identifying the organisational determinants of absorptive capacity for SMEs and RIs so that knowledge transfer can occur successfully. The SMEs can then foster long term sustainability through the development of their own organisational absorptive capacity. These determinants are also based on partner specificity, that is, the combinative capabilities of both the SME and RI affect the success of knowledge transfer. It is R&D related since this knowledge transfer is usually scientific or technical. The use of absorptive capacity in this context is useful therefore because it values external sources of knowledge and R&D processes, as well as other avenues for the development of competitive advantage. There are other organisational determinants of

absorptive capacity such as organisational structure and therefore through internal organisational capabilities. Examples of such are efficient and effective knowledge sharing systems (Van den Bosch et al., 1999). Organisational size affects organisational processes such as knowledge sharing systems. Therefore it is also useful for explaining why developing capabilities in an SME would be different than developing capabilities in an MNC.

The second limiting assumption is absorptive capacity is only developed when there is valuable external knowledge. The existence of a specific relationship between the SME and RI for knowledge transfer most likely means there is already some level of internal capability of absorptive capacity. Therefore, it can be safely accepted that, given this specific situation for the knowledge transfer, at least some absorptive capacity capabilities are already developed in order to see the value of the external knowledge from the RI (Lee, Lee, & Pennings, 2001).

The third limiting assumption is that some of the absorptive capacity literature equates relevant prior knowledge with absorptive capacity. Following from the above argument however, a distinction between the two can be made, where prior knowledge is an *antecedent* to absorptive capacity. Prior knowledge builds absorptive capacity, which in turn leads to more knowledge gathering. This knowledge then becomes prior knowledge, again increasing absorptive capacity. Not seeing prior knowledge as a direct measure of absorptive capacity allows it to become dynamic. Further, not only does the firm have to acquire new knowledge, it also has to learn how to process it and apply it. Therefore, emphasis is not only on knowledge content but also knowledge process. The important component that I consider has been omitted from Todorova and Durisin's (2007) model is

the operationalisation of the construct. Therefore, the model I propose uses Jansen et al.'s (2005) research into organisational determinants, specifically, the combinative capabilities of the SME and RI. This should allow future research to recommend actionable practical recommendations for developing absorptive capacity, something absorptive capacity literature stream now lacks.

Viewing absorptive capacity as a capability that processes knowledge content also overcomes the next limiting assumption outlined by Lane et al., (2006). This is the assumption that competitive advantage is based on the scarcity of knowledge. This assumption places emphasis on appropriating knowledge rather than developing competencies. A focus on absorptive capacity as a process and competitive advantage as an outcome would broaden this view. Hence, a model for knowledge transfer between SMEs and RIs must incorporate an understanding that capturing and processing new knowledge are not distinctly separate.

For the last limiting assumption, Lane et al., (2006) also suggested that previous literature had not understood absorptive capacity as a multi-level construct. There is a lack of recognition that an organisation's absorptive capacity is dependent not only on industrial and organisational characteristics but also on the characteristics of the *individuals* working within the organisation. The importance of this concept is particularly significant in the context of SMEs where the characteristics of the owner/manager will have a profound impact on the SME's absorptive capacity. Further, because of the small size of the SME organisation, the characteristics of the employees and their interactions with each other (that is, the organisational culture) and with external knowledge sources will be especially

relevant. The use of Todorova & Durisin's (2007) model and Van den Bosch et al.'s (1999) combinative capabilities in the proposed model addresses the impact of the individual's absorptive capacity through the inclusion of social integration mechanisms and social capabilities. These describe the processes of knowledge sharing within the organisation.

4.4 The Development of the Model

Absorptive capacity, therefore, has a number of advantages for describing the transfer of knowledge. The limitations identified by Lane et al., (2006) are mitigated through closer analysis of the particular context being assessed here. Overall, the advantages outweigh the limitations and further examination of absorptive capacity as a tool for understanding successful knowledge transfer is warranted. The above discussion highlights a number of issues that Todorova and Durisin's (2007) model have not included and which are of particular importance to an absorptive capacity model for SMEs and RIs. This section develops a theoretical absorptive capacity model that addresses the particular issues surrounding the situation of knowledge transfer between a SME and a RI.

Building the Model

The model uses Cohen and Levinthal's founding research of absorptive capacity as a construct as a starting point. Absorptive capacity is useful for looking at the SME and RI knowledge transfer relationship because it acknowledges that a university-led RI is a source of useful external knowledge and that R&D develops an organisation's learning capabilities.

Todorova & Durisin's (2007) research and model of absorptive capacity are used as a framework as it represents the most advanced assessment of absorptive capacity as a construct. Other aspects of key papers on absorptive capacity are included as appropriate.

The Starting Framework

Since the model uses Todorova and Durisin's (2007) model as starting point, it is useful to understand the detail of the article more fully. The article was written in response to Zahra and George's (2002) article on reconceptualising absorptive capacity as a construct. It discusses the drawbacks and improves on Zahra and George's conclusions by including some important points that Zahra and George seemed to miss from their analysis of Cohen and Levinthal's original work. In particular, they did not discuss the existence of useful knowledge in scientific communities. As it is written in response to Zahra and George's (2002) article, it will be useful to consider their conclusions in the context of SMEs and RIs.

Absorptive Capacity as a Multi-dimensional dynamic capability

A review of absorptive capacity literature shows that Zahra and George (2002) were one of the first to recognise that the literature stream lacked coherence as a research community. Absorptive capacity was developed as a multi-dimensional dynamic capability that allowed organisations to create knowledge and use it for competitive advantage (Zahra & George, 2002). They refined absorptive capacity as a "set of organisational routines and processes by which firm acquire, assimilate, transform and exploit knowledge to produce a dynamic organisational capability" (2002, p. 186).

This development is important as seeing the construct as a dynamic capability means that an organisation's knowledge flows can be analysed and linked to the development of absorptive capacity (rather than just R&D). The four components of acquire, assimilate, transform and exploit are combinative. Additionally, their output of absorptive capacity is competitive advantage, specifically in the areas of strategic flexibility, innovation and performance. This is more useful than Cohen and Levinthal's (1990) output of technical knowledge (and as an implied result of profitability) as it emphasises the importance of creating sustainable competitive advantage. This also addresses the limitation of seeing the development of absorptive capacity as R&D centric.

The acquisition dimension was defined as the "firm's capability to identify and acquire externally generated knowledge that is critical to its operations" (Zahra & George, 2002, p. 189). This differs from the Cohen and Levinthal's (1990) original definition because it adds the importance of acquiring valuable knowledge rather than just identification. The acquisition dimension has three attributes: intensity, speed and direction, and is limited by learning cycles and resources. This dimension is also path-dependant, in that it is reliant on the characteristics of previous identification and acquisitions of external knowledge. Considering acquisition is important because as organisations, SMEs have smaller resources at their disposal due to their size. Therefore, any decision to purchase must be made carefully.

The assimilation dimension was defined as "the firm's routines and processes that allow it to analyse, process, interpret, and understand the information obtained from external sources" (Zahra & George, 2002, p. 189). Their definition places emphasis on the difficulty of

having expertise in a context-specific knowledge retrieved from an external source as originally identified by Cohen and Levinthal (1990). SMEs need to be aware of their assimilation processes because of their small size, their processes maybe too simple to deal with the complexities of bringing information together.

The transformation dimension covers conclusions from Cohen and Levinthal's (1990) work on applying cognitive and behavioural theories to absorptive capacity and organisational learning. Transformation was defined as "the firm's capability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired knowledge" (Zahra & George, 2002, p. 189). They also discuss the idea of bisociation, which is using knowledge from one frame of reference in another, for the creation of new innovative knowledge. An SME would have a different frame of reference to an RI and would be able to see opportunities for the use of the new knowledge being transferred that the RI would not.

The final dimension of exploitation was added as Zahra and George (2002) believe the main focus of Cohen and Levinthal's (1989; 1990; 1994) work on absorptive capacity was on the exploitation of gathered knowledge. Analysis of these papers, however, suggests that the focus was actually the opposite. Organisations should invest in gathering external knowledge spillovers – which is largely an explorative process. This is because knowledge gathering from external sources such as universities concerns less targeted research (that is, primary research that is not readily turned into profit). In fact, customers should not set the direction for future R&D, even though it is a form of more targeted research. Allowing customers to dictate future R&D is a purely exploitative practice but limits the ability of the organisation to see radical competence-destroying industrial shifts. Zahra and George

(2002) then split the four dimensions into the two factors of potential and relative absorptive capacity in order to capture the explorative and exploitative nature of learning approaches. Since their article extends absorptive capacity in a number of important ways, Todorova and Durisin (2007) then analyse and refine their conclusions.

Background to Todorova and Durisin (2007)

Todorova and Durisin (2007) start by not using the 'recognising the value' component as a substitute for the acquisition dimension of Cohen and Levinthal's (1990) absorptive capacity. The 'recognising the value' component is a separate process and is encountered before the other dimensions of absorptive capacity. By doing this, they emphasise the importance of valuing new external knowledge, that it is a conscience activity and involves more than just gathering information as Zahra and George (2002) state. Also, rather than seeing the dimensions of assimilation and transformation as consecutive actions, Todorova and Durisin see them as different processes that interact with each other. The assimilation dimensions is described as *altering new knowledge* so that it is able to be understood using *existing* cognitive schemas, whereas the transformation dimension involves the *changing of* existing schemas to understand new knowledge. Therefore, knowledge structures only change when the new knowledge is unable to be assimilated by the organisation. Additionally, new knowledge may only become exploitable after moving between these two dimensions for any given number of times.

Another improvement on Zahra and George's (2002) model is the critique of the splitting of absorptive capacity into PACAP (potential absorptive capacity) and RACAP (realised absorptive capacity). Zahra and George (2002) recommend using the ratio between RACAP

and PACAP as a way to discuss the overall direction of and organisation's knowledge gathering (exploratory vs. exploitative) and use it as an explanation for successful competitive advantage. However, Todorova and Durisin (2007) argue that looking at the four dimensions of absorptive capacity (rather than just two) is better for construct validity and therefore empirical research. It is more beneficial to look at all four dimensions and assess the balance of exploratory and exploitative knowledge for each dimension.

Todorova and Durisin (2007) also discuss the contingent factors of Zahra and George's (2002) absorptive capacity. Zahra and George (2002) introduce the importance of social integration mechanisms, that is, investing in social networks for knowledge sharing and generation, on the relationship between PACAP and RACAP. Todorova and Durisin (2007) argue that this factor should affect the relationships between all five components as they were conceptualised as a set of social interactions. Additionally, Zahra and George state that only strong-ties social networks are positive for knowledge generation. However, weak-ties enable better simple knowledge search processes and strong-ties are better for complex knowledge and during the knowledge transfer process (Todorova & Durisin, 2007). In the context of SMEs, examples of weak-ties could be distant colleagues of the owner/manager. These weak-ties allow the owner/manager to come across more diverse and perhaps more innovative ideas. Examples of strong-ties are direct organisational relationships between the SME and RI or within the SME. These types of relationships allow direct transfer of specific knowledge, for example, the relationship between the primary liaisons between the SME and RI.

The factor of regimes of appropriability played an important part in Cohen and Levinthal's (1989, 1990) model of absorptive capacity. This was due to the idea that knowledge

spillovers should not be a disincentive for R&D investment. Cohen and Levinthal saw it as mediating the antecedents for the construct, but Zahra and George (2002) believe that it mediated the outcomes. Todorova and Durisin (2007) believe there is not enough research to understand which relationship is more affected; therefore they see it as a factor that affects both antecedents and outcomes.

An original factor added by Todorova and Durisin (2007) is power relationships. This was defined as “relationships that involve the use of power and other resources by an actor to obtain his or her preferred outcomes” (Todorova & Durisin, 2007, p.782). This factor affects the exploit dimension due to its issues with resource allocation processes and also the valuation of new knowledge. This implies that organisations should be careful using stakeholders and customers to set objectives as this can hinder the correct valuing of new knowledge. Lastly, Todorova and Durisin (2007) use causal loop diagramming to show the path-dependency aspect of absorptive capacity. This better captures the feedback mechanisms and gives a choice for research methodologies, such as the use of longitudinal research methods.

Application to the SME and RI knowledge transfer process

It is advantageous to use Todorova & Durisin’s (2007) model as a starting framework for a number of reasons. First, their model still uses the output of competitive advantage, which is more suitable than using Lane et al.’s (2006) output of firm performance. Competitive advantage gives more emphasis to creating sustainable long-term performance for organisations and this is important for the SME. The absorptive capacity of the SME creates sustainable competitive advantage because it develops the ability to forecast, that is, see

important industrial changes and take advantage of them. Also, Todorova & Durisin's (2007) model maps more complex relationships between the components of absorptive capacity, whereas Lane et al.'s (2006) model sees it as a simple transition from exploratory to transformative to exploitative learning.

Second, Todorova & Durisin's (2007) components of absorptive capacity describe the SME and RI relationship more accurately. Incorporation of the recognising the value component allows discussion on how the SME would recognise the valuable external knowledge from the RI. This recognition does not exist automatically within an organisation and needs to be developed as a capability. Generally a characteristic of smaller firms is that they are often unaware of the fact that universities are sources of knowledge (Meeus, Oerlemans, & Hage, 2004). In New Zealand, recent Government reports show a very low level of awareness about the research being undertaken by RIs by the majority of SMEs. Therefore, future research in this area could focus on how SMEs can become aware that universities and RIs are sources of knowledge.

Third, using the 'transform' component of the model means that we can acknowledge that new knowledge is not automatically assimilated and used, that is, individuals within the SME might have to adjust their way of thinking to understand the new knowledge from the RI. Future research could cover how SMEs who needed repeated attempts to commercialise a new product or process from an RI, managed to do so and whether changing their mental models was a factor for success. This would then lead to practical recommendations on how to cope with or reduce the need for repeated attempts at understanding the new knowledge.

Fourth, the use of Todorova & Durisin's (2007) contingency factors of power relationships and social integration mechanisms addresses the question of organisational culture within the SME. This is important for SMEs because as small organisations, people within the organisation become the predominant influence of organisational culture. Knowledge-sharing networks affect all transfers of knowledge within an organisation and therefore so do social integration mechanisms. The contingency factor of power relationships further refines why some organisations capture new knowledge and others do not, that is, there are individuals within an SME that use power to get resources to complete their own goals. These resources can come from within the organisation and externally from organisational stakeholders. Further research could analyse whether the typical flat organisational structure of an SME allows easier access to organisational resources and whether this organisational structure leads to the successful commercialisation of the new knowledge from the RI. This could lead to practical recommendations on how a RI can choose an SME that would be more likely to successfully commercialise their new product or process.

Lastly, Todorova & Durisin's (2007) contingent factor of regimes of appropriability plays a part in the SME & RI relationship because it involves issues related to Intellectual Property rights. This contingent factor can be further researched in the SME & RI relationship, for example, how regimes of appropriability affect knowledge transfer relationships between the SME & RI. Also, can these relationships be fostered from the initial licensing of the new technology to later, when the SME grows to a point where it can use high information gap research capabilities (Izushi, 2003). Future research can also focus on how regimes of appropriability change when the SMEs knowledge requirements from the RI change, for example, what happens when an SME grows and becomes successful and how does it

impact on their current and future demands for appropriability. This could lead to practical recommendations on which regimes of appropriability are suitable for what growth stage the SME is at, for example, the difference between a small start-up SME that is commercialising its first product or process from the RI and a larger high-growth SME that is a repeat customer.

In conclusion, using Todorova & Durisin's (2007) framework facilitates customising the proposed model for the specific situation of an SME learning a new product or process from an RI. In the next section, I will build upon the framework set out above to further develop the proposed model. As the model is changed and added to, I will outline the advantages of the changes and additions in relation to the knowledge transfer relationship. Only advantageous changes will be made so this section will conclude with a description of my model and its limitations. Limitations are useful to understand when the model can be applied and how it can benefit from future research.

The model I have developed is shown in Figure 6. The development of this model will now be discussed.

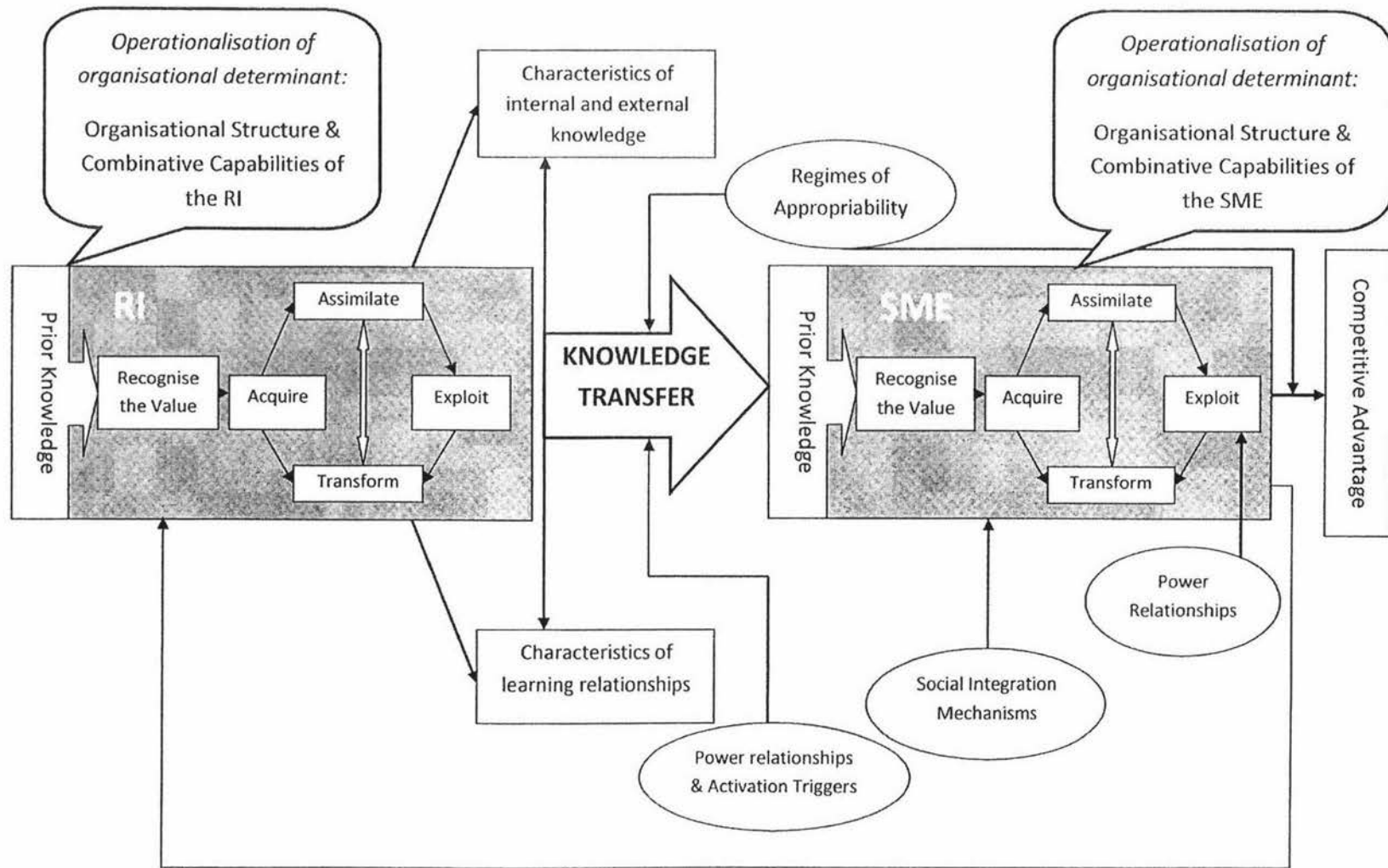


Figure 6. The RI to SME Knowledge Transfer Model using Relative Absorptive Capacity.

Adding the Antecedents

The first development of the model is the addition of the antecedents of characteristics of internal and external knowledge and learning relationships. The characteristics of internal and external knowledge include whether the knowledge is basic or specialised and what level of expert knowledge the SME has in the area of the RI's product or process. The first external driver focuses on the knowledge content and knowledge similarities between learning partners. This driver outlines how knowledge base differences between an SME and RI can influence the knowledge transfer relationship. This can lead to recommendations as to how to manage these differences, such as what level of involvement is needed by the RI or their academic inventor and how does this change during a successful knowledge transfer process.

The second external driver, characteristics of learning relationships are the "non-knowledge aspects of learning relationships" (Lane et al, p.857). This covers areas such as the organisational fit between two partners in a learning relationship, or relative absorptive capacity. In other words, this considers how easy it is for the SME to learn from the RI (Lane & Lubatkin, 1998). Future research could focus on what aspects can hinder or help this learning relationship, such as the impact of differing organisational cultures between the RI and SME on successful knowledge transfer.

The use of the drivers of characteristics of internal and external knowledge and characteristics of learning relationships stresses the importance of seeing the SME to RI knowledge transfer relationship as inter-organisational learning, that absorptive capacity in this context is relative. Organisations cannot learn knowledge equally from all sources -

rather the success of knowledge transfer is affected by the similarities and dissimilarities between the two learning partners. It is also dependent on the ability of both to communicate (Fukugawa, 2005), particularly in SME-to-RI linkages. Absorptive capacity can therefore can be seen as a firm level construct (SME and RI separately) and at the inter-organisational level (SME and RI in tandem). In the proposed model, an example of this is how well the SME can learn from the RI given their differences and similarities in areas such as organisational structure and knowledge bases.

Adding the Learning Dyad Relationship

The RI and SME knowledge transfer relationship can be seen as a learning partnership and, therefore using the terminology of teacher-student pairing is advantageous (Lane & Lubatkin, 1998). The inter-organisational or relative absorptive capacity is a learning dyad-level construct similar to an individual's cognitive learning process (Lane & Lubatkin, 1998). Partner specificity plays an important role in the SME and RI relationship. The SME (student) must be aware of the RI's (teacher) organisational problems or dominant logic. So the RI's dominant logic is the way they develop their commercial objectives and the way they achieve those objectives despite their shortcomings. SMEs can not learn new knowledge from an RI without taking its processes into consideration. Future research could examine how successful knowledge transfer is influenced by their learning dyad relationship and what policies should be implemented to encourage this. In my model, this issue falls under the antecedent of characteristics of learning relationships.

Adding Organisational Determinants

Organisational forms of the learning partners also affect relative absorptive capacity (Lane & Lubatkin, 1998). Additionally, Van den Bosch et al. (1999) argued that organisational form is an organisational determinant of absorptive capacity. Overall organisational structure affects the scope, flexibility and efficiency of knowledge assimilation (Van den Bosch et al., 1999). Therefore, different organisational structures affect the way an organisation combines and exploits knowledge, and so impacts on their absorptive capacity. Additionally, absorptive capacity is linked to incremental and radical innovation because it is supported by increasing the depth of closely related knowledge. This also leads to path-dependency, similar to Cohen and Levinthal (1989, 1990, 1994).

Organisational form is defined as “types of infrastructure which enables the process of enabling, assimilating, integrating and utilising knowledge in a specific way” (Van den Bosch et al, 1999, p.554). In their research, Van den Bosch et al (1999) use the three traditional organisational forms of functional, divisional and matrix. They acknowledge that more recent forms exist but omit them for simplicity. For future use, it would be important to first look at the specific organisational forms SMEs take; for example, different types of SMEs may place different sets or levels of responsibility on managers.

In the proposed model, this determinant of absorptive capacity is added to examine how this would pan out in practice. For example, the addition of organisational determinants of absorptive capacity might allow further discussion on how and what measures need to be developed in order to examine the particular learning relationships between the SME and RI for successful knowledge transfer. Future research in this area could use organisational

forms as an observable way of seeing the organisation's unobservable knowledge-processing abilities (Van den Bosch et al., 1999). Future research could also study the organisational structure differences between the SME and RI and how it affects successful knowledge transfer. This could lead to practical recommendations on how differences or similarities could be managed for a positive outcome.

Another organisational determinant of absorptive capacity is combinative capabilities (Van den Bosch et al., 1999). They exist inter and intra-organisationally to absorb knowledge from all types of environments. There are three types of combinative organisational capabilities; systems, coordination and socialisation (Van den Bosch, et al., 1999). System capabilities are formal networks that are used to integrate explicit knowledge, such as strategic direction, policies and procedures (Van den Bosch et al., 1999). These are able to be manipulated by managers because they are formal and explicit.

Regardless of their inherent in-flexibility, systems capabilities did not have a negative effect on absorptive capacity. Rather, they had a positive effect on an organisation's absorptive capacity because it tended to get rid of constricting socialisation capabilities over a period of time. Although this result was gathered from large companies, this is also relevant to SMEs. SMEs are flexible and can adapt to rapidly changing businesses because of their lack of formal procedures. This can however, hinder the development of beneficial problem-solving abilities. Additionally, this can be increasingly problematic if the RI is bureaucratic in nature as differences between them can hinder effective knowledge transfer.

Coordination capabilities involve work-place group relationships that allow the absorption of new knowledge. They can be either designed or emergent and are path-dependent (Van den Bosch et al, 1999). They are developed in large organisations through training and job rotation, natural liaison devices and participation. Socialisation capabilities are described as general ways to act under unspecified events and are communicated tacitly (Van den Bosch et al, 1999). These capabilities are otherwise known as the organisational culture. This is relevant to SMEs because a dysfunctional organisational culture will greatly affect both of these capabilities and in extreme circumstances encourage NIH syndrome. Additionally, since they are path-dependent, dysfunctional coordination and socialisation capabilities are hard to combat. SMEs must give careful consideration to these capabilities. This is because, due to their size, a SME's organisational culture has great influence but also fewer resources to deal with ingrained dysfunctional organisational culture.

In my proposed model, these capabilities are represented in power relationships and social integration mechanisms. It is important to address the issues of social capital in this research context because SMEs control few assets. Their main asset is their people and so SME owner/managers tend to develop competencies in retaining and nurturing their people so that they retain their knowledge base. Additionally, the main asset of RIs is their ability to conduct R&D and therefore their human capital. Looking at combinative capabilities of the SME and RI in tandem can expand the understanding of the inter-organisation level of the absorptive capacity construct, that is, partner specificity.

Combinative capabilities are also emergent and idiosyncratic but do have common features based on how organisation's deal with the dimensions of absorptive capacity (Jansen et al.,

2005). Further research into operationalisation of absorptive capacity found that it was more useful to look four dimensions of absorptive capacity rather than anything more simplistic (like Zahra and George's (2002) PACAP and RACAP)(Jansen et al., 2005; Todorova & Durisin, 2007). Although using four components increases validity for future research, it would be still useful to further investigate the balance between knowledge searching and knowledge exploiting capabilities. For example, future research in this area could develop ways to categorise organisational capabilities into the four dimensions of absorptive capacity and hypothesize on how this affects sustainable competitive advantage for the SME. This could lead to empirical research that concludes with practical recommendations on assessing the absorptive capacity component mix of the SME (and RI), for example, a SME failing at successfully commercialising the RI's product or process may find that it is not concentrating enough resources on developing the exploitation capabilities. The SME then could implement practical recommendations on how to rectify this problem.

Coordination capabilities were found to enhance the acquire, assimilate and transformation dimensions of absorptive capacity. Additionally, unlike Van den Bosch et al., (1999), socialisation capabilities did not negatively influence the acquire and assimilate dimensions. This is interesting in relation to the model I propose because it lends to questions for future research into how the organisational culture of the SME and/or RI positively affects the knowledge transfer and how it can be encouraged. As described before, SMEs tend to place importance on social capital (and we can safely assume so do RIs). Social capital allows more efficient, deeper and swifter knowledge transfers (Yli-Renko, Autio, & Sapienza, 2001). This also implies that absorptive capacity in the RI-to-SME knowledge transfer relationship is relational.

Sustainable competitive advantage is added as the overall output of this knowledge transfer relationship because a SME wants profitable longevity and a university-led Research Institute is funded by the government because the knowledge transfer increases economic performance. Organisational determinants of organisational absorptive capacity are added to represent the importance of operationalising absorptive capacity and conducting future research in this vein. The use of combinative capabilities also supports the impact of the learning dyad relationship and organisational structure on successful knowledge transfer.

In summary, utilising theories and results from the absorptive capacity literature stream, I have developed an exploratory model for depicting the knowledge transfer relationship between a RI and a SME (Figure 6). Todorova and Durisin's (2007) model of absorptive capacity presented a recent iteration and was used as a starting framework. Ideas on learning partnerships and partner specificity were used to describe the relational view of an SME and RI's absorptive capacity. Adding antecedents of characteristics of learning relationships and knowledge types gives us further analysis into how knowledge transfer is affected. Seeing absorptive capacity as a multi-dimensional dynamic capability allowed the model to see absorptive capacity as a process and something that can be directly developed by people within the SME and RI. Finally, the use of results from research into the operationalisation of absorptive capacity is important because it addresses the much needed gap in this area and provides a way to conduct future research.

With specific reference to the model (Figure 6), the boxes representing the SME and RI hold the components of their organisational absorptive capacity. As the organisation that will take the new knowledge to market, the main focus of the SME could be argued as the

exploit dimension of absorptive capacity. However, it is more useful to recognise that the SME must balance all of its dimensions in order for successful and functional use of the knowledge transferred. Similarly, it can be said that the main function of the RI is the 'recognising the value' component. However, the RI also has absorptive capacity and its dimensions, although these are not the primary focus of the relationship in this instance. In addition to these dimensions of absorptive capacity is the emphasis of prior knowledge.

One of the important antecedents of absorptive capacity outlined by Cohen and Levinthal and others is the impact of the level of prior knowledge. This is added in a separate box to represent its role as an antecedent. The other antecedents of characteristics of internal and external knowledge and characteristics of learning relationships are added to show that knowledge type and the dyadic relationship between the SME and RI affects successful knowledge transfer. Additionally these antecedents also affect each other. Other factors influencing successful knowledge transfer are social integration mechanisms and power relationships which represent the impact of organisational culture. Activation triggers represent the changes in the organisation or the industry that encourage the SME to look for external knowledge. A feedback loop is added to further show the process as dynamic.

One of the key purposes for conducting business for the SME is to achieve sustainable competitive advantage and is shown as the overall output. Lastly, boxes showing the organisational determinants of organisational absorptive capacity are added. These are combinative capabilities and organisational structures in order to consider the impact of partner specificity on knowledge transfer. They also signify the value of operationalising

absorptive capacity and pursuing future research in this field. A glossary of definitions for the model's components is included in Appendix B.

The Limitations of the Model

The scope of the model is limited by the literature and research used to build it, this has been partly addressed earlier by outlining the five limiting assumptions of absorptive capacity. The model is also limited in scope by its view of the RI and SME relationship as a dyadic one and how it affects relative absorptive capacity.

In relation to my specific model, it is restricted to describing the RI to SME knowledge transfer relationship. Also, more importantly this is an *exploratory* model, and would greatly benefit from less theoretical approaches, such as case study research in the New Zealand context. It is a starting point for the discussion of future research that will use empirical research. Although it uses conclusions from research that uses empirical methods to measure organisational operationalisations of absorptive capacity, this research will need to be refined in order to suit the context of the model, for example, what measures can be used in order to conduct empirical research on how the coordination capabilities component of combinative capabilities of both the RI and SME affects successful knowledge transfer. Or it would be interesting to see if SME and RI organisational processes can be neatly described within the five components of absorptive capacity. The main problems arise out of the operationalisation of absorptive capacity and how to develop accurate measures.

There is no empirical research that clearly follows and models the real world knowledge transfer relationships between RIs and SMEs. It is easy to extrapolate research on larger organisations but harder to consider these conclusions for SMEs and RIs as a group, especially in New Zealand. Additionally, since most empirical research has been done on MNCs, the implications of downsizing these conclusions for SMEs are unclear. The model is also limited by the large number of issues associated with successful knowledge transfer, such as organisational culture, characteristics of learning relationships and even the impact of internal and external knowledge networks.

In conclusion, this chapter has addressed the advantages and disadvantages of using absorptive capacity and outlined how it can be applied to the specific situation of a RI transferring knowledge to an SME. The relationship has also been discussed in terms of dyadic learning, operationalisation and important antecedent and outcomes. An exploratory model has been developed adding components that better describes the SME and RI knowledge transfer relationship. I have then outlined the limitations of my exploratory model. In the concluding chapter I identify the key findings from this research and examine future research ideas.

Chapter Five

Conclusions and Recommendations for Future Research

The purpose of this thesis was to apply the construct of absorptive capacity to examine the knowledge transfer process between an SME and a university-led Research Institute. This concluding chapter discusses how applying absorptive capacity in this context is valuable for understanding how a SME learns new knowledge from an external source and the important role the RI plays. The application of absorptive capacity in this context also covers a gap in the literature and therefore extends the current state of knowledge of the construct. A theoretical model is offered and in this chapter its implications are considered. Lastly, recommendations for future research are offered.

Absorptive capacity was introduced and initially developed by Cohen and Levinthal (1989, 1990, 1994) from economics and organisational learning literature. It describes the ability of an organisation to recognise valuable new knowledge from external sources, learn it and apply it commercially for long-term profitability. It also allows organisations to forecast changes in the industry and take advantage of opportunities before competitors. Since then it has been used in a myriad of disciplines from describing the learning capabilities of MNCs (Minbaeva, Pedersen, Bjorkman, Fey, & Park, 2003) to whole regions of a country (Davenport & Bibby, 1999). Despite its popular use, there is some concern that the construct has become negatively reified, that is, used without addressing its underlying limitations. However, absorptive capacity is still useful and can be applied properly by first understanding its background and then addressing its limitations. The most popular use has

been in the area of strategic alliances and more specifically R&D partnerships. This is because conducting R&D leads to new innovative products and processes. However conducting R&D is costly and time-consuming, so organisations enter into R&D alliances to reduce these limitations.

SMEs account for a large proportion of business conducting overseas and especially in New Zealand. Due to their limited size and resources, SMEs have trouble funding costly R&D. University-led Research Institutes are an excellent source of new knowledge generated from R&D. The OECD advises member countries, such as New Zealand, to strengthen academia-to-industry linkages in order to increase economic performance. These linkages increase a country's economic performance by supporting the flow of new innovative knowledge developed by RIs into SMEs. These SMEs then commercialise the knowledge and turn it into sustainable competitive advantage. Most research into SMEs has been on the entrepreneur as a unit of interest or on specific challenges they face currently, such as barriers to successful internationalisation. Literature on RIs focuses on governmental policies and funding instruments. However, there is little research examining the knowledge transfer between an SME and RI nor on what influences successful knowledge transfer. Using absorptive capacity in this context, we can begin to understand this process.

5.1 Development of the Model

A model is developed to examine the knowledge transfer relationship between a SME and RI using absorptive capacity literature. Use of absorptive capacity literature allows some insight on how the relationship is different from other concepts of intra and inter-

organisational learning. Rather than using concepts such as strategic alliances and mergers to explain the RI to SME knowledge transfer relationship, I can build a model better suited to its particular idiosyncrasies. Using concepts such as strategic alliances is problematic because it concentrates on large multinational corporations that conduct their own R&D. These organisations enter into strategic alliances usually to gain industry advantage by using each other complementary competencies. This is different to the situation considered in this thesis, where the SME does not conduct R&D but absorbs R&D knowledge from the RI. Additionally, the absorptive capacity literature argues that knowledge can not be simply bought, such as through mergers and acquisitions of smaller companies. This is because the absorptive capacity construct recognises that the organisation must first have the ability to understand the new knowledge fully, that is, its implicit and tacit components.

I use Todorova and Durisin's (2007) model of absorptive capacity as a starting point for the discussion and development of my model because it presents the most current state of the literature. However, this is a general model of absorptive capacity and it is changed to fit the SME and RI knowledge transfer relationship.

Governments are encouraged to support academia-to-industry linkages because it encourages economic performance. This is the overall reason for the knowledge transfer relationship between the SME and RI. The SME, due to its size and lack of resources, uses the RI as a source of R&D knowledge and turns it into profitability. However, the output of the model is competitive advantage. This is because it emphasises the importance of creating a sustainable business venture for sustainable economic growth. If the SME sees

competitive advantage as its main objective it understands that it has to behave strategically to exist, such as forecasting industrial shifts.

Using competitive advantage also means that the development of absorptive capacity by the SME is not R&D centric. This addresses a limitation of absorptive capacity in its literature stream where its development is directly linked to carrying out R&D. This is despite the fact that extending research finds that absorptive capacity can be developed through other organisational processes. Therefore, the model acknowledges this point and sees absorptive capacity as a multi-dimensional dynamic capability. This is important because the SME is not developing absorptive capacity through R&D activities. It is using knowledge from the RI who carries out the R&D.

There are other issues for the SME due to its size and lack of resources. The SME must first recognise the value of external knowledge, which it obviously does consciously since it is in a knowledge transfer relationship with an RI. However, the SME must be careful in what knowledge it chooses to acquire. This is because it has a limited pool of resources and therefore identifying and acquiring external knowledge must be a considered decision. Additionally, acquiring new knowledge also builds a knowledge base used for future acquisitions and identification. Hence, it is even more important for the SME to get the correct knowledge initially.

However, it could be problematic for the SME to simply understand and integrate the knowledge from the RI. The SME and RI would have dissimilar frame of references due to their differing roles. The SME must process the new knowledge to a point where it can be

exploited for profit. The model views this process as an interaction between assimilating and transforming the new knowledge. The SME would have to change its way of understanding the new knowledge (transforming) until it can analyse and understand it properly (assimilate). All these concepts, recognising the value, acquiring, assimilating, transforming and exploiting external knowledge, represent the dimensions of absorptive capacity.

The ability of absorbing knowledge from the SME is not wholly dependent on itself. As outlined before, the SME and RI have different world views and therefore different ways of understanding the new knowledge. For that reason, in the model the RI is not just represented as a source of external knowledge but another organisation with its own absorptive capacity processes. The successful transfer of knowledge between the RI and SME is dependent on how well they talk to each other, that is, partner specificity. This means that the development of the SME's absorptive capacity is relative.

The relationship between the SME and RI can be seen as a learning dyad, that is, teacher-student pairing. For successful knowledge transfer to occur, the SME must be aware of the RI's way of doing things, or their dominant thinking. The ease of learning the new knowledge from the RI is dependent on the characteristics of learning relationships. Another antecedent is the characteristics of internal and external knowledge. This outlines whether the knowledge is basic or specialised and what level of expertise the SME has. The SME must be aware of the differences in the knowledge bases between itself and the RI in order to process the knowledge being transferred. This would allow the SME to process the

knowledge deeply. These two antecedents represent the impact of partner specificity on the knowledge transfer relationship between the SME and RI.

Within a SME, social capital is considered by the owner/manager as the most important asset of the organisation. Therefore, in order to enable successful knowledge transfer, the SME must also look towards its individuals. This is similar to the development of absorptive capacity within an organisation. Organisational culture plays an important role within an SME, it affects the dimensions of absorptive capacity within the SME (social integration mechanisms) and individuals that use organisational power to get their goals (power relationships) affect the knowledge transfer process directly and also the ability to exploit the new knowledge.

The SME usually looks to an RI for new knowledge for a reason, whether it is organisational change or industrial change. For example, in terms of organisational change, the SME could be looking at selling their products overseas. Using the new knowledge to develop their products would give them a point of difference within their chosen target market. Or, in terms of industrial change, the new knowledge from the RI could represent a gap in an existing market and would represent a lucrative opportunity. These reasons are represented by the inclusion of activation triggers in the model.

Another industrial factor that the SME must be aware of is how easy it is to gather knowledge from external sources, that is, the volume of knowledge spillovers. The knowledge available from the RI is an example of knowledge spillover in an industry. Originally, economists believed that this was a disincentive for investing in an industry.

However, the absorptive capacity concept argues otherwise, that an organisation must have the capability to recognise and understand that knowledge spillover in order to use it.

Therefore, the SME that understands this does not view knowledge spillovers as a disincentive to do business in their industry and is using the knowledge from a RI. Although knowledge spillovers are not a disincentive for organisational learning, appropriating this knowledge can still be an issue, such as the impact of intellectual property rights. These concepts are represented by the inclusion of regimes of appropriability and affect both the knowledge transfer and the output.

Lastly, there must be a way to measure the absorptive capacity processes within the SME and RI and analyse their differences to include issues of partner specificity. The organisational structure of the SME and RI affects the way they develop absorptive capacity and therefore absorb knowledge. The organisational structure of the SME is what makes it special and different from other organisations such as MNCs. Another determinant of absorptive capacity is combinative capabilities, capabilities such as strategic direction and job rotation. These determinants represent a concrete way to develop measurements for absorptive capacity for future research. Looking at these determinants of the SME and RI in tandem can also expand the understanding of partner specificity in the knowledge transfer relationship.

5.2 Management Implications

The application of absorptive capacity to knowledge transfer in the SME/RI context raises a number of management implications for the owner/manager of the SME, the RI and for

Government policy-makers. SMEs should find solace in the fact that existing in an industry that has a lot of knowledge spillovers does not mean that the environment is too competitive to survive in. Managers of SMEs should be confident that although they have limited organisational resources in terms of money and people, there are still processes they can develop that will lead to competitive advantage. Although SMEs do not have the money to perform costly R&D research, they can address this limitation by working with RIs.

Government bodies have realised that strengthening knowledge transfer between SME and RIs helps not only the long term profitability of the SME but also the economic performance of the whole country. However, most research focuses on strategic alliances between large companies or governmental policies that fund universities and their research institutes. There is little research that focuses on the knowledge transfer that occurs specifically between a SME and RI.

Research in this area is needed for development of organisational determinants of relative absorptive capacity between the SME and RI. Then specific managerial action can be recommended so that the quality of the knowledge transfer process can be improved. If higher quality knowledge can be acquired, assimilated, transformed and exploited commercially by the SME, the SME could enjoy sustainable competitive advantage.

The use of the absorptive capacity construct in the knowledge transfer relationship between the SME and RI is useful. This is because it allows the managers of the SME to better understand how processes can be developed to increase competitive advantage.

Additionally, the construct can be used to understand the impact of partner specificity on successful knowledge transfer. Managers of SMEs must understand that the capability of

the RI also plays a part in how well they absorb the new knowledge. Future research is recommended in this vein, such as, how would SMEs recognise that RIs are valuable sources of external knowledge and what can be done to encourage this recognition. Also, what types of SMEs learn knowledge from the RIs and how does this affect successful knowledge transfer. The theoretical model developed in Chapter Four offers a starting point for discussion for other future research directions.

Managers of SMEs should realise that sustainable competitive advantage is a better outcome to aim for than just profitability. This allows a deeper understanding of the strategic direction of the organisation rather than just pursuing particular products and processes for quick return. Developing processes that build absorptive capacity can allow managers to forecast changes in the industry and take advantages of opportunities, thus prolonging the organisation's sustainability. Future research could find measures of successful knowledge transfer and whether this impacted on the sustainability of the SME.

The characteristics of the knowledge within the SME and RI and of the knowledge being transferred should be taken into consideration. The SME manager should understand that what types of knowledge they normally deal with will impact on absorbing the new knowledge from the RI. For example, how much expertise does the SME have in the RI's field? Is the knowledge based on basic science or applied science? What knowledge bases does the SME have to understand the knowledge being transferred? Future research could concentrate on what types of industries (such as biotechnology or IT) have strong academic to industry links, specifically the existence of knowledge transfer relationship between SMEs and RIs. This would allow better understanding of the 'real world' nature of SME and RI

knowledge transfer relationships. For example, what organisational or industrial triggers make SMEs seek knowledge from a RI?

Examining organisational structure may be an observable way to see unobservable knowledge-processing networks (and therefore absorptive capacity in its entirety) within the SME and RI. Looking at differences in overall strategic direction or how flat or deep the hierarchy and comparing that to whether successful knowledge transfer occurred could be useful. Then future research in this vein could lead to more targeted questions on specific capabilities.

A more concrete way managers of SMEs and RIs could look at developing absorptive capacity (and therefore successful knowledge transfer and sustainable competitive advantage) is to look at combinative capabilities of their organisations. These are categorised as system, coordination and socialisation. In terms of system capabilities, future research could first look at the differences in procedures and policies of the SME and RI and how this affects successful knowledge transfer. These capabilities would be easiest to manipulate for managers as they are formal and explicit. For coordination capabilities, future research could look at whether these capabilities exist in a small organisation such as a SME, for example, job rotation. Or whether the level of training of SME employees compared the level of training of RIs influences successful knowledge transfer. Socialisation capabilities cover the organisational culture of the SME. Future research could see how to classify organisational culture as functional or dysfunctional in relation to successful knowledge transfer, or whether a difference in culture between the SME and RI affects the transfer.

The implication for government and their policies is that RIs need to be funded and encouraged to engage with SMEs. Policy analysts can recognise the potential of using absorptive capacity as a method for examining knowledge transfer at the organisational level, such as the importance of monitoring SMEs to see if they are aware of RIs as external sources of knowledge and setting guidelines for the management of the knowledge transfer relationship. This can enable policies and processes that make knowledge transfer successful between SMEs and RIs. This means that funding spent can be efficient and effective, but more importantly, increase the innovativeness and performance of the economy.

5.3 Future Research

As the theoretical model of absorptive capacity was developed in Chapter Four, numerous opportunities for specific future research possibilities were identified. Here I examine the general areas for future research.

Once the organisational determinants of absorptive capacity of the SME and RI are properly defined and developed, future research can look at the temporal aspect of the relationship. For example, how the SME grows over time and its changing relationship with the RI. As the SME grows and its organisational structure changes, research could investigate how developing absorptive capacity would also change. Also, in particular, how does the knowledge transfer relationship between the SME and RI change? After the transfer of knowledge finishes, what ties does the SME keep with the RI? Do they go back to the RI and does the SME's needs change and in what way? For example, at the early stage, the SME

may seek the knowledge from the RI in order to find a new technology to commercialise and turn into profit. Then as the technology is successful as a commercially applied product, the more organisationally mature SME may go back to the RI. The SME may do this in order use the RI's research capabilities to further develop the technology into diversified or specialist products. Here the SME first uses the RI as a way to scan the industry environment. Then later the SME may use the RI as a way to develop their own inclinations from their own forecasting ability (developed through absorptive capacity). Future research could look at the types of SMEs that do develop a long term relationship with the RI. As SMEs get larger or experience high-growth over time, are they more likely to invest in such a relationship? Does the learning dyad between the SME and RI turn from a one-way relationship (where the SME learns from the RI) to an increasingly two-way approach (where the relationship becomes a mutual learning experience)?

Future research could also examine whether future knowledge transfer becomes easier or more successful as the SME and RI develop a long term relationship past the initial introductory knowledge transfer. Does the initial introductory knowledge transfer set the tone for future relationships or lack thereof? Does successful knowledge transfer and then successful competitive advantage from that knowledge affect whether the SME consider RIs as good sources of external knowledge? Future research could investigate how important the initial knowledge transfer experience is for the SME and what lessons, if any, they learn from unsuccessful knowledge transfer.

Additionally, future research could study how the long term relationship between the SME and RI impacts on the SME's processes. This can be contrasted to SMEs that do not develop

a relationship with an RI. Do SMEs that use RI become more sophisticated in their ability to utilise new technologies and therefore shape their overall strategic direction for competitive advantage. For example, does their portfolio of products become more diverse and do they use the new technologies to cross-over into other industries and therefore become more successful? Or do SMEs that do not use RIs become more successful because they stick to 'business as usual' strategy and view stability as the preferred outcome?

Future research could first concentrate on qualitative research methodologies, such as interviews with managers and employees of SMEs and RIs involved in the transfer of knowledge. This would give an initial idea of what the knowledge transfer process is like and what problems and solutions arose. Case studies of successful and unsuccessful knowledge transfer relationships between a SME and RI would be useful in this regard. This method would explore what measures could be used for the operationalisations of absorptive capacity, that is combinative capabilities and organisational structure. Additionally, the measures that constitute improved competitive advantage from successful knowledge transfer could be identified. Once these measures are found, propositions on how the similarities and differences of the SME and RI and how these affect successful knowledge transfer could be discussed. This discussion could lead to further research into how to determine a method for predicting the outcome of such relationships and therefore what can be done to encourage a successful outcome for both parties. This can then be used on an organisational scale, such as a screening process for SMEs and/or RIs. At an individual scale this would enable managers to directly manage the knowledge transfer and the relationship. This could also be used by government bodies to fund specific policies that encourage success.

An exploratory and theoretical analysis such as this invariably raises more questions than it answers. However, absorptive capacity has been found to be a useful tool for examining the relationship between an SME and RI in the knowledge transfer process. My next research journey will consider the finer details.

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Appendix 1

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While SMEs are diverse, typically an SME may:

- have begun spontaneously from just one idea or new product and may continue to be an incubator for innovative ideas and products
- have an owner/manager with little formal business experience or few generic business skills
- have begun because the founder/owner has a particular technical expertise
- comprise the founder/owner and up to four employees (often with an unpaid family member providing administrative support)
- have the owner as the only person in a managerial position, and no board or formal governance arrangements
- operate on trust, rather than on systems and contracts
- have a tight family-like culture where the values of the owner are strongly shared by the staff and workplace practices are flexible and suited to individual employees' needs
- focus on a small range of products or services sold mainly on the local domestic market
- have all personal assets, including the owner's home, committed as security for the business
- acknowledge the owner's time as one of its scarcest and most valuable assets
- operate flexibly, on a 'reasonable person' basis, rather than on an informed and strict observance of regulations
- have a vision and outlook that is bounded by the horizons, skills and experience of the

founder/owner, the pressures of day-to-day management and tight resource constraints

(i.e. a tactical rather than a strategic approach)

- endeavour to operate independently of other businesses and institutions and to favour self-help over seeking advice
- not be aware of the regulations to which it is expected to adhere
- in provincial areas, be a key part of the social fabric of the community
- close within three years of its inception, not infrequently in circumstances that could easily have been prevented.

These characteristics mean that managers in successful small firms need to be multi-skilled rather than specialists, with expertise in a diverse range of areas.

Appendix 2

Glossary of Key Terms used in the RI to SME Knowledge Transfer Model using Relative Absorptive Capacity

Activation Triggers –

“Triggers are events that encourage or compel a firm to respond to specific internal or external stimuli” (Zahra & George, 2002, p. 193)

Acquire –

“Firm’s capability to identify and acquire externally generated knowledge that is critical to its operations” (Zahra & George, 2002, p. 189)

Assimilate –

“The firm’s routines and processes that allow it to analyse, process, interpret, and understand the information obtained from external sources” (Zahra & George, 2002, p. 189)

Characteristics of internal and external knowledge –

“Knowledge content...[and its]...tacitness...The influence of knowledge type on the firm’s ability to use it” (Lane et al., 2006, p.846)

Characteristics of learning relationships –

“The non-knowledge aspects of learning relationships – issues such as strategic , cultural, structural and compensation fit” (Lane et al., 2006, p. 857)

Combinative Capabilities –

“...units need to develop organisational capabilities, defined as combinative capabilities, that enable them to synthesize and apply current and newly acquired external knowledge” (Jansen et al., 2005, p.1000).

Competitive Advantage –

Profitability and business capabilities of an organisation that surpasses its competitors.

Exploit –

“Exploitation as an organisational capability is based on routines that allow firms to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations” (Zahra & George, 2002, p.190)

Knowledge Transfer –

“Knowledge transfer between organisational units as a process that covers several stages starting from identifying the knowledge over the actual process of transferring the knowledge to its final utilisation by the receiving unit” (Minbaeva et al., 2003, p. 587)

Operationalisation of organisational determinants –

Applying organisational determinants of the construct in primary research.

Organisational Structure –

Structural characteristics of an organisation, such as depth of hierarchy.

Prior Knowledge –

“Prior knowledge includes basic skills or even a shared language but may also include knowledge of the most recent scientific or technological developments in a given field” (Cohen & Levinthal, 1990, p. 128)

Power Relationships –

“Power relationships [are]... those relationships that involve the use of power and other resources by an actor to obtain his or her preferred outcomes” (Todorova & Durisin, 2007, p.782).

Recognise the Value –

Process of valuing new external knowledge.

Regimes of Appropriability –

Practices surrounding the ability of appropriate knowledge, such as intellectual property rights.

RI -

University-led Research Institute.

Social Integration Mechanisms –

“Social integration mechanisms...facilitate the sharing and eventual exploitation of knowledge” (Zahra & George, 2002, p. 194).

SME –

Small and Medium-sized Enterprises

Transform –

“The firm’s capability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired knowledge” (Zahra & George, 2002, p. 189)