PERSPECTIVES ON INDUSTRIAL

CLUSTERING AND THE PRODUCT,

RESOURCE AND KNOWELDGE

BASED VIEWS OF MANAGEMENT

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ABSTRACT

This project examines the theoretical basis for linking industrial clustering to the strategic management of firms. Specifically, a recently deployed theory building framework defined three perspectives on clustering, the competitiveness perspective, the externalities perspective and the territorial perspective, but stopped short of explaining when, where and to whom these perspectives are relevant. This thesis proposes that firms are the central recipient of cluster effects and that the product-based, resource-based and knowledge-based approaches to management provide the theoretical base from which the operational contexts of each cluster perspective can be defined. Three cluster-management relationships are modelled and beta-tested on a sample of cluster-based firms. The empirical analysis is designed to provide feedback to the theory building process and not to prove or disprove the theory itself.

The analysis yielded little if any evidence that the proposed cluster-management relationships are present in the sample that was studied. This result was a surprise as the exuberance with which clusters and their benefits are often promoted suggests that in a cluster there should be a pronounced correlation between firm performance and cluster attributes. The statistical limitations of this analysis mean the results can not be inferred to the general population and that the theoretical propositions are not actually disproved. Nonetheless, the muted observations do cast attention on the need for better modelling and measurement instruments in the field of cluster research. In addition, this project initiates a deductive process by which subsequent research can focus on the causal pathways that comprise the phenomenon of industrial clustering; including the pathway that links clusters to firms and then to economic performance.

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CHAPTER 1

The phenomenon of firms with similar or related activities grouping together has been observed since the 19th century (Alfred Marshall, 1890) and is rooted in the discipline of economic geography. Over time this phenomenon has been studied under the guise of several different concepts including the innovative milieu, the growth pole and the learning region.[1] Nonetheless, most recent studies draw to some extent on Porter's (1998a: 197) work that defines industrial clusters as, "… geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions."

At its core, the study of industrial clustering is about proximity and the way in which it fosters a variety of cooperative and competitive actions that "are kinds of economic co-ordination parallel to, and sometimes intertwined with …" the traditional forms of economic coordination (the invisible hand of the market or the hierarchy of the firm) (Cooke, 1999: 58). It is argued that the differences observed from one cluster to the next reflect the ongoing process of finding the critical and necessary balance between competition and cooperation (Dei Ottati, 1994; Cooke, 1999). If this balance can be successfully found, the cluster concept proposes accelerated rates of innovation and growth that can be entrenched by path dependency and first mover advantages, a promise few can overlook in an increasingly globalized economy with accelerated rates of change and greater levels of uncertainty (Gilpin, 2001).

The notion that similar things grow together is the simple, obvious idea that allows almost anyone to connect to the concept of clustering. Yet, it is the diverse mix of actors and underlying complexities that have driven the phenomenon's recent popularity. Consider for a moment that from its roots in economic geography the phenomenon of clustering has garnered attention from political scientists interested in the role of government agencies and civic organizations; sociologists and psychologists interested in the root nature of interactions; as well as, business

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[1] For more on the innovative milieu, growth pole or learning region see Maillat (1995), Parr (1999), and Florida (1995), respectively.

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managers and economic development practitioners interested in the decision making and behavioural implications of proximity. This multi-disciplinary interest is a direct result of including companies, suppliers, service providers and associated institutions in the explanation of what constitutes a 'similar thing'. The net effect of this breadth of interest is that the cluster literature is now comprised of a rich mix of multi-disciplinary concepts and explanations. It is thus necessary for all subsequent research to respect the multi-disciplinary nature of this field of research. This means rather than trying to pull the phenomenon of industrial clustering inside the boundaries of specific disciplines one must find ways to align and synergistically merge concepts and theories across disciplines.

1.1.   The Problem

While the multi-disciplinarity of cluster research is likely its greatest asset and the basis for grand expectations of discovery and applicability, it is also a source of criticism. Critics view cluster literature as a grab bag of concepts and mechanisms with essentially no limits as to when and where they can be applied. The literature has been called "fuzzy" (Markusen, 1999), "vague" (Martin and Sunley, 2003) and guilty of tending "to conflate ideas rising from quite different perspectives" (Gordon and McCann, 2000). This lack of structure and clarity within cluster literature is causing additional problems. Specifically, the central role and importance of the firm has been lost somewhere in the minefield of multi-disciplinary concepts and explanations.

Researchers and practitioners increasingly treat clusters like an organism that can be tweaked and modified to generate the desired economic performance. This presumes a direct link between clusters and the economy while effectively ignoring the fact that economic performance is an aggregate measure of individual firm performance. This means the only way for clusters to impact aggregate economic performance is to have an effect on individual firm performance. In other words, firms stand between clusters and economic performance. The distinction is admittedly nuanced but simply means that researchers and practitioners need to focus more on how industrial clustering influences the performance of individual firms and less on the collective performance effect that tends to accumulate.

At the outset of this project the objective was to generate some tangible benefits for firms by observing the direct impacts that cluster have on firm performance. The observation of performance effects was expected to provide insight on the choices that firms can make to increase their ability to successfully harness the benefits of clustering. However, in the course of the literature analysis, it became evident that there was not much of a theoretical base linking individual firm performance and decision making directly to cluster attributes. Much of the cluster literature either measured aggregate, regional performance effects or focused solely on an interesting cluster attribute by assuming away the causal pathway between that attribute and firm performance. As a result, the focus of this project shifted toward enhancing the theoretical base that enables the linking of cluster and management literatures.

The objective of building a better theoretical link between cluster literature and management literature was substantially enhanced by Maskell and Kebir's (2005) recent application of a theory development framework to the field of industrial clustering. The framework employs a series of questions (what, how, why, and when/where/to whom) designed to deductively identify the components, relationships and justifications for industrial clustering. In the frameworks initial application past research was triaged into three unique perspectives on clustering: the competitiveness perspective, the externalities perspective and the territorial perspective. Each perspective was characterized by a different underlying relationship structure and set of benefits. However, since the questions of when, where and to who each perspective is relevant were not addressed the theory building framework remained incomplete.

1.2.   The Objective

This project takes the opportunity to re-establish individual firm performance as the central focus of theories on industrial clustering. Three views on firm management were gleaned from the management literature and proposed as the appropriate explanation of when, where and to whom each perspective on clustering is relevant. The product-based, resource-based and knowledge-based views on management each describe a firm with a distinct type of management philosophy and underlying strategic motivation. Presumably, each perspective on clustering corresponds to one of the approaches to management.

1.3.   The Approach

The link between each cluster perspective and views on management was established by a series of logic-based arguments taken from both bodies of literature. These relationships were subsequently modelled and tested on an existing set of data. The sample included firms believed to be operating in a clustered environment. The analysis was treated as a beta-test of the proposed theory with a focus on revealing substantial flaws in logic and opportunities to improve the model's functionality.

1.4.   Organization of the Thesis

The remainder of the thesis is divided into four chapters. Chapter two describes the theory development framework and reviews what others have said about the cluster perspectives as well as the three views on management. Chapter three pulls the cluster and management literatures together to form a model with three propositions that link the cluster perspectives to the views on management. The propositions are translated into a variety of proxy variables so that the relationships can be tested. In the fourth Chapter the results of the empirical analysis are presented. This leads to the concluding chapter where the results are analyzed and their implications discussed.

CHAPTER 2

The phenomenon of industrial clustering and all of its related sub-phenomena have been studied for centuries. The body of literature spans many academic disciplines and practical boundaries. In doing so it extends our understanding of economic coordination, provides new tools and metrics for managing agglomeration, and brings once abstract concepts (e.g. knowledge management) closer to widespread practical application. In fact, it could be argued that the interdisciplinary nature of the phenomenon is exactly what makes clustering attractive to such a broad and global audience of researchers and practitioners.

Despite an observable depth and breadth of cluster related research there remains a lack of formal structure and classification within the literature. This is what enables the conflating of ideas and leads to a fuzzy understanding of the phenomenon. In this regard the body of literature related to industrial clustering can be seen as being in its infancy.

This chapter will review several pieces of literature that begin to distil our understanding of clusters into a deductive framework (sections 2.1). The framework acts as a common platform for disentangling the multitude of underlying entities, processes and phenomena. As a result, the deductive framework yields three distinct perspectives on the clustering phenomenon (section 2.2). Each perspective argues that proximity fosters a different relationship structure among the cluster agents. Unfortunately, the triaging approach used by the deductive framework stops short of explaining the operational contexts in which each cluster perspective is more or less relevant. These operational contexts are vital to anchoring the theoretical perspectives in practical circumstances. Thus several dominant perspectives from the strategic management literature are reviewed for their ability to explain different operational contexts (section 2.3). By reviewing both of these large bodies of literature – industrial clustering theory and strategic management theory – this chapter builds toward a more complete deductive framework that can be used to move the body of literature beyond its infancy by facilitating more structure and clarity (section

2.4). This will subsequently enable future research to uncover the causal pathways behind the phenomenon of industrial clustering.

2.1.   A Theory Building Framework

The literature surrounding the cluster phenomenon has been critically assessed by many. Markusen (1999) labelled the concept as 'fuzzy' while Martin and Sunley (2003) take direct aim at a commonly used cluster definition provided by Porter (1985, 1990, 1998a, 1998b). They describe the definition as "deliberately vague and sufficiently indeterminate" to ensure it can be applied in many sectors. Gordon and McCann (2000) state that "… discussion of industrial clustering has tended to conflate ideas arising from quite different perspectives." Maskell and Kebir (2005) go on to argue that the melding of different perspectives and prevalence of multiple labels has led to research that has, "… mostly been concerned with making sense of empirical findings rather than contributing to the discovery of the serene and luminous expanse of conceptual clarity where all may meet and expatriate together." Together these criticisms make it safe to declare our current understanding of the cluster phenomenon incomplete.

Being aware of the short comings in the cluster literature is only the starting point. The critics have in fact provided direction and identified the tools to be used in the pursuit of conceptual clarity. Markusen (1999: 870) suggests the simplest solution to addressing the fuzziness of a concept is to ask the question: "How do I know it when I see it?" More specifically she suggests that agents, structures and actions be identified to ensure there is a "… clear attribution of power, responsibility, and range of possible response on the part of actors" (Markusen, 1999: 871). This approach reappears in a theory building framework recently promoted by Maskell and Kebir (2005). In this framework 'a complete theory' requires one to, "… address the questions of *'what'*, *'how'*, *'why'* and usually also of *'when/where/who'*."[2]

By answering each of the 5 W's (and one how) the framework produces distinct building blocks necessary for the development of a theory and its subsequent models (table 2.1). Addressing the question *'what'* identifies variables, concepts and constructs. The question *'how'* defines the

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[2] Maskell & Kebir (2005: 3) primarily attribute this framework to Whetten (1989) but also cite Dubin (1987), Gagliardi (1999), Lengnick-Hall & Wolff (1999) and Sutton & Staw (1995).

causal links and correlations between these factors. Taken together the *'what'* and the *'how'* define the subject or in this case answer Markusen's question of: how do we know a cluster when we see it? The question *'why'* produces the justifications for the *'what'* and the *'how'*. The answer to *'why'* and the way in which the answer is communicated is crucial in determining the acceptance and influence of the theory. Maskell and Kebir (2005: 4) refer to the answer of *'why'* as the core of the theory. The final group of questions, *'when/where/who'*, creates the context and limitations for the theory.

Table 2.1: Theory Development Framework

		Industrial Clustering Theory
What?		Defining concepts & variables
How?		Relationships or links between the variables
Why?	**Existence**	When will a cluster emerge? What causes cluster formation?
	Extension	What limits the expansion of a cluster? Why don't we live in one massive city?
	Exhaustion	What causes clusters to disappear?
When/Where/Whom? (context)		In practice, what are clusters associated with?

Maskell and Kebir (2005: 4) take the theoretical framework one step further by identifying three arguments that must be addressed by any cluster theory when answering the question *'why'*:

- The *existence argument* should, "… account for the economic and social benefits that firms may accrue when colocating" (Maskell and Kebir, 2005:4). The list of expected benefits is important to explaining the motivation of firms and other agents involved in clusters. Each of the cluster perspectives emphasizes a different set of benefits and thus a unique reason for the existence of clusters.
- The *extension argument* provides, "… an explanation of the diseconomies encountered when exceeding certain geographical and sectoral thresholds" (Maskell and Kebir, 2005: 4-5). This is essentially a list of the negative effects of agglomeration that act as a counterbalance to cluster benefits. This list reveals when a cluster ceases to be the location of choice and new organizations find alternate locations while previous tenants begin to move out of a cluster.
- The *exhaustion argument,* "… spell(s) out the internal or external conditions that made previous decisive colocation benefits turn sour during the lifecycle of the

cluster" (Maskell and Kebir, 2005: 5). This argument acknowledges that clusters are not invincible and identifies conditions that have, throughout history, led to declines in localized competitiveness. One of the most cited circumstances under this argument is the depletion of important local natural resources. When the natural advantage disappears so to can the entire competitive advantage of the cluster.

Addressing these three arguments – existence, extension and exhaustion – ensures a comprehensive answer to *why* and when combined with answers to *what, how and when/where/whom* will create a highly robust theory on industrial clustering.

2.2. Cluster Perspectives Summarized

With an overall objective of fostering greater conceptual clarity, Maskell and Kebir used the theory building framework to unpack and triage what others have said about the phenomenon of industrial clustering. They identified three lines of inquiry within the cluster field. The three lines of inquiry are labelled: (1) the competitiveness perspective, (2) the externalities perspective and (3) the territorial perspective. The competitiveness perspective (Isard, 1951; Porter, 1985, 1990, 1998a, 1998b) argues that proximity fosters direct economic linkages characterized by shortened communication lines; more and better intelligence related to competitors and markets; lower costs (transaction, search, etc.); and intensified rivalry. The externalities perspective (Marshall, 1890; Krugman, 1991b, Krugman and Venables, 1996; Romer, 1990, 1994; Lucas, 1998) argues that proximity fosters indirect linkages or an informal network structure that enables location factors and public goods to enhance the local division of labour (specialization), increase the presence of spillovers, and improve the overall technology development process. The territorial perspective (Aydalot, 1986; GREMI[3]) argues that proximity leads to a non-economic structure that builds trust, common values, exchange of information and ultimately a collective development process. Gordon and McCann (2000) earlier achieved a similar segmentation of the cluster literature however, Maskell and Kebir's (2005) use of the theory-building framework

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[3] GREMI is an acronym for 'Groupe de Recherche Europeen sur les Milieux Innovateurs' or the European Resserach Group on Innovative Milieux formed in 1986 to study the interaction between innovation and localised factors (together termed 'territory') (Maskell & Kebir, 2005: 8).

encourages a more deductive approach better suited to disentangling the multitude of underlying entities, processes and phenomena.[4]

2.2.1. The Competitiveness Perspective

The competitiveness perspective argues that proximity fosters direct economic linkages characterized by shortened communication lines; more and better intelligence related to competitors and markets; lower costs (transaction, search, etc.); and intensified rivalry. Direct economic linkages are identifiable and embedded in stable exchange relationships among firms and their suppliers, distributors, competitors, and customers (Gordon and McCann, 2000: 518). These are often referred to as backward, forward or horizontal trade linkages.

This perspective is most often associated with Porter's (1985, 1990, 1998a, 1998b) work on 'competitive strategy'. This work wasn't explicitly about clusters but it did identify industrial clustering as a driver of industrial and national competitiveness. By doing this Porter contributed to moving "economic geography from the periphery to the mainstream" (Porter, 1994:38 as cited in Maskell & Kebir, 2005: 7). The essence of Porter's work is that national competitiveness is an extension of industrial competitiveness; and industrial competitiveness is, in turn, determined at the regional level. In order to illustrate how competitiveness is determined at the regional level Porter outlined a relatively complete theory of industrial clustering.

According to Porter, clusters are comprised of value chain agents. Value chain agents can be core competitors in the local industry or they can be upstream (e.g. suppliers) or downstream (e.g. distributor, customer) industry participants. The agents can be from a complementary or competing (substitute) industry that finds some similar benefits in the particular location. Finally, Porter includes agents that have a symbiotic relationship with a particular industry. These agents include government organizations, industry associations, business service providers (e.g. accountants, financiers, management consultants), and other service organizations. Porter introduced the 'diamond' model to categorize these agents according to their location in the value

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[4] Gordon & McCann (2000) use the labels 'Industrial-Complex model', 'Pure Agglomeration model' and 'Social-Network model' to represent, respectively, the competitiveness, externalities and territorial perspectives.

chain. According to the theory development framework used by Maskell and Kebir (2005) value chain agents are *'what'* competitiveness clusters are made of.

From industry to industry and region to region this collection of cluster agents will look quite different. What doesn't change is the driving force behind *'how'* the agents are related. According to the diamond model, each type of agent can potentially have some form of exchange relationship with the core competitors of the focus industry. These exchange relationships, when established and maintained, represent forward, backward or horizontal linkages. These linkages are governed by the basic principles of economic exchange (e.g. supply and demand) and thus will only be established when some form of value can be derived by both parties.

It is important here to make the distinction between exchange relationships and linkages. Exchange relationships ought to be viewed as one time interactions between two parties. Each interaction is assessed on a cost-benefit basis. According to Location Theory[5] these exchange relationships may lead to clustering as several firms within an industry "attempt to minimize distance, transportation, and production costs; obtain cheap labour; and minimize risks" (Dicken and Lloyd, 1990 as cited in Bekele and Jackson, 2006: 4). From the competitiveness perspective these exchange relationships are important for more than just the case by case benefits they generate. Exchange relationships form the basis for sustained linkages to emerge. Linkages can be viewed as conduits for recurring exchange. As such, linkages become an invisible infrastructure through which a variety of benefits can flow. Porter indicates that the initial exchange relationships are important to the emergence of the cluster but it is the maintenance of trade linkages that fosters long term competitiveness.

From the competitiveness perspective the *'emergence'* argument is that short term benefits from local exchange relationships can promote co-location. These benefits can include lower search costs and lower transportation costs. The *'extension'* argument states that clusters persist as firms work to maintain exchange relationships and incidentally foster an invisible infrastructure that enables additional benefits like access to information about competitors, awareness of new innovations, and a greater sense of rivalry. If more of these exchange relationships can be

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5 For more on Location Theory, Bekele and Jackson (2006) cite the following: Weber, 1929; Isard, 1951; Dicken and Lloyd, 1990.

entrenched as sustained linkages then the second order benefits (e.g. market & competitor intelligence, technology dispersion, intensified rivalry) become increasingly accessible. It is these benefits that extend beyond the short term and, as Porter emphasizes, are critical to accelerating the innovation process and enhancing competitiveness. However, Porter notes that co-location can also foster negative effects like ebbing rivalry or regulatory inflexibility that can ultimately lead to the *'exhaustion'* of the agglomeration.

Therefore, the central argument to *'why'* clusters exist is that through proximity they can turn short term benefits of exchange relationships into second order benefits that impact long term competitiveness.

In summary, the competitiveness perspective argues that proximity fosters direct economic linkages characterized by shorter communication lines; more and better intelligence related to competitors and markets; lower search and transaction costs; and intensified rivalry. All of which play a role in accelerating innovation and enhancing competitiveness. As such the competitiveness perspective emphasizes the need to efficiently and effectively use backward, forward and horizontal trade linkages to innovatively respond to markets and remain competitive.

2.2.2. The Externalities Perspective

The externalities perspective (Marshall, 1890; Krugman, 1991b, Krugman and Venables, 1996; Romer, 1990, 1994; Lucas, 1998) argues that proximity fosters indirect linkages or an informal network structure that enables location factors and public goods to enhance the local division of labour (specialization), increase the presence of spillovers, and improve the overall technology development process. Externalities, also known as location factors, are the aspects of a place that exist beyond the realm of any single firm and the transactions they engage in yet remain spatially contained so that access is restricted to individuals or organizations within an appropriate proximity to that location. They range from being readily observable elements like the labour pool or service infrastructure to more intangible items like education systems or the quality of local leadership.

The basis of this perspective is that even though location factors or externalities exist in all locations, they deliver the most value and form the basis of competitive advantage in locations where organizations foster the 'right' relationship structure. Advantages derived from location factors are much harder to imitate or recreate because they are rooted in the involvement of multiple organizations (Barney, 1995). In this perspective firms are indirectly linked to one another through their mutual interest in deriving value from locational factors. As a result, proximity is important to the relationship between firms and location factors--not the firm to firm relationships emphasized in the competitiveness perspective. Furthermore, there is no assumption that firms must cooperate, at least beyond what makes sense to them in self-serving, competitive environment. What firms are inclined to do is protect their investment in the advantages of a particular location. This is done by using the locational advantages in a way that keeps from depleting them.

A core difference between the externalities and competitiveness perspectives is the way in which a firm is believed to respond to their external environment. The competitiveness perspective assumes that uncertainties from the external environment can be managed by internalizing them through the development of formal relationships and long term contracts. The externalities perspective emphasizes that a firm designs and builds its internal capabilities with the intent of proactively responding to the external environment. Hence, location factors are valued for the ways in which they enable firms to interface with the broader external environment. For example, a thick labour force allows for timely redevelopment or deployment of skill sets while spillovers support early awareness of changes and the dispersion of sagacity.

In terms of the theory development framework used by Maskell and Kebir (2005) – *'what', 'how', 'why'* –the externalities perspective argues there are two core variables that explain *'what'* makes up clusters: firms[6] and location factors. It further argues that the location decision is *'how'* the core variables are linked. The basic logic states that as firms decide where to locate, or whether or not to remain where they are, they assess what several locations have to offer. This process leads to the identification of location factors, an overall attribution of value to the

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[6] While Maskell and Kebir use the term 'firms' it is this authors view that all organizations could be included as they all make some sort of location decision.

collection of location factors in each place and finally a relative ranking of each option. The process culminates with firms choosing where to locate. This choice directly ties them to the location and indirectly associates them with the other organizations in the location. As the location decision process continuously repeats itself it serves to define the location, whether it is a cluster or just holds the potential to become one.

When the basket of location factors is 'just right' there will be a convergence of interested firms; in other words, demand for the location will grow and agglomeration can emerge. In the externalities literature the forces of attraction that emerge when factors are just right are known as centripetal (in) forces. They have been attributed to location factors (externalities) related to the labour force, non-traded inputs or knowledge flows (table 2.2). It is these location factors and their power of attraction that explain *'why'* clusters emerge. In the theory development framework, centripetal forces satisfy the existence argument (Maskell and Kebir, 2005).

Table 2.2: The Forces of Agglomeration

Centripetal Forces	Centrifugal Forces
Labour Force Externalities: ▪ Specialized skills ▪ Low search cost to fill positions ▪ Inter-firm flow of employees ▪ Etc.	Immobile factors of production (not available): ▪ Natural resource inputs ▪ Lack of labour and / or skills ▪ Barriers (e.g. distance) to market access ▪ Etc.
Non-traded Input Externalities: ▪ Availability of financial capital ▪ Business support services (consultants or advisors). ▪ Cost of essential services (fire, sewer, transport, waste removal, etc.) ▪ Etc.	Land rents & other costs of doing business: ▪ Rents, ▪ Taxes, ▪ Cost of services ▪ Etc.
Knowledge Flow Externalities: ▪ High Quality Personnel (development of, availability, etc.) ▪ Stock of ideas and idea production environment ▪ Track record of interaction & collaboration ▪ Informational spillovers between firms. ▪ Etc.	Pure external diseconomies: ▪ Pollution, ▪ Crime, ▪ Traffic, ▪ Etc.
Source: Krugman, P. 1998. "The Role of Geography in Development" Paper prepared for the Annual World Bank Conference on Development Economics, Washington, D.C., April 20–21, 1998.	

These forces of attraction are offset by forces of dispersion known as centrifugal forces (table 2.1). Centrifugal forces include immobile factors of production and/or barriers to consumer

demand; rising land rents and other costs of doing business; as well as pure external diseconomies like pollution, crime, and traffic (Krugman, 1998a). These forces explain the limits to cluster expansion or, in other words, *'why'* we don't all live in one big city. As such centrifugal forces are the basis of the extension argument in the framework used by Maskell and Kebir (2005).

While the externalities perspective emphasizes the importance of centripetal and centrifugal forces in the formation and extension of clusters it also recognizes that other factors, unrelated to externalities, also play a role. Specifically, advantages can be derived from natural and man-made elements including: climate, topographic suitability, proximity to raw materials or transportation routes. When these sort of factors, or the location factors mentioned earlier, play a critical role in an agglomeration they become the most likely reason for *'exhaustion'* of that cluster. In other words, the externalities perspective argues that the depletion of critical factors is what causes a cluster to disappear.

The notion of critical factor depletion is probably easiest to picture with a natural advantage derived from a non-renewable resource. For instance, clusters related to the mining industry will usually be dependent on the viability of the resource being mined locally (e.g. potash, coal, oil). If or when that critical input is used up or becomes uneconomic to extract, the advantage of that location will be significantly undermined. The same effect, however, can be expected when any critical location factor is depleted. For instance, if an agglomeration emerges to access the low cost, abundant labour in a region, the longevity of that agglomeration will be threatened when labour availability disappears and / or labour costs rise.

The externalities literature is usually traced back as far as Alfred Marshall's (1890, 1925) work on localization economies. This occurs for a couple of reasons. First is his observation that firms are linked directly (through exchange relationships) and indirectly (through a shared labour market, service infrastructure, etc.). This distinction between types of linkages formed the theoretic branch for both the competitiveness and externalities perspectives to evolve. The externalities perspective, of course, focuses on the importance of indirect linkages to both the emergence of agglomeration and the capturing of its benefits. It is this focus on indirect linkages

that sets the externalities perspective apart from the competitiveness perspective which emphasizes direct exchange relationships and sustained trade linkages.

The second aspect of Marshall's work that pervades the externalities perspective is the notion of 'mysteries in the air'. This was Marshall's terminology for his third type of localization effect – pure external effects - and refers to the specialized knowledge that emerges around the core business in an area. The basic argument is that over time a unique local ability to understand and develop new ideas associated with local areas of focus can emerge. This can manifest itself in a wide variety of ways (especially the quality of skills development programs, educational systems, etc.) but overall represents a unique business sense or sagacity[7] that can impact the path of future development. This concept is probably best illustrated by the idea that a tradesman's (fisherman, carpenter, etc.) child that grows up exposed to the trade will have a more intuitive and deeper understanding of that trade that someone who simply studied the skills.

As the externalities perspective has continued to evolve the 'mysteries in the air' have become known more as knowledge spillovers or dynamic information externalities. According to the New Economic Geography literature (Krugman, 1991a, 1991b, 1998a, 1998b) as well as the Endogenous Growth literature (Romer, 1990, 1994; Lucas, 1998; Solow, 1994) knowledge spillovers, and other forms of information externalities, are important determinants of long term economic growth. As such, location factors related to knowledge / information appear more important to competitive advantage and overall performance than other location factors (labour force, services and infrastructure). These other location factors simply facilitate the emergence and extension of the cluster while the 'mysteries in the air' influence firm performance.

Even though the importance of knowledge spillovers seems to be pervasive, the literatures are ripe with debate and theories about when, where, how and why dynamic externalities work. In the Marshall-Arrow-Romer (MAR) model of endogenous growth the knowledge flows are attributed with a negative impact on long term growth. Basically the dissemination of ideas through imitation, spying, and mobility of labour without compensation is expected to dissuade

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[7] Sagacity is the quality of being discerning, sound in judgment, and farsighted (wisdom). It directly contrasts the stream of cluster literature that suggests proximity and agglomeration are valuable because they increase the possibility of making radical discoveries; in other words the need to be lucky to be successful.

investment because firms can't be certain they will be able to appropriate the full value of the investment before imitators enter the marketplace (Bekele & Jackson, 2006: 16). Other unresolved debates around dynamic information externalities include: regional knowledge diversity versus specialization; local monopoly of ideas versus local competition for ideas; appropriate geographic limitation of knowledge sharing (local, regional, national, international, etc.); and the importance of knowledge to traditional sectors versus high tech sectors. For the time being these debates will be deferred to subsequent research. What is important to note is that the 'mysteries in the air' are the central focus of the externalities perspective.

In summary, the externalities perspective argues that proximity fosters indirect linkages or an informal network structure amongst the firms in any given location. This indirect linkage is characterized by a shared interest in protecting public goods and developing location factors. It is these location factors, especially the so called 'mysteries in the air', that can enhance the local division of labour (specialization), increase the presence of spillovers, and improve the overall technology development process. All of which are important in shaping each firm's ability to respond to its external environment and remain competitive over the long run.

2.2.3. The Territorial Perspective

The territorial perspective (Granovetter, 1985; Maillat, 1995; Lawson and Lorenz, 1999; Malmberg and Maskell, 2002) argues that proximity leads to a non-economic structure that builds trust, common values, exchange of information and ultimately a collective development process. The collective learning process focuses on how three elements (technology, organization, and territory), taken together, can represent a 'localized initial context without frontier' (Maskell and Kebir, 2005: 8). This perspective is rooted in the innovative milieu approach developed by the GREMI group[8]. It embraces the importance of networks, trust-relations, reciprocal openness, cooperation and collaboration.

Gordon and McCann (2000: 520) describe this perspective, what they call the social network model, as built on the belief that trust-based relationships lead to different behaviour on the part

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[8] GREMI is an acronym for 'Groupe de Recherche Europeen sur les Milieux Innovateurs' or the European Resserach Group on Innovative Milieux formed in 1986 to study the interaction between innovation and localised factors (together termed 'territory') (Maskell & Kebir, 2005: 8).

of individuals or groups of individuals than do market-based relationships (transactions, contracting, etc.) or firm-based relationships (hierarchically organised). Trust-based behaviour enables greater joint risk taking, flexible organisation configuration, and the pursuit of mutually beneficial goals. The distinguishing feature of their social-network model is that it is applied in situations where neither price signals (market) nor monitoring (firm) are sufficient to ensure the success of an activity.

According to Maskell and Kebir, the answer to '*what*' from this perspective includes technology, organization and territory. Territory being the concept around which a certain unity can be developed as all participants share a desire to impact a common future. These three cluster components are brought together by a collective learning process. The learning process is the answer to '*how*' the concepts of technology, organization and territory are linked. An important feature of the collective learning process is that it is bigger than any single participant. This feature precludes large corporations from acting as the unilateral development force in a particular territory, at least as far as this model is concerned. The concepts of technology, organization and territory become linked when three conditions emerge:

- A set of independent agents, capable of strategically managing material and immaterial resources, is present. Implicit in this, is that each agent brings something of value to the table.
- The agents have some capacity or experience among them at learning and adapting to a changing environment. The collective learning process requires some skills and will not commence until they are present.
- Finally, the agents must be open to working with others (cooperation, collaboration, networking, etc.) in pursuit of group benefits. Not all agents or operating contexts permit this sort of organization logic or philosophy. (Maillat, Quevit and Senn, 1993 as cited in Maskell and Kebir, 2005: 8)

Together the '*what*' and the '*how*' describe a cluster defined by a set of agents who believe they share a common development trajectory which they can influence by working together.

The territorial perspective is further explained and justified by the *existence, extension* and *exhaustion* arguments. The existence argument states that the initial set of relationships develops

spontaneously. The spontaneity of these relationships doesn't necessarily imply that a magical 'poof' leads to their creation but rather that their emergence is the result of a complex combination of motivation and timing. There are a limitless number of reasons why any agent will arrive at the necessary combination of philosophy and skills. Arriving at this combination will foster a motivation that is irrelevant if no other agents share that motivation at that particular time. Hence, in the face of daunting odds the initial set of relationships appears to emerge spontaneously.

The existence argument further states that when the collective learning process does emerge it is rooted in the promise of uncertainty reducing mechanisms associated with non-market relationships. Maskell and Kebir (2005: 8) specifically identify the potential for developing: trust-relations, reciprocal openness, lower risk of unilateral appropriation, mutual acquaintance, collaboration, dissemination and exchange of information, know-how and networks for innovation.

The extension argument addresses how the set of relationships and development trajectory evolve. As the agents pursue their common vision by working together on a variety of projects they develop relational capital. The concept of relational capital incorporates non-monetary resources, such as local value sets (entrepreneurial, family, professional, etc.) into the collective learning process. It is believed that relational capital acts as a motivator (or disincentive) to ongoing participation in the collective development process. It essentially identifies which actors are participants in the localized coordination system by defining the non-market value of their contributions.

The exhaustion argument emphasizes the negative impact that individual interests can have on the collective development process. When individual interests out-weigh community interests the motivation to work together dissipates. In particular, opportunistic behaviour can immediately undermine the trust necessary for the collective development process.

In summary, the territorial perspective argues that proximity spontaneously leads to a non-economic structure that builds trust, common values, exchange of information and ultimately a

collective development process. Non-market relationships lead to different behaviours by cluster agents than market or firm-based relationships would. These behaviours foster an environment and culture characterized by trust and cooperation. This environment is viewed as necessary to the pursuit of a limitless frontier that can only be achieved by emphasizing the synergies of the collective over the interests of the individual.

2.2.4. Empirical Evidence in Cluster Literature

As stated earlier the previous sections are a review of the three lines of inquiry that Maskell and Kebir discuss in their initial application of the deductive framework. The emphasis is understandably on a limited number of works that serve to shape our conceptual understanding of the clustering phenomenon. This tends to ignore a large body of empirical work that seeks to operationalize the conceptual understanding of clusters. Much of this empirical work employs an inductive approach that proves valuable for demonstrating the many ways in which clusters' manifest themselves in unique processes, tools, mechanisms, entities and phenomena important to localized competitive advantages. Essentially this body of work describes the inner workings of a cluster. This empirical body of the literature has investigated items as varied as: start-ups, spin-offs and spin-ins; patents, licensing and other forms of codified knowledge; high quality personnel and scientific stars; urban amenities; the density and centrality of networks; and the relative concentration of employees.

In some instances the emphasis has been on showing how prevalent the clustering phenomenon is. Malmberg and Maskell (2002) describe several of these studies which use industry level statistics to demonstrate high and rising levels of agglomeration in a variety of industries. These studies included: Krugman's (1991a) analysis of 106 industries across the US; Enright's (1993) investigation of the forces that shape the agglomeration found by Krugman (1991a); Malmberg and Maskells's (1997) review of industrial agglomeration in Nordic countries over a twenty-year period; Isaksen's (1996) use of a location quotient to demonstrate the local labour market agglomeration in Norwegian industries; and Head, Ries and Swenson (1995) study of the location decisions of 751 US-based, Japanese production facilities. All of these projects were able to demonstrate the existence of agglomeration and as Malmberg and Maskell (2002: 436) say,

"[show] support for maintaining the thesis that spatial cluster[ing] at the industry level is a widespread enough phenomenon to justify further study."

In other instances the empirical research focused on observing the different types of activity associated with agglomeration. Buenstorf and Fornahl (2006) note a number of studies that focus on the role of spin-offs within emerging clusters including examples, "for industries as diverse as the semiconductor industry (Moore and Davis, 2004), the U.S. automobile industry (Klepper, 2004), the U.S. tire industry (Buenstorf and Klepper, 2005) and the Italian plastics district of Correggio (Patrucco, 2005)." Clayman and Halbrook (2004) cast spin-offs as an indicator of a healthy research and innovation sector, especially in the biotechnology and health care industries.

Malmberg and Maskell (2002: 437) note that, "when empirical research showed that firms in a localized cluster did not conduct much business together…" the study of business to business linkages gave way to the study of knowledge spillovers. Within this context, Bekele and Jackson (2000: 8) note, "several studies highlight the strong presence of social networks, inter-personal relations, face-to-face encounters, casual or tacit information flows, and culture (norms of trust and reciprocity) among local actors as invaluable assets for their success (Piore and Sabel, 1984; Pyke, Becattini and Syngberger, 1990; Lawson and Lorenz, 1999; Malmberg and Maskell, 2002). This literature includes the observation of codified knowledge like patents, citations and licensing (Jaffe, Trajtenberg and Henderson, 1993; Phillips and Ryan, 2003) as well as a focus on people as a vector of knowledge, information and skill. For instance, Zucker, Darby and Armstrong (1998) relate the positive impact of local universities on firm growth to a formal exchange between star scientists and the companies. These formal exchanges take a number of forms that revolve around direct employment or advisory services, joint-authorship of articles and patenting activity.

Storper and Venables (2002) attempt to push our understanding of knowledge spillovers beyond the notion of interaction measured by joint-publishing or citations. They suggest that face-to-face contact is the causal mechanism that determines the effectiveness of interaction and thus the degree of knowledge spillover or transfer. These authors base their argument on the fact that, "face-to-face communication is not just an exchange; it is a *performance*, where speech and other kinds of actions, and context, all come together to communicate in a very complex way on many

different levels at the same time." (Storper and Venables, 2002: 14-15). This work implies there is a varying quality to interaction. Simply bringing companies, their employees, local scientists, consultants and other support agents into contact does not guarantee the benefits of agglomeration.

Florida (2001, 2002a, 2002b) utilized a number of indices to measure aspects of local culture like diversity and openness (see also Gertler et al., 2002). In doing so, he was testing if the attraction power of a certain set of local amenities (those attractive to the bohemia or 'creative' class) was related to the clustering of 'talent' and technology-based industry. The hypothesis is that in building the type of tolerant and diverse environment that attracts Bohemians, a region will also be creating an environment attractive to the type of skilled (educated) employees associated with innovative, technology-based industries. In a critique of this work, Glaeser (2004) shows that the education or human capital variable accounts for the vast majority of the relationship to growth in population, not the Bohemian index or agglomeration of artistic types that it measures. Nonetheless, the discussion around the role of local diversity and 'creativity' in relation to human capital and local growth remains an interesting topic.

The type of culture that Florida attempts to measure is not the same type of culture that Saxenian (1990, 1994) describes in her accounts of agglomeration in Silicon Valley and Route 128. The Saxenian culture is that of entrepreneurialism and decentralized, flexible and specialized manufacturing. This culture is all about complex supplier and subcontracting relationships; regional institutions like trade associations, specialized consultants and venture capital; and a variety of networks that all help socialize the costs and risks associated with the regional production system. In their analysis of such network systems, Procyshyn, Ryan and Phillips (2003) were able to use social network analysis techniques to measure the network structure of a cluster in order to explain how it operates as an invisible highway upon which knowledge and information can flow.

While each of these initiatives can be critiqued as to their appropriateness and effectiveness, they have all helped push the literature toward identifying the most relevant concepts and work toward making them more concrete and measurable. The variation within the empirical literature reflects

the different theoretical perspectives discussed earlier. Storper and Venables (2002) describe the topics of interest as: (1) backward and forward linkages, including access to markets (think competitiveness perspective), (2) the clustering of workers (think externalities perspective), and (3) localized interactions which promote technological innovation (think territorial perspective). Observations of backward and forward linkages tend to measure agglomeration of competitors, suppliers and customers as well as the agglomeration of different types of complex interactions amongst these players (e.g. subcontracting, cross-licensing, and spin-offs). Observing clustered workers entails a look at agglomeration and specialization amongst the workforce (e.g. presence of consultants) as well as the concentration of other assets that enhance or unleash the skill of these workers (e.g. universities, research facilities, and local amenities). The investigation of localized interactions places a greater emphasis on abstract or intangible facets of clustering like face-to-face interaction, knowledge exchange and networking. Operationalizing these factors is done via proxies such as patents, collaborations, and association memberships. The breadth of the empirical body of literature demonstrates the complexity of the cluster phenomenon and thus the need to use multiple measurement instruments to gain quality insight.

Despite defining a wide variety of ways to observe the phenomenon, the empirical literature struggles to move beyond the individual input-output mechanisms of industrial clustering. In a limited number of instances researchers have engaged in the behavioural modelling that defines and tests the causal pathways that could better explain how clusters might be influenced or even managed. Subsequent research will benefit from a greater focus on pulling the underlying concepts and phenomena together to paint a comprehensive picture of the different theoretical perspectives on clustering.

2.2.5. Observations on the Cluster Literature

To quickly summarize, the assessment of cluster literature as being fuzzy is accurate in so much as it refers to a lack of boundaries between the three perspectives that Maskell and Kebir have identified. By not explicitly separating the three lines of enquiry at the outset, much of the literature has tended to observe individual mechanisms and sub-phenomena without helping to prove / disprove the general laws and principles that define this enormously complex phenomenon.

By deploying the theory building framework, Maskell and Kebir have begun the process of deductively disentangling three different applications or explanations of the cluster phenomenon (table 2.3). The three perspectives can be distinguished according to their focus on different types of benefits. The competitiveness perspective focuses on traded benefits; the sort of win-win exchanges that occur amongst members of a value chain and are enhanced, over time, by proximity. The externalities perspective emphasizes untraded benefits or spillovers that can only be accessed via geographic proximity and thus serve as a localized competitive advantage. The territorial perspective focuses on extra-economic benefits -- those that are generated by an investment of trust and relational capital, not money.

Table 2.3: The Cluster Perspectives Unpacked

		Competitiveness Perspective	Externalities Perspective	Territorial Perspective
What?		Value Chain Agents	Externalities: location factors, public goods and the stock of ideas	Local knowledge pool, Technology, Organization, and Territory
How?		Forward, Backward & Horizontal trade linkages	Untraded interdependencies, dynamic externalities, know-how	Collective learning process
Why?	**Existence**	Benefit dispersion (rapid & complete)	Centripetal forces	Local relationship building
	Extension	Cost-benefit comparison	Centrifugal forces	Relational capital, local value sets
	Exhaustion	Ebbing rivalry, regulatory inflexibility, etc.	Critical factor depletion	Individual interests, opportunistic behaviour

The different benefits associated with each perspective imply unique implications for the phenomenon. The competitiveness perspective, with its emphasis on business-to-business interactions and value chain linkages, casts the cluster phenomenon as a valuable tool in the primary, production-based marketplace that we associated with all of the goods and services of today's capitalist society. In this perspective the cluster is a tool for achieving economies of scale and scope without assuming the cost/risk of integration. The externalities perspective places a

greater emphasis on the relationship between organizations and the secondary or periphery marketplace that supports and sustains the capitalist economy through mechanism such as labour force development, applied research and development, and the provision of specialized services. In this perspective, the cluster is cast as a tool for developing and deploying the public goods and local assets that enable organizations to be the best they can be. The territorial perspective looks at an entirely different marketplace: the social market, where exchange is governed by intrinsic human needs, not the laws of capitalist markets. In this perspective, clusters are cast as an economic community where trust, common values and relational capital are used to drive a collective development process that brings organizations and technology together in pursuit of a limitless frontier.

While the separation of these perspectives is an important step toward conceptual clarity it is important to note that in practice none of these perspectives can realistically be separated from the others. Every location will find some form of formal business to business linkages alongside informal links to local public goods as well as a some higher form of motivation (higher than economic motives) to push the local community toward a limitless frontier. However, making the distinction between the different perspectives and their underlying relational mechanisms creates the opportunity to investigate the causal mechanisms and behavioural models with more clarity and simplicity so as to prove / disprove our understating of when, where and to whom clustering is relevant.

2.3.   Operational Context: the strategic relevance of clusters

Maskell and Kebir (2005) did not fully employ the theory building framework. They limit themselves to addressing the building blocks of: what, how and why (including the three key arguments of existence, extension, and exhaustion). They stop short of answering the questions when/where/who, which are necessary for establishing the context for each perspective. In limiting themselves, Maskell and Kebir recognize the importance of getting the theory right (or close to right) before beginning to apply it in real world contexts where 'shades of grey' tend to rule over the simplified modeling preferred by the academic community. To this end, Maskell and Kebir suggest the academic community focus on building a consensus around the proposed cluster concepts (what), relationships (how) and theoretic arguments (why) while avoiding the

questions of relevant context which hold the potential to muddy the conceptual clarity with real world 'exceptions to the rule' and hybrid models.

In contrast to this approach, it is this author's view that addressing the context and limits of each cluster perspective is absolutely critical to minimizing the 'conflating' of ideas and creating the desired conceptual clarity. By answering the questions of when, where and to whom each cluster perspective is relevant, one is able to use the framework to further disentangle the perspectives by defining when each must yield to the others. As the relevant context is defined it anchors each perspective in real world circumstances that help illustrate the fundamental principles and inherent reasoning behind agglomeration. By considering what clusters are associated with in practice, it becomes possible to define clear boundaries between each perspective.

Addressing the question of cluster relevance, at least in terms of 'who', raises the issue of the appropriate unit of observation in cluster studies. Some have argued that clusters are most relevant to individuals. Florida (2002a) suggests that clusters foster amenities that attract the best and brightest workers in the labour the force. Others argue that clusters are most relevant to some form of a collective. In particular, the innovation systems approach (Lundvall, 1992; Nelson, 1993; Cooke, 1998) suggests clustering is beneficial to either the regional innovation system as a whole or the national innovation system as a whole.

While the benefits of clusters might accrue on a number of levels, this project focuses on the firm because of its central role in deploying economic resources and contributing to economic activity. Even amongst those who focus on the relevance of clusters to firms there is debate about how those firms should be observed. For instance, some argue that the large multinational firm should be broken into smaller business units to more accurately reveal its strategic decisions and actions. Others prefer to segment firms according to size; arguing that small and medium sized firms have a different impact on economic growth (e.g. via innovation) than do large multinational firms (e.g. via foreign direct investment and technology transfer). For the time being, this project defers these debates to subsequent research and instead focuses on how broader theories of firm management can illustrate the context (when, where and to whom) in which each perspective on clustering is relevant.

Management literature can be cast in a simple framework where strategy is the causal variable and performance is the dependent variable. Strategy, in general, represents some form of intentional action taken to maximize strengths and opportunities while minimizing weaknesses and threats in order to create and sustain competitive advantage (Barney, 1995: 49). Performance is some measure of whether or not a firm has achieved its purpose and the related objectives. Depending on perspective, the purpose of a firm may range from creating value for the owners, satisfying the customer, maximizing employment, achieving high levels of profitability, or a combination of all of these. The objective of management science, within this simple framework, is to explain the difference between firms that "have the occasional stroke of genius or lucky break" and those that "over time consistently make their businesses succeed" (Bossidy and Charan, 2004: 4). In practice, those who achieve consistent success are said to have 'business savvy'. The concept of business savvy, as explained by Bossidy and Charan (2004), is the process of developing and implementing effective firm strategy. Thus, explaining the operational context of firms requires understanding how strategy is managed.

Figure 2.1 illustrates a framework to explain strategic management. It demonstrates that firm performance is a function of firm strategy. As stated previously, performance can take several forms (financial, operational, and strategic) depending on how the firm defines its purpose and objectives. Also implicit in figure 2.2.1 is that strategy is a function of both internal (competitive advantages) and external elements (competitive position). The commonly used SWOT tool was established for the analysis of these internal and external elements. The SWOT tool allows managers to identify internal strengths and weaknesses and external opportunities and threats. The segregation of the firm into internal and external elements has led to the emergence of two separate literature streams: the product-based view (PBV) of the firm and the resource-based view (RBV) of the firm. Each view, respectively, focuses on either the external or internal determinants of strategy.

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          EXTERNAL
      (Competitive Position)
         (Environment)

                                              PERFORMANCE
                                                ▪ Financial
   INTERNAL    ───▶  STRATEGY  ▷▷▶             ▪ Operational
(Competitive Advantage)                         ▪ Strategic
(Resources & Competencies)

          OTHER
   (Mission/Vision/Objectives)
      (Stakeholder Preferences)
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Adapted from: Woodcock, P. and P. Beamish. 2003. *Concepts in Strategic Management*; 6th ed. Toronto: McGraw-Hill Ryerson.
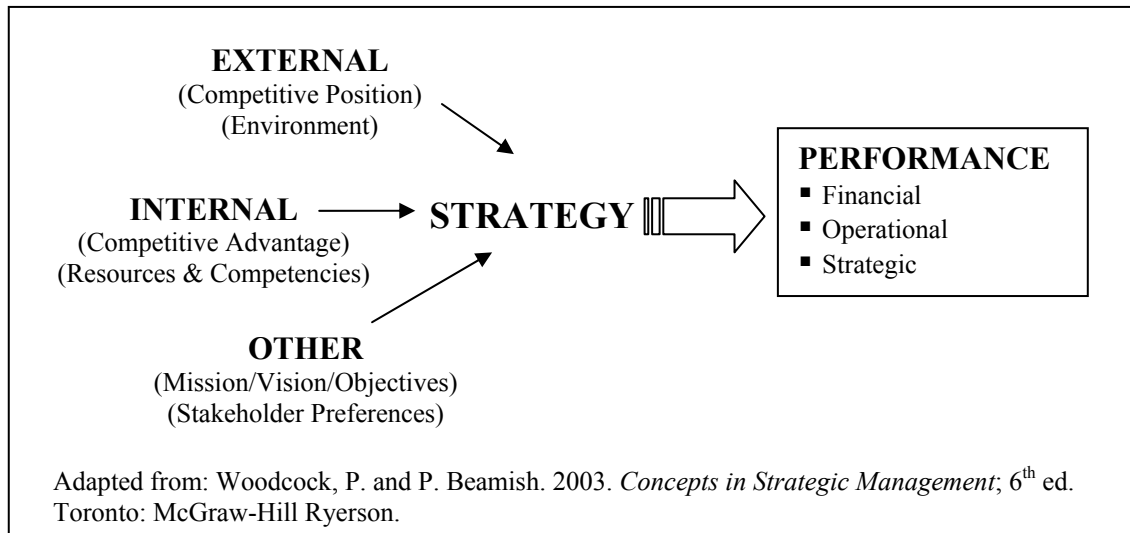
Figure 2.1: Strategic Management Framework

2.3.1. The Product-based view of Management

Much of the earliest literature focused on the external elements that impact firm performance. This stream of the literature is known as the product-based view of the firm (Porter, 1985, 1990, 1998a, 1998b). The strategic objective in the PBV is to dominate in a product or service market. Firms are able to dominate when they have the best understanding of the industry, particularly the opportunities and threats that are emerging. This perspective is demand focused; firms are challenged to identify changes in consumer tastes and preferences and respond to exogenous economic shocks (e.g. the OPEC oil shock spurred a market for smaller, fuel efficient automobiles). Only after a firm has analysed the competitive environment are its resources selected and capabilities developed. The PBV of strategy asks what it is that the firm must do to dominate in its selected industry. Pursuit of these answers is expected to generate the most desirable internal configuration.

The PBV asserts that every industry has a unique structure and that this structure makes each industry more or less attractive. The most attractive industries present the most opportunities with the fewest threats (opportunities imply revenue and threats imply a cost to firms). Porter (1985: 5) defines industry structure as "… the underlying economic and technical characteristics of an industry" and argues that these characteristics generate 'rules of competition' which in turn define an industry's attractiveness. Porter (1985: 4) states that "competitive strategy grows out of a sophisticated understanding of the rules of competition…" and that the ultimate objective of

strategy is "… to cope with and, ideally, to change those rules in the firm's favour." As a result, the PBV of strategy is focused on the external environment of the firm and is primarily reactive in nature. Strategy is essentially a rules-based response to the changes of a dynamic marketplace.

In an effort to improve analysis of industrial structure, Porter (1985: 5) introduced the 'Five Competitive forces that determine Industry Profitability': threat of new entrants; threat of substitute products (services); bargaining power of suppliers; bargaining power of buyers; and rivalry among existing firms. The importance of each of these forces varies from one industry to the next but the purpose of the framework is to enable each firm to "see through the complexity and pinpoint those factors that are critical to competition in its industry, as well as to identify those strategic innovations that would most improve the industry's – and its own- profitability" (Porter, 1985: 7). Understanding the forces allows firms to appropriately position themselves for the greatest opportunity to succeed. Porter further argues that the framework fosters innovation in strategic management by directing creative efforts to those aspects of an industrial structure that are most important to profitability. In this sense, the PBV suggests that innovation occurs as a response to demand.

In addition to the Five Forces model, Porter uses the concepts of value, value activities, value chains, and value systems to explain the interface between industry structure and internal firm elements. Porter (1985: 38) defines value as "… the amount buyers are willing to pay for what a firm provides them." The value of an entire industry, also referred to as industry attractiveness, reflects the collective actions of all actors in that industry. The actions of individual firms can either increase or decrease a buyer's willingness to pay but ultimately all actions and actors are interconnected. Porter describes a value system in which every industry actor represents a collection of activities that create value. He describes these collections of value activities as value chains. Porter argues that each activity is associated with a different level of value and cost. The difference between total value and collective cost is known as margin. (Porter, 1985: 38) The PBV argues that firms compete to maximize their margin. The most successful firms are those that understand which activities are high value and how certain activities can work together to increase margin. The ideal configuration of a firm maximizes the complimentarity between all of its activities. Porter asserts that each firm is unique in the way it combines value activities; their

uniqueness is a reflection of their knowledge of the industrial structure and rules of competition. Hence, the strategic objective of the PBV is to effectively design a firm's products and activities to maximize the gap between production cost and customer's willingness-to-pay.

Porter's five forces model and value chain approach are effective concepts in explaining how firms can compete better. The PBV argues that knowledge of the industry structure and rules of competition determine how firms choose their internal structure. There are a vast number of activities that add value throughout an industrial value system; as a result, there are an endless number of permutations and combinations that generate unique competitive results. The firm that can harmonize its knowledge of the industrial structure with its value activities will successfully achieve its desired competitive position.

In striving for the sort of value chain efficiency where costs can be driven down while revenues are increased, each firm must navigate the complexity of interconnected actors, complementary activities and competitive positioning. It is in this game of constant jockeying for position and brokering for support that clustering becomes relevant.

2.3.2. The Resource-based view of Management

The resource-based view (RBV) focuses on the internal elements of a firm and emerged in contrast to the PBV. In the resource-based perspective a firm first looks inside to answer the question 'does the firm have what it takes to be number one?' This perspective recognizes that firms evolve over time and there are times within a firm's lifecycle that are better suited to pursuing dominant market positions. In contrast, the PBV identifies only one desirable competitive position for a firm: that of dominance. The contrast between these views establishes a 'chicken or egg' argument; does an external focus (PBV) generate the ideal internal structure or does a meticulous focus on the internal structure (RBV) generate desirable external accomplishments? The answer to this question is less important than the connection it underscores between a firm's internal and external environment. A successful strategy in either of the views will require some knowledge of the counterparts, whether those are external or internal attributes.

The underlying principle in the resource-based view was introduced by Penrose (1959) when she described the firm as "… an evolving collection of resources" (Rugman and Verbeke, 2002: 769), suggesting that over time firms will change because of their ability to learn or acquire new resources and capabilities. The strategic goal, from the perspective of the RBV, is to secure the factors required to build core competencies. Core competencies become the basis for establishing and maintaining competitive advantage. Strategically, those firms that do not develop their resources and capabilities will fall behind and ultimately fail. Thus the long run focus of the RBV means that innovation is pursued proactively in an effort to disrupt the market in favour of the innovative firm. In contrast, firms competing from the PBV consider innovation as an incremental process, necessary only to react to the changing needs of the market. This is not to say that the RBV pushes innovation to the marketplace but rather that it seeks to anticipate the changing needs of the market rather than simply react to them.

The RBV of the firm argues that changing demand factors and exogenous economic shocks are not inherently good or bad. Threats and opportunities are a function of a firm's internal capability. Core competence or incompetence determines whether or not an external event or element becomes a threat or an opportunity for a firm. For example, it was the design and marketing capabilities' of Japanese automakers that allowed them to do a better job of responding to the OPEC oil shock, thus turning what was a threat to North American automakers into an opportunity for themselves. For this reason, the RBV argues that competitive advantage is derived from a firm's internal attributes. Barney (1995: 50) identifies four categories of resources and capabilities (table 2.4): financial, human, organisational, and physical. Firms theoretically possess assets and liabilities in each of these categories. The RBV of strategy suggests that the firm has direct control over the possession, maintenance, and development of all of these assets/liabilities and must take the initiative to utilize each.

Table 2.4: Types of Resources and Capabilities

Asset	Examples
Financial resources	Debt, Equity, retained earnings, etc.
Human resources	Experience, knowledge, judgement, risk-taking propensity, and wisdom of individuals associated with the firm
Organisational resources	History, relationships, trust, and culture attributed to groups of individuals; as well as, formal reporting structure, management control systems, compensation policies.
Physical resources	Machines, manufacturing facilities, and buildings.
Barney, J. 1995. "Looking inside for competitive advantage" *Academy of Management Executive* 9 (4).	

As stated earlier, the primary goal in the RBV is to secure the resources required to build competencies. Competencies in turn become the basis of a firm's competitive advantage. Barney (1991, 1995) identified four characteristics of resources that are necessary for sustainable competitive advantages to emerge. Resources must be valuable, rare, inimitable, and optimally organized. Resources and capabilities are valuable when they enable a firm "… to exploit opportunities and/or neutralize threats" (Barney, 1995: 50). In addition to this, the value of resources or capabilities continually changes in conjunction with customers' tastes, industry structure and technology. Barney (1995: 52) suggests that Porter's five forces model is valuable in "… isolating potential opportunities and threats that the resources a firm controls can exploit or neutralize."

Despite being valuable, resources may fail to provide a competitive advantage if they are not rare. If most competitors can access a similar valuable resource no one will retain an advantage. However, even when valuable resources are common they remain important to competition. Without the valuable resource a firm would be at a disadvantage. When firms possess a valuable resource that is also rare they must find ways to protect their advantage. Hence the characteristic of imitability becomes important to achieving a sustained competitive advantage.

Firms must find ways to keep competitors from duplicating the valuable, rare resource or substituting a strategically equivalent resource. Barney identifies three ways in which resources become more difficult to imitate. When resources develop under unique historical conditions they can come to reflect the unique personality, experience, and relationships of the firm.

Alternatively, resources or capabilities may incorporate an intricate web of many small decisions. The individual decision may not be difficult to imitate but the fact that they are so minor makes them 'invisible' to other firms and thus impossible to imitate. Finally, resources based on social complexity are more difficult to replicate than standard physical resources commonly protected by patents. Reverse engineering can quickly solve the mysteries of physical resources but is ineffective against "… organizational phenomena like reputation, trust, friendship, teamwork and culture" (Barney, 1995: 55).

A resource that is simultaneously valuable, rare and inimitable tends to provide a sustained competitive advantage. However, this is not always the case. Barney (1995) discusses the inability of Xerox to successfully commercialize several technological innovations that can now be considered valuable (current market values are large), rare (developed in house), and inimitable (the technological complexity presented large costs to imitate these innovations). The technological innovations include: "the personal computer, the mouse, windows-type software, the laser printer, the paperless office, Ethernet, and so forth" (Barney, 1995: 57). The inability of valuable, rare and costly-to-imitate resources to generate a competitive advantage is attributed to systemic failures within the organisation. Barney (1995) refers to organisational components (formal reporting structure, management control systems, compensation policies, etc.) as complementary resources. On their own these components have a limited ability to contribute to competitive advantage but together they enable firms to fully utilize valuable, rare and costly-to-imitate resources. In the case of Xerox, there was little or no incentive for management to commercialize new technology. The new product commercialization process was onerous, compensation was built on maximizing current revenue not developing new markets, and there was no communication between Xerox PARC[9] scientists and Xerox management. Together these organizational components reflect more of a product-based view of the firm than the learning and innovating view presented by the resource-based view and ultimately led to missed opportunities on the part of Xerox. The short comings of Xerox reflects the RBV that a product (or service) focus (PBV) will lead a firm to compete for short term competitive position to the neglect of longer term learning, adaptation and innovation.

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[9] Xerox PARC (Palo Alto Research Centre) is a subsidiary of Xerox that conducts scientific research with the intention of generating innovative commercial products and services. See http://www.parc.xerox.com/ for more information.

At the core of the RBV is the assumption that developing, controlling and ultimately combining resources and capabilities into novel products, processes and services can provide a greater return than constantly jockeying positions in pursuit of incremental increases in efficiency or market share as in the PBV. In this way, the RBV is much more interested in assuming the risk and cost of creating markets than the PBV is. Rugman and Verbeke (2002: 771) observe: "The resource-based view of the firm implies that firms pursue disequilibrium (monopolistic advantages) through 'a process of Schumpterian competition[10], path dependencies, first-mover advantages, irreversible commitments and [use of] complementary or co-specialized [resources]'." Firms with this focus on innovation and market-making require access to a diverse set of resources and the capability to engineer or interface these building blocks to create new products, processes and services. These firms also need ways to ensure their novel creations remain valuable, rare, and inimitable. Finally, the operation has to be optimally organized to maximize the market returns of innovation. From the resource-based perspective, industrial clustering is strategically relevant for the ways in which it can support the process of innovation and market-making.

2.3.3. The Knowledge-based view of Management
With innovation becoming a focus of firm performance and strategy the concept of knowledge has risen in importance. Both the product-based view and resource-based view of management have attempted to incorporate the concept into their explanations of firm management. In the case of the product-based view, the unique characteristics of knowledge (non-rivalry and non-excludability) are seen as valuable factors in shifting the 'rules of engagement'. From the resource-based view, knowledge is considered the most "… important productive **resource** in terms of market value and the primary source of Ricardian rents" (Grant, 2002: 136). This raises some question as to whether or not knowledge-based arguments are an extension of the existing views on management (product-based vs. resource-based) or if they represent an entirely new perspective on management of the firm.

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[10] Joseph Schumpeter introduced a comprehensive definition of innovation that is widely utilized. He describes 5 types of innovation: "… i) introduction of a new product or a qualitative change in a existing product; ii) process innovation new to an industry; iii) the opening of a new market; iv) development of new sources of supply for raw materials or other inputs; v) changes in industrial organization." (Padmore and Gibson, 1998: 5)

On this, Grant (2002: 135) argues that the knowledge-based view is not a theory of the firm but rather a collection of "ideas about the existence and nature of the firm that emphasize the role of knowledge." This argument is accurate in so much as it draws attention to the fact that the knowledge-based perspective is much less developed than the competing perspectives. However, it fails to acknowledge the fundamentally different assumptions that drive the knowledge-based perspective compared to either the product-based view or the resource-based view. For instance, in the product-based view a firm's strategic decisions are driven by an external focus where it asks how it stands relative to its competitors and how it can positions itself to be most successful. From the resource-based perspective a firm's strategy is driven by an internal focus where the objective is not to simply out perform the competitor but rather to continuously improve at the personal mission of engineering novel products, services and processes valued by the marketplace. In contrast to both of these perspectives, the knowledge-based view of firm management does NOT assume either an internal or external focus as the driver of strategic decisions. Rather, knowledge-based arguments begin with a focus on expanding the knowledge frontier so as to drive the creation of wealth. Even though these efforts to create knowledge can draw a firm's focus into external and internal aspects of performance, the firm continues to make its strategic choices according to knowledge requirements and not competitive positioning or product/service development. For this reason this project will treat the knowledge-based view of the firm as a third perspective on firm management.

Before expounding on the strategic implications of knowledge; it is necessary to review the characteristics of knowledge that make it the most valuable factor of production. Knowledge is non-rivalrous meaning once it has been created it can be reproduced at virtually no additional cost. Knowledge is thus a virtually infinite resource once a firm has created it. This resource becomes especially valuable when the laws of scale are applied. The low (or zero) marginal cost of reproducing the knowledge means that increasing returns to scale apply to its production. There are several strategic implications to non-rivalry. First, any effort to maximize the return from knowledge will first seek to minimize the fixed cost of producing that knowledge. Once knowledge is created and protected, it must be applied as widely as possible to ensure that the benefits of scale are maximized and all returns are captured. In addition to returns from scale, knowledge can be adapted to and applied across a wide number of industries and applications.

Thus a firm must also manage its knowledge assets to maximize returns from economies of scope.

In addition to being non-rivalrous, knowledge is not entirely excludable. This means that it is difficult to stop others from accessing knowledge once it has been created. Knowledge is thus valued by society for its spillover effect. Once created it is inevitable that the benefits from new knowledge will spread. Strategically, this poses a problem for firms trying to maintain any advantage based on knowledge. Firms must find ways to keep their competitors from accessing and reproducing the knowledge resource. The non-excludability of knowledge is thus believed to act as a disincentive to firm investment in knowledge development.

The conflict between non-rivalry (the vast potential market value of new knowledge) and non-excludability (the risk of not being able to capture that value) introduces what has been referred to as a "... dichotomy of knowledge-based activity in the economy." (Grant, 2002: 136). There are activities related to increasing the stock of knowledge – what March (1991) refers to as exploration – and activities related to deploying knowledge in the form of goods and services – what March (1991) refers to as exploitation (Grant, 2002: 136).[11] Exploration (knowledge creation) is a human process and as such subject to the limits of human performance. In order to maximize exploration efficiency individuals specialize (Grant, 2002: 136). In practice the exploration process is most commonly associated with scientific research and experimentation activities. Exploitation, on the other hand, requires a diversity of knowledge because products and services are comprised of many pieces of knowledge. In practice, the integration of knowledge can be thought of as the developmental and deployment activities that turn the results of basic and applied research into a saleable or exchangeable item.

Based on this dichotomy of knowledge-based activity, Grant (2002: 136) argues that firms competing from a knowledge-based strategy rely on "... some process of knowledge integration that permits individuals to apply their specialized knowledge to the production of goods and services while preserving efficiencies of specialization in knowledge acquisition (Demsetz,

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[11] See also Spender (1992) for work on knowledge generation and knowledge application.

1991)." In other words, these research intensive firms rely on strategy to strike a balance between expanding the knowledge frontier and being rewarded for doing so.

With this argument Grant is essentially expanding the dichotomy of knowledge-based activity to include integration as well as exploration and exploitation. To better illustrate this third dimension of knowledge-based activity Grant (2002: 138-139) describes several integration mechanisms that minimize the costs of communication and learning:

- *Rules and directive*s – impersonal approaches to coordination (e.g. plans, schedules, forecasts, rules, policies and procedures, standardized information and communication systems).
- *Sequencing* – time-patterned sequences where each specialist's input occurs independently during an assigned time slot.
- *Routines* – complex patterns of behaviour that function in an automatic fashion in response to a small number of signals or choices (Winter, 1987: 165).
- *Group problem solving and decision making* – high-interaction, non-standardized coordination mechanisms used when there are is a high degree of task complexity and task uncertainty (e.g. meetings).

The successful use of these integration mechanisms requires that the individuals participating have some form of common knowledge between them. As Brown and Duguid (2000) observe, it can be difficult to get knowledge to move unless people share the relevant skill, craft or practice. Common knowledge comes in the form of shared language, symbolic communication (literacy, numeracy, etc.), specialized concepts (jargon), shared meaning (metaphor, analogy, and story telling), and a recognition of individual knowledge domains.

To illustrate how commonalities amongst individuals enable knowledge to flow Brown and Duguid (2000) draw a contrast between 'communities of practice' and 'networks of practice'. Communities of practice are small, tight-knit groups of people that work together (e.g. a team of scientists). By virtue of frequent interaction, direct communication, collaboration and the sharing of insights and judgements, these individuals find it relatively easy to circulate new ideas within the group. However, getting ideas out of the community can be substantially more difficult because outsiders do not understand the shared practice. For this reason Brown and Duguid

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(2000: 29) argue that firms exist to provide, "… formal links, joining diverse communities into a coupled system for getting work done and, in particular, for promoting new ideas into marketable products or services."

Networks of practice, on the other hand, are comprised of individuals that engage in the same or very similar practice but do not necessarily work together (e.g. a professional association of accountants). The common practice amongst these individuals confers a degree of insight and implicit understanding that also enables knowledge and ideas to circulate. In networks of practice the ideas are transmitted via indirect communications (e.g. professional newsletters, journals, and conferences). The most important implication of networks of practice is that they become an outlet for knowledge flows when information and ideas cease to flow between the communities of practice that make up a company. The denser these networks are, the more fluidly knowledge can flow. In the case of industrial clustering, the density of these networks can be increased to the point where local networks of practice function much like communities of practice. This essentially means that clusters facilitate the integration of knowledge by providing alternate pathways of shared practice upon which ideas can flow.

While the integration mechanisms and the concept of common knowledge are important to operationalizing the knowledge-based view of strategic management, they also illustrate how the knowledge-based view tends to overlap with strategic tactics and practices associated with the other views on management. For instance, the impersonal approach to coordination associated with rules and directives (e.g. schedules, forecasts, and standardized information) could easily be construed as a product-based response to managing the external environment. Similarly, the sequenced input of different specialists can be considered a resourced-based response to producing new products and services by developing novel combinations of resources and capabilities. This conceptual overlap occurs because knowledge serves some function in all of the management perspectives.

The implication of this overlap is that it can be challenging to distinguish the less developed knowledge-based view of management from the product-based and resource-based views. This distinction is best made by recognizing the unique strategic implications of knowledge within

each perspective. In the product-based view, knowledge is simply one of several factors of production that a firm must seek to control so as to optimize its competitive position. In this view the many forms of knowledge (e.g. knowledge of competitor's actions, fluctuations in demand or changes in supply capacity) can be given a value and traded like land, labour, or capital. From the resource-based perspective knowledge is like any other resource or capability in that is only one ingredient in the recipe for competencies and incompetencies that define a firm's competitive advantage. Like the other resources (financial, physical, human, etc.), knowledge can be developed over time and reconfigured with other resources to help a firm achieve its changing objectives. From the knowledge-based view, knowledge is elevated beyond the level of common inputs or resources. Knowledge is treated as the catalyst of value creation within the firm. In this role, knowledge can be applied to the external environment and the associated factors of production to impact competitive positioning; or it can be used to drive the internal development of resources and capabilities. However, it does not matter if knowledge is used externally or internally, the strategic objective is always to create wealth by expanding the knowledge frontier.

The most fundamental principle behind the knowledge-based view of firm management is that value is derived from the creation and application of knowledge. Firms competing from this perspective achieve successful performance via a research intensive effort that finds a balance between creating knowledge, integrating it into marketable items and exploiting the value inherent in these offerings. From this perspective, clustering is useful in mitigating the negative impacts of the non-excludability of knowledge while optimizing the economies of scale and scope presented by the non-rivalry of knowledge.

2.3.4. The Empirical link between Firm Management and Clusters

Very little work has sought to explain, let alone test, the theoretical link between approaches to firm management and general theories on clustering. Observations and measurements related to firms and industrial clustering have focused on descriptive tombstone data (firm size, dollars invested, number of product launches, etc.) as a way of demonstrating specific effects associated with clustering (increased research intensity, greater foreign direct investment, etc.) as well as the general presence of a cluster. For instance, Folta, Cooper and Baik (2006) observe that as a cluster becomes larger firms see more benefits in terms of their ability to innovate through

patenting, attract alliance partners and attract private equity partners. However, once clusters reach a certain threshold level[12] the marginal benefits begin to decrease as the cluster gets larger. While this work is able to demonstrate a non-linear relationship between cluster size and organization performance it does not address the possibility that a firm's approach to management will impact its capacity to benefit from agglomeration.

In another study, Acs, Audretsch and Feldman (1994) find that both large and small firms benefit from an increase in research and development expenditure but that large firms benefit more from industry expenditures while small firms benefit more from university or public research expenditures. Again, this assumes away the differences in firm strategy by focusing only on technologically advanced, research intensive companies to observe the causal impact of clusters on organization performance. This process of focusing on only one type of approach to firm management (often the knowledge-based approach) is common in the literature that observes the relationship between clusters and firm performance.

One study that explicitly applies the resource-based view of firm management to industrial clustering found that a unique set of resources and capabilities could be observed in two ceramic tile clusters located in Spain and Italy (Hervas-Oliver & Albors-Garrigos, 2007). These authors also found that the cluster-based resources and capabilities were considered relevant to firm performance by firm managers in the respective clusters. Their findings represent a preliminary attempt to cast theories of industrial agglomeration in the terms of the different management perspectives so as to make clustering more relevant to the strategic management process that firms are increasingly engaged in.

While some initial attempts have been made, there remains a dearth of literature linking management theories to theories of agglomeration. This gap in the literature represents an opportunity for future research. In particular there is a need to observe and test the relationship between different approaches to firm management and the economies / diseconomies of agglomeration.

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[12] In this study the threshold for benefits related to patenting was found to be at about 65 firms. Beyond this number of firms, the benefits tended to give way to the negative effects of agglomeration (Folta, Cooper and Baik, 2006: 218).

2.3.5. Observations on the management views

Management literature was reviewed for its ability to provide insight on the context in which each cluster perspective is relevant. According to the theory building framework used by Maskell and Kebir (2005), management literature should help address the questions of when, where and to whom each cluster perspective is relevant. In doing so, it further disentangles the perspectives on clustering by anchoring each to operational circumstances that illustrate when one perspective yields to the others.

The simple summary of management literature is that it addresses the relationship between strategy and firm performance and implies that cluster impacts on performance are filtered through firm strategy. This, in itself, is a powerful statement worthy of its own detailed investigation. However, in the context of this research project, it is assumed to be the appropriate fundamental causal chain amongst clusters, firm strategy and performance.

To summarize, the three views on management of the firm all assume that successful performance is a function of strategy formulation and execution. Each, however, focuses on a different primary determinant of strategy. The product-based view emphasizes that strategy is a response to the external competitive environment and leads to success in so much as it maximizes profit margins by achieving value chain efficiency and favourable market position. The resource-based view holds internal resources and capabilities as the key objects of strategy. The inherent logic is that regardless of what happens outside a firm, each company's performance is determined by the way it chooses to combine resources and capabilities to generate competencies while minimizing incompetencies and ultimately delivering products or services. The knowledge-based view argues that knowledge (and its application) is the sole determinant of performance and strategy focuses on its creation, integration and exploitation. In practice, the three management views describe firms with considerably different assumptions as to what defines successful performance and how to achieve it. This means that while strategic objectives, tactics and actions may at times be similar amongst firms with different views, their underlying motives will be fundamentally different. Thus, it is the strategic motivation of firms that defines when, where and to whom each perspective on clustering is relevant.

## 2.4.	Conclusion

In reviewing the body of literature related to industrial clustering it quickly becomes clear that even though the breadth and depth of research is impressive there is a noticeable lack of formal structure and classification. This lack of structure has enabled the conflating of ideas and generated a reputation of fuzziness. The first steps toward addressing the lack of structure have been taken via the introduction of a theory building framework that triages previous work into three perspectives. This process of regrouping past cluster research into a deductive framework is meant to encourage more behavioural modeling and experimental testing rather than the existing approach of simply making sense of individual observations. The initial recasting of cluster literature left the theory building framework incomplete. This gap in the framework exposes the opportunity to strengthen the theory-based link between firm management and industrial clustering. This link is further modelled and tested in the subsequent chapters.

CHAPTER 3

This chapter proposes a link between cluster literature and firm management literature. Three basic relationships are proposed in Section 3.1. The models for observing and testing these relationships are described in section 3.2 and include a review of how the variables were constructed. Section 3.3 discusses the source of data along with several limitations to the analysis.

3.1.   The Analytic Framework

The previous chapter focused on the introduction of a theory building framework within cluster literature. The framework is particularly valuable as a tool for transitioning research efforts from an inductive approach to a deductive approach. This transition is a natural part of the iterative process that is science. For instance, the initial accumulation of inductive research is absolutely indispensible in proving the wide-spread existence of the clustering phenomenon and discovering a wide variety of its underlying concepts, processes and sub-phenomena. In other words, the emphasis on observing and measuring individual instances of clustering has served to make the phenomenon more tangible. Unfortunately the piecemeal nature of the inductive work is making the entire body of literature more susceptible to criticisms of fuzziness and self-fulfilling observation. For this reason the deductive framework is an attractive way to create the structure and consistency within the literature that will enable more explanatory behavioural modelling and testing of causal pathways. Furthermore, the common framework creates a gathering ground and environment for systematically melding ideas from the multitude of disciplines that have so far been brought to bear on this subject (as opposed to the ad hoc approach associated with the criticisms of fuzziness and conflating of ideas).

Structure and consistency is partially achieved by triaging past research into three perspectives on clustering. Each perspective is able to draw boundaries around certain types of relationship structures and their related set of benefits (table 3.1). The competitiveness perspective focuses on

the impact proximity has on business-to-business exchange relationships and trade linkages. The externalities perspective looks at the relationship between companies and location factors or public goods. The territorial perspective views agglomeration in terms of the social networks and relational capital within which all economic activity is embedded.

Table 3.1: Gap in the Theory Development Framework

		Competitiveness Perspective	Externalities Perspective	Territorial Perspective
What?		Exchange Relationships & Traded Benefits	Location Factors & Untraded Benefits	Relational Capital & Extra-Economic Benefits
How?				
Why?	**Existence**			
	Extension			
	Exhaustion			
		In practice, what are clusters associated with?		
When/Where/Whom? (context)		?	?	?

Unfortunately in its initial application the framework was not completely addressed (table 3.1). In particular, the operational context of each perspective was not defined. This aspect of the framework is critical in defining the limits to the application of each perspective. In practice, this means defining when one perspective will yield to the others. It is this gap in the framework that this project seeks to address.

Given the central role of the firm in deploying economic resources and contributing to economic activity it seems logical to turn to management literature for an explanation of operational contexts that might apply to the different perspectives on clustering. The review of management literature reveals three views of strategic motivation. Each view implies that a fundamentally different driver of behaviour (e.g. competitive positioning, resource development or knowledge utilization) can define the context in which firms and clusters operate (table 2.5). These views on management manifest themselves in different focuses for performance outcomes as well as different paths to achieving the desired outcomes. The product-based view focuses on dominance over competitors by way of jockeying for position and brokering support within the value chain. The resource-based view seeks the competitive benefits of innovation via the development of

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resources and capabilities. The knowledge-based view pursues positive-sum wealth creation through the development and deployment of knowledge assets.

Before these views on management can be confirmed as the missing piece of the framework one must test their implied relationship to the various perspectives on clustering. The framework, as illustrated in table 3.2, implies three testable propositions:

P_1: the competitiveness perspective is related to the product-based view of management.

P_2: the externalities perspective is related to the resource-based view of management.

P_3: the territorial perspective is related to the knowledge-based view of management.

These proposed matches between cluster perspectives and management views are based on commonalities in each of the literatures. The competitiveness perspective and the product-based view share a focus on value-chain concepts and the business-to-business relationships they regard. The externalities perspective and the resource-based view both hold resources and capabilities as central to successful performance. Finally, the territorial perspective and knowledge-based view both emphasize the potential of a positive-sum or limitless future where knowledge is the driving force behind success.

Table 3.2: Research Propositions from the Theory Development Framework

		Competitiveness Perspective	**Externalities Perspective**	**Territorial Perspective**
What?		Exchange Relationships & Traded Benefits	Location Factors & Untraded Benefits	Relational Capital & Extra-Economic Benefits
How?				
Why?	**Existence**			
	Extension			
	Exhaustion			
		Are the perspectives on clustering related to the views on firm management?		
When/Where/Whom? (context)		**Product-based View** Competitive Dominance via Value Chain Control	**Resource-based View** Creative Destruction via Internal Develop.	**Knowledge-based View** Value Creation via Knowledge Assets

The proposed relationships represent a simplified conceptualization of the relationship between two large bodies of literature. The relationships assume that any given cluster will be

characterized purely by one perspective and its related view of management. This is obviously a utopian view of a phenomenon known for its complexities. In practice any agglomeration will most certainly display attributes from more than one of the cluster perspectives as well as host organizations that hold different views on management. This means one could conceivable observe all three cluster perspectives (and the related views on management) in a single cluster. Even so, if the literatures are related as hypothesized some degree of correlation should be observable. The following sections describe how each proposition has been modelled, including the construction of proxy measures and selection of variables.

3.2.   Conceptual Model and Measurement Constructs

The variables and measures used in this project were derived from the survey instruments of a larger initiative designed to study cluster-driven innovation in Canada. The Innovation Systems Research Network (ISRN) is a collection of researchers from five regional nodes based in Atlantic Canada (ACISN), Quebec (RQSI), Ontario (ONRIS and PROMIS), and Western Canada (Innocom). The ISRN cluster study investigates how "…local networks of firms and supporting infrastructure of institutions, businesses and people in communities across Canada interact to spark economic growth" (ISRN, 2008). A common set of surveys (appendix A) was prepared to collect data in "… more than 20 clusters across the five regions in newly emerging knowledge-intensive areas (e.g. biomedical, photonics/wireless) as well as in more traditional sectors (e.g. manufacturing, wood products, food and beverage, automotive and steel)" (ISRN, 2008). The ISRN survey instrument was designed to:

"… measure the number and importance of product and process innovations produced by responding firms (dependent variable) and explore its relationship to a set of independent variables including: the importance of different external sources of innovative ideas, firm size, and the sophistication, internal resources or 'absorptive capacity' of the firm." (ISRN, 2003: 3)

As such it incorporates a number of measures related to cluster attributes and firm performance that are valuable to the research objective of this project.

3.2.1. Proposition 1: the Competitiveness perspective and the Product-based view

The competitiveness perspective on clustering argues that proximity fosters sustained trade linkages that shorten communication lines, reduce costs (e.g. transaction, search, negotiation and enforcement), intensify rivalry as well as deliver more and better intelligence on competitors and markets. The platform for these effects is the exchange-based relationships amongst organizations and their suppliers, distributors, competitors and customers. Hence, the value chain focus of the product-based view of management best describes the performance objectives that benefit from the competitiveness style of clustering. Specifically, organizations are assumed to purse dominance over their competitors by managing their value chain relationships so as to maximize margin (the gap between production costs and customer's willingness-to-pay). Value chain relationships contribute to this objective by: (1) removing uncertainty surrounding input costs and sales opportunities and (2) providing information about changes in the competitive environment. Thus it is proposed that the competitiveness perspective on clustering is related to the product-based view of management.

This proposed relationship is modelled by a number of variables. The competitiveness perspective on clustering is represented by the local agglomeration of customers, suppliers or competitors. The product-based view of management and its objective of competitive dominance are represented by corporate revenues, the presence of growth and the importance of international and domestic sales.

The variables representing the product-based view of management were constructed from the questions in figure 3.1. The variable measuring corporate revenue (REVENUE) asks each respondent to approximately report their establishment's[13] gross revenues. The original six response categories are collapsed into three categories (None, $1 million or less, more than $1 million) to ensure the response frequencies are not too fragmented. Revenue represents the amount of money collected from customers. By itself, this measure says little about the firm's performance relative to its competitors or its own capability. However, within the context of the

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[13] An establishment is defined as the local entity of the organization. This is in contrast to reporting values for the entire firm (across the entire national or global entity).

proposed relationship, more revenue means firms have reached more customers and are succeeding at their performance objectives. .

Company Fact Sheet

11. Please indicate your establishment's gross revenues for the most recent fiscal year:

    _ None (i.e. development phase)
    _ Less than $500,000
    _ $500,000 to $1,000,000
    _ More than $1,000,000 to $10,000,000
    _ More than $10,000,000 to $100,000,000
    _ More than $100,000,000

10. Over the past 3 years has your establishment's volume of production (gross revenues):

    _ Increased   - approximate percent: _____%
    _ Decreased - approximate percent: _____%
    _ No change

8.   What percent of your establishment's sales are in the following markets?

    Local (within 100km)   _____%
    Rest of the province: _____%
    Rest of Canada: _____%
    United States: _____%
    Europe: _____%
    Pacific Rim: _____%
    Rest of world: _____%

Figure 3.1: Source of Variables for the Product-based View of Management

The second variable measures corporate growth (GROWTH) by asking each respondent how their establishment's volume of production has changed in the past three years (figure 3.2.1). The responses form an ordinal variable with three response categories (decreased, unchanged, and increased). Within the context of the product-based view of management, GROWTH reflects the ability of a firm to successfully adapt to changes in the competitive environment and maintain a preferred competitive position.

The third (DOMESTIC) and fourth (INTERNATIONAL) variables represent the geographic location of the firm's sales. Each respondent is asked to identify what percentage of their sales can be attributed to each of seven geographic markets (Local, Rest of Province, Rest of Canada,

US, Europe, Pacific Rim, Rest of World). These seven categories were collapsed into two categories: domestic sales and international sales. Domestic sales are those that occur locally (within 100 km), provincially and within Canada. International sales are those that occur in the United States, Europe, the Pacific Rim or the Rest of the World.

Due to differences in the recording by individual survey technicians the original open-ended responses were immediately recoded into the following 12 categories: Not Applicable, None, 1-10%, 11-20%, 21-30%, 31-40%, 41-50%, 51-60%, 61-70%, 71-80%, 81-90%, 91-100%. The creation of these categories complicated the calculation of total domestic sales and total international sales as the original responses could not simply be totalled. Alternatively, the mid-point of each category is substituted for the original response (e.g. 1-10% = 5% while 71-80% = 75%). To illustrate this, consider a firm that reports 50% of its sales occurring locally (within 100 km) and 50% occurring in the Rest of Canada. This firm should receive a score that reflects 100% of its sales occurring domestically; however, since the original response of 50% is represented by the category of 41%-50% it is given the mid-point value of 45%. When domestic sales are totalled, the score for the variable DOMESTIC is only 90% (45% local + 0% provincial + 45% Canadian). This is a slight under-representation of the original response but should provide an acceptable ordinal measure of each firm's activity in domestic and international markets.

Three variables representing the competitiveness perspective on clustering were constructed from the questions in figure 3.2. Each measures the presence of a certain type of value chain agglomeration. The first variable measures the local presence of key customers (CUSTOMERS) by asking each respondent where their key customers are located. The original response categories of local, Canadian, North American or Global are treated as a progressive scale representing how dispersed each companies key customers are. A local concentration of key customers is believed to provide sophisticated demand signals that allow firms to respond quicker to industry changes and to generate highly valued, incremental innovations.

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Figure 3.2: Source of Variables for the Competiveness Perspective on Clustering

The second variable measures the agglomeration of suppliers (SUPPLIERS). It asks each respondent where their key suppliers are located: local or non-local. Local clustering of key suppliers reduces the transaction costs (transport, storage, etc.) associated with the production process, thereby increasing a firm's margin and ability to dominate.

The third variable measures the presence of competitors (COMPETITORS) by asking each respondent where their key competitors are located: local or non-local. A local agglomeration of competitors allows insight into industry trends thus enabling a firm to react in a timely manner to changes. A concentration of competitors is also theoretically associated with intensified rivalry that can improve industry-wide efforts to reduce hurdles to successful performance (trade barriers, standardization, etc.).

The three variables representing the competitiveness perspective on clustering are hypothesized to correlate with each of the four variables that represent the product-based view of management (table 3.3). Should a correlation be found, subsequent testing will be needed to determine the direction of causality and the magnitude of the relationship.

Table 3.3: Hypotheses related to Proposition 1

Proposition 1: the competitiveness perspective is related to the product-based view	
Competitiveness Perspective on Clustering	**Product-Based View of Management**
H_1: The local presence of customers (CUSTOMERS) H_2: The local presence of key suppliers (SUPPLIERS) H_3: The local presence of key competitors (COMPETITORS)	Is related to a firm's revenues (REVENUES).
H_4: The local presence of customers (CUSTOMERS) H_5: The local presence of key suppliers (SUPPLIERS) H_6: The local presence of key competitors (COMPETITORS)	Is related to a firm's growth (GROWTH).
H_7: The local presence of customers (CUSTOMERS) H_8: The local presence of key suppliers (SUPPLIERS) H_9: The local presence of key competitors (COMPETITORS)	Is related to a firm's domestic sales (DOMESTIC).
H_{10}: The local presence of customers (CUSTOMERS) H_{11}: The local presence of key suppliers (SUPPLIERS) H_{12}: The local presence of key competitors (COMPETITORS)	Is related to a firm's international sales (INTERNATIONAL).
H_0: The null hypothesis in each case is that there is no relationship between the variables.	

3.2.2. Proposition 2: the Externalities perspective and the Resource-based view

The externalities perspective on clustering emphasizes the importance of location factors and public goods to an improved division of labour (specialization), the creation of spillovers and an overall robust local innovation system. Proximity is deemed vital in enabling access to the benefits associated with location factors (also known as externalities). Furthermore, advantages derived from location factors are considered much more difficult to imitate or recreate because they are rooted in the involvement of multiple organizations. Hence from the resource-based view of management, location factors are important resources to be developed, controlled and combined to create novel products, processes and services that confer monopolistic advantages (first mover advantages, path dependencies, etc.). In other words, the externalities perspective is related to the resource-based view of management by their shared focus on a process of Schumpterian competition.

The proposed relationship between the externalities perspective and the resource-based view of management is represented by several variables. The presence of an externalities perspective is measured by proxies for location factors such as: a skilled labour force, specialized infrastructure, and tailored support services. The resource-based view of management is represented by a measure of innovativeness.

The innovativeness variable (INNOVATION) was based on an earlier innovation index created by Procyshyn (2004) from the five questions in figure 3.3. Each respondent receives a score ranging from 0 (least innovative) to 7 (most innovative) on the innovation index. This means that the variable is ordinal and can be used with non-parametric tests. However, the limited number of responses means the variable may be more useful if collapsed into fewer categories. This is not a trivial process as the meaning of the variable may be lost if done incorrectly. Two methods of this re-coding were considered. First, the split can be made so that scores ranging from 0 to 3 represent non-innovative firms and scores from 4 to 7 represent innovative firms. This split is made at the median of the scale and ensures that any firm delivering a world first innovation (minimum score of 4) would still be considered innovative. The second re-coding sets the non-innovative range of scores from 0 to 4 (5-7 = innovative). This was the approach used by Procyshyn (2004) and is based on the measures of central tendency used to describe the sample of responses (median=5, mode=5, mean=4.56). Each of these versions of the INNOVATION variable was tested against the variables representing the externalities perspective to determine if one or the other was a more sensitive measure. No substantive difference was observed between the results obtained from these measures. As a result, the first method which categorizes world-first innovators as 'innovative' is used for this project.

1.1 During the last three years, did your company offer new or significantly improved **products** (goods or services) to your clients? [0=no, 1=yes]

1.2 During the last three years, did your company offer new or significantly improved **production/ manufacturing processes**? [0=no, 1=yes]

2.1 Were these innovations:
___ New to the World? [3]
___ New to Canada? [2]
___ New to your Firm? [1]

2.2 Does your firm hold an existing or pending patent on this or other products and processes? (if so how many) [0=no, 1=yes]

2.3 Is your firm currently developing a new product or process? (Please describe) [0=no, 1=yes]

Figure 3.3: Innovation Index Questions

The four variables representing the externalities perspective of clustering are derived from the questions in figure 3.4. The responses to each of the questions are coded into a dichotomous variable with response categories of yes or no. The first variable measures the presence of a skilled labour force (LABOUR) by asking each respondent if the local labour force possesses any sort of specialization. This measure identifies a labour force that might drive innovation through competition for individual positions as well as competition for the best employees. Additionally, a specialized labour force is presumably bound by common experiences and a shared understanding of language and symbolism that enable ingenuity and inventiveness.

> **Part D: Locational/Infrastructure Factors**
>
> 4.   Does the labour force in your locality or region possess any distinctive skills, knowledge or capabilities that are an asset to your company? [LABOUR]
>
>   Do you use consultants? Are they local/non-local? [CONSULTANT]
>
> **Part F: Local Cluster Characteristics/Social Capital**
>
> 4. Are there any UNIQUE Saskatoon assets or capabilities that have contributed significantly to the development of your local industry or cluster? If yes, explain. [ASSETS]
>
> 5. Does your company employ any specialized service providers (law firms, underwriters, accountants, business or technical consultants) located in this region? [SERVICE]

Figure 3.4: Source of Variables for the Externalities Perspective on Clustering

The second variable (ASSETS) asks each respondent if the local region possesses any unique assets or capabilities. The objective of this measure is to identify the presence of specialized infrastructure. The presence of this infrastructure represents both the physical resource platform as well as the local capabilities need to translate infrastructure into a source of competitive advantage behind each company's product or service offering.

The third variable is a proxy of local competency in support services (SERVICE) and asks each respondent if they use local specialized service providers. Specialized service providers include lawyers, accountants, technical consultants and other service providers that deliver technical skills or high level expertise that can prove critically important to a firm's effort to improve itself. These support agents are also thought to be valuable vectors for organizational and process innovations.

The fourth variable (CONSULTANT) is derived from a question added to the Saskatoon survey. It is similar in nature to the variable SERVICE as it asks each respondent if they use local consultants. Consultants are a sub-category of specialized service providers that presumably provide services closely related to the local area(s) of specialization where innovation is occurring. This means consultants can have a direct impact on the innovation activity of interest to the resource-based view of the firm.

As with the previous proposition, the four variables representing the externalities perspective are hypothesized to correlate with the innovation index that represents the resource-based view of the firm (table 3.4). Should a correlation be found, then subsequent tests will be necessary to determine the direction of causality and the magnitude of the relationship. The variables representing the externalities perspective will also be compared to one another in an effort to determine how much they overlap.

Table 3.4: Hypotheses related to Proposition 2

Proposition 2: the externalities perspective is related to the resource-based view	
Externalities Perspective on Clustering	**Resource-Based View of Management**
H_{13}: The presence of a specialized labour force (LABOUR) H_{14}: The presence of unique local assets and capabilities (ASSETS) H_{15}: The use of local specialized service providers (SERVICE) H_{16}: The use of local consultants (CONSULTANT)	Is related to a firm's innovativeness (INNOVATION).
$H_{0:}$ The null hypothesis in each case is that there is no relationship between the variables.	

3.2.3. Proposition 3: the Territorial perspective and the Knowledge-based view

The territorial perspective on clustering concerns itself with the non-economic relationship structure that can be fostered by proximity. These non-market relationships lead to different behaviours on the part of cluster participants and in particular create trust, common values, and reciprocal openness. All of which support creative approaches to information exchange including cooperation or collaboration. The knowledge-based view of the firm covets these extra-economic benefits for their ability to assist in finding a balance between creating knowledge, integrating it into marketable items and exploiting the value inherent in these offerings. As such, it is proposed that the territorial perspective on clustering is related to the knowledge-based view on management.

This relationship is modelled by five variables representing the territorial perspective on clustering and one variable representing the knowledge-based view of management. The proxy measures of the territorial perspective focus on the presence of trust or trust-based relationships because of their central role in defining non-market relationships. Since the knowledge-based

view is commonly associated with research activities the variable chosen to represent it is designed to measure the research intensity of each respondent.

Knowledge management (e.g. creation, integration and exploitation) is a relatively new and intangible concept that is difficult to measure directly. As a result the research and development expenditure of each respondent was taken as a proxy measure of research intensity and the presence of a knowledge-based view on management. Each respondent was asked to report their research and development (R&D) expenditure by checking off a box associated with some level of expenditure (figure 3.5). The original six response categories were collapsed into three categories ($1 million or less, more than $1 million up to $10 million, and over $10 million) to ensure the data was not too fragmented. The category split was based on the median of the scale (more than $1 million up to $10 million).

Company Fact Sheet

What were your firm's R&D expenditures for the most recent fiscal year?

__ N/A __<$.5M __$0.5M-$1M __$1M-$10M __$10M-$100M __>$100M

Figure 3.5: Source of Variable representing the Knowledge-based view

R&D expenditure is not an exhaustive measure of knowledge-based management; alternative measures such as an intellectual property strategy (patents, trade secrets, copyrights, licensing, etc.) or publication and citation activity could be used as well. For the purpose of this project it was deemed one measure would suffice in determining the presence of correlation between territorial clustering and knowledge-based management.

The territorial perspective on clustering is represented by five variables constructed from the questions in figure 3.6. The first variable (INTERACTION) considers a high level of interaction with other cluster agents (in this case research agencies and technology transfer centres because of their importance to the knowledge creation process) as an indicator of a greater level of trust

than a low level of interaction. Responses to this question were coded into four categories: never, rarely, regularly, and frequently.[14]

Part E: Role of Research Institutions/Technology Transfer Centers

1. How frequently do you or others in your company interact with public research institutes or technology transfer centres (local or non-local), including federal or provincial government institutes, universities and colleges to gain access to new sources of knowledge?

2. What types of knowledge exchange are you (or others in your company) involved with?
[ ] Formal collaborative research projects
[ ] University faculty working in, or consulting with the company
[ ] Participation in research consortia
[ ] Licensing of your own firm's technologies
[ ] Licensing of other companies' technologies
[ ] Licensing or patenting of public research inventions
[ ] Development or adoption of new technology
[ ] Development of specialized training program with a college or university
[ ] Company personnel working with a college or university

4. What primary benefits do you derive from these relationships?
[ ] Leveraging R&D expenses
[ ] Access to technical expertise/IP
[ ] Source of new product ideas
[ ] Information about the knowledge frontier
[ ] Connection to larger research community
[ ] Market credibility
[ ] Lower overhead costs on research
[ ] Access to equipment and material
[ ] Problem solving
[ ] Improvement of in house R&D
[ ] Hiring and retention of employees
[ ] Coops and Interns

Part F: Local Cluster Characteristics/Social Capital

1. Do you consider your company to be part of a network of related firms in your region/locality, (i.e. a cluster)? What evidence is there of this?

8. Does your company (or key individuals in it) belong to any formal or informal associations at the local or regional level? **If yes**, which are the most valuable and why? **If no**, why not? Are there any significant networking events that you attend regularly?

Figure 3.6: Source of Variables representing the Territorial Perspective on Clustering

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[14] A set of guidelines was developed to ensure consistency in the coding of this variable. Each category was associated with an acceptable set of terms as follows (acceptable terms in brackets): Never (Never); Rarely (Monthly, less than monthly, rarely, seldom); Regularly (weekly, between 1 to 3 times a week, frequently, often, regularly, or a close relationship); Frequently (continuously, daily, extremely frequently, or all the time)

The second variable representing the territorial perspective (EXCHANGE) measures the respondents' propensity to collaborate by asking each respondent to identify the various types of exchanges they have been involved in (figure 3.6). Respondents were presented a list of nine types of exchange and asked to select all that apply. It is important to note that this variable does not report the volume of collaboration but rather focuses on the variety in collaborative methods. This is believed to measure the freedom with which a firm is able to engage in risky, research intensive activities. Intuitively, trust and other social constructs associated with the territorial perspective of clustering tend to facilitate the greater level of risk-tolerance shown by firms that collaborate widely and creatively. This variable was re-coded to form an ordinal scale (3 or fewer, 4-6, and 7 or more) suitable for non-parametric analysis.

The third variable considers the benefits of collaboration (BENEFITS). Each respondent was asked what benefits they derive from their knowledge exchange relationships (figure 3.6). The underlying logic is similar to the EXCHANGE variable in that the emphasis is again on the variety of benefits as opposed to the volume and/or value of the benefits. A greater variety of benefits derived from collaboration is indicative of a more developed territorial-style of cluster. The responses to this variable also had to be recoded into an ordinal scale (0-3, 4-7, and 8-11) to permit the use of non-parametric testing.

The fourth variable (NETWORKING) asks the respondents if they consider themselves part of a local network (figure 3.6). The territorial perspective on clustering assumes economic development is a collective process that requires willing participation. As a result, one expects participants of a territorial cluster to acknowledge their participation in a local network. This variable is a dichotomous variable with response categories of yes or no.

The fifth variable (ASSOCIATION) representing the territorial perspective on clustering is similar to the NETWORKING variable in that it asks respondents if they are part of a local association (figure 3.6). Participation with local associations indicates a level of connectedness and commitment to a common development objective that one associates with the territorial perspective. This variable is also a dichotomous variable with response categories of yes and no.

The four variables representing the territorial perspective on clustering are hypothesized to correlate to the knowledge-based view on management as represented by the proxy measure of research intensity (table 3.5). Assuming correlation can be established, additional tests will be needed to determine the directionality of the relationship as well as its magnitude. In addition to these tests, the variables representing territorial clustering will be compared to one another in an effort to determine if there is any covariance amongst them.

Table 3.5: Hypotheses related to Proposition 3

Proposition 3: the territorial perspective is related to the knowledge-based view	
Territorial Perspective on Clustering	**Knowledge-Based View of Management**
H_{17}: A firm's frequency of interaction (INTERACTION) H_{18}: The number of knowledge exchange types (EXCHANGE) H_{19}: The number of knowledge exchange benefits (BENEFITS) H_{20}: Being part of a network (NETWORK) H_{21}: Being part of an association (ASSOCIATION)	Is related to a firm's research and development expenditure (RESEARCH).
$H_{0:}$ The null hypothesis in each case is that there is no relationship between the variables.	

3.3.   The Data Source and Limitations

The previous sections define 18 variables that produce 21 hypotheses to test the three proposed relationships between cluster literature and management literature. This approach relies heavily on proxy data to indicate the co-presence of the cluster perspectives and management views. While this sort of indirect observation will limit the sensitivity of the analysis it is not expected to be a problem if the relationships are as strong as much of the previous research suggests. The issue of sensitivity is further addressed by using multiple variables to represent each perspective on clustering to ensure the most complete measurement.

As previously mentioned, the data is sourced from the ISRN cluster initiative which conducted surveying in 20 clusters from across Canada representing multiple sectors of the economy. The ISRN project treats "… the possible existence of cluster dynamics as a hypothesis to be investigated and either verified or rejected" (ISRN, 2003: 17). This assumes that clustering can occur in varying magnitudes over time and space. In other words, all locations can be

investigated for the presence of forces related to clustering whether or not a cluster has previously been proven to exist. This approach places less emphasis on the existence of clustering and more emphasis on how the varying degrees of agglomeration impact economic outcomes. It also means that even though the locations investigated by the ISRN were selected for the presumed presence of a cluster, the analysis of data may or may not prove this to be the case.

Several types of surveys were prepared in order to access the unique perspectives of companies, government agencies, research organizations, associations, and venture capitalists. The surveys were extremely comprehensive; covering all facets of clustering as they were understood at the time (networking, trade linkages, location and infrastructure factors, the role of research and technology transfer centres, social capital, etc.). This enabled the potential for response bias to be minimized by the use of more than one variable to measure some of the concepts. For this project, only the company questionnaires and their accompanying fact sheets are analyzed.

An initial list of potential respondents was constructed from knowledge of the local sector. These respondents were contacted via the cold call method and asked to participate. The list of respondents grew as each participant was asked to identify additional potential respondents. This snowball method of sampling ensured a sample comprised of similar and related agents. The final sample was comprised of 92 firms/agents in the biotechnology and new media sectors in Vancouver and Saskatoon. Interviews were conducted over a two year period (2002/2003) and thus represent only a snapshot in time. All interviews were taped and transcribed. The responses were subsequently coded by one individual to ensure consistency in the interpretation of answers.

The sectors selected for investigation are often cited as prone to clustering. The biotechnology sector requires long term investment before returns are realized. The risk associated with these long term investments, coupled with the expert knowledge requirements, fosters a natural environment for the risk sharing practices associated with clustering. The new media sector is prone to clustering for different reasons. The expert knowledge required by the industry is derived from a combination of technological capabilities and artistic creativity. In addition to these expert knowledge requirements, the sector rapidly changes to meet consumer demands. The industry thus embraces clustering to foster expert capabilities and to maintain access to the

market. By including respondents from multiple locations and multiple sectors, one is able to test if the proposed relationships are robust enough to emerge from more than one context.

Due to smaller sample sizes non-parametric tests will be utilized.[15] Non-parametric tests make fewer assumptions about the distribution of the sample population and can be used to analyze nominal and ordinal scale data. The analysis is conducted in two stages. First, all the tests are run against the subset of 49 biotechnology respondents. Following this the new media respondents are added to the analysis to create a total sample of 92. By adding the new media respondents one can expect to observe the models' sensitivity to sample size as well as the firm's sector. For each individual statistical test the actual sample size varies with the presence of missing values or non-response by the companies.

To summarize, the initial application of a theory building framework to cluster literature led to the identification of three distinct perspectives on the phenomenon. These three deductive lines of logic were left incomplete when the final component of the theory building framework was not addressed. In order to complete the theory building process, it has been proposed that three views on management effectively address the operational context associated with each perspective on clustering. In order to test this relationship between cluster literature and management literature the theory will be taken for a test lap in a small but robust data set. The analysis, with its use of non-parametric tests, a ninety percent confidence interval and a focus on correlation not causation, is designed to be generous to the propositions. Specifically, nonparametric tests enable a smaller sample size to be used and relaxing the confidence interval from 99% to 90% makes it easier to observe a statistically significant relationship. Furthermore, several statistical tests which do not determine causality were able to be used because of the desire to determine correlation before investigating causation. Since this project is attempting to build a theory, as opposed to testing one, this approach is considered acceptable. The expectation is that the presence of correlation will confirm the relationship between the two bodies of literature and act as a starting point for refinement and testing of the theories. However, if a correlation is not

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[15] Nonparametric procedures place fewer parameters on the data being analyzed. In this case the small sample size determined the need for nonparametric procedures. The findings derived from nonparametric procedures can not be inferred to the general populations but rather represent only the sample being analysed.

detectable then one must circle back and make a fresh attempt at completing the theory building process.

CHAPTER 4

This chapter presents the findings from the empirical testing of the three proposed theories related to clustering. There are two potential outcomes to all of the tests. First, the relationships being tested might be statistically significant suggesting that the relationships do indeed exist and that additional test are necessary to determine the nature of the relationships (magnitude and direction). Alternatively, statistically significant relationships might not be observed. This sort of finding, if correct, suggests the theory does not hold true for the observed sample. In order to argue that non-significant results are not observed in error, the possibility of misspecified observations and the use of inappropriate tests must be minimized.

As discussed in chapter 3, non-parametric methods are utilized. "[These] methods are organized according to the type of sample structure that produced the data to be analysed – for example, one sample (paired samples), two independent samples, and so forth – and the type of inference to be made (hypothesis to be tested or quantity to be estimated by a confidence interval)" (Gibbons, 1993: 2). All tests assume independence; each respondent must contribute only one score on the cluster-related variables and one score on the management related variables and each respondent should not be able to influence the other respondents. The raw data for all of the statistical tests can be found in appendix B. It should be further noted that when using nonparametric techniques to conduct hypothesis testing the hypothesis refers only to the relationship as it is in the sample; the findings can not be inferred to the general population.

The findings of the research are presented in four sections. The first three sections (4.1 through 4.3) describe the tests and specific findings related to each of the three propositions. Section 4.4 discusses the findings that are common to all three propositions.

4.1.   Test Results for Proposition 1

The competitiveness perspective on clustering and the product-based view of management share a focus on value-chain concepts and related business-to-business linkages. As a result it is proposed that *the competitiveness perspective is related to the product-based view*. In order to test this proposition the three variables related to competitiveness-style clustering (CUSTOMERS, SUPPLIERS, and COMPETITORS) were compared to each of the variables representing the product-based view of management (REVENUE, GROWTH, DOMESTIC, and INTERNATIONAL).

The nonparametric Kruskal-Wallis test, a test of location[16], was deemed the appropriate test for these relationships. It is used to test if "… the samples of scores come from the same population (the null hypothesis) or from several populations that differ in location (the alternative hypothesis)" (Leach, 1979: 148). The test assumes a random sample with independent scores on each variable. The correlation coefficient is represented by the test statistic eta. The chi-square test statistic used in the Kruskal-Wallis test is more accurate with a larger sample size (at least 30). This assumption is violated for all tests using only the biotechnology sample. Using the entire sample (biotechnology and new media) brings the sample sizes close to or above 30 for all variables. The results of the Kruskal-Wallis tests are reported in table 4.1.

With the entire biotechnology/new media sample, the total population is 92. The Kruskal-Wallis tests were run on this population. All but two tests returned non-significant results. The relationship between COMPETITORS and INTERNATIONAL, while weakly significant (at 90% confidence), explained only 20% (eta = 5.003/26-1) of the variability in the dependent variable. It should be noted that the focus of analysis is the presence of correlation and that no theoretical assumptions have been made as to the directionality of causation between the variables. However, some of the tests require the designation of independent and dependent variables. In these instances the cluster-related variables were considered the independent variables while the management-related variables were deemed the dependent variables.

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[16] Measures of location are concerned with the value of a measure of central tendency (location). In other words they attempt to find a typical or central value that best describes the data.

Table 4.1: Test Results for Proposition 1

Kruskal-Wallis (mean-rank) test of location		CUSTOMERS	SUPPLIERS	COMPETITORS
REVENUE	Kruskal-Wallis (chi-square)	1.759	**6.395**	5.326
	df	4	**2**	3
	N	50	**43**	49
	Sig. (2-tailed)	0.780	**0.041****	0.149
GROWTH	Kruskal-Wallis (chi-square)	3.661	2.884	2.304
	df	3	2	2
	N	35	28	34
	Sig. (2-tailed)	0.300	0.236	0.316
DOMESTIC	Kruskal-Wallis (chi-square)	0.395	2.250	1.906
	df	4	2	2
	N	30	24	29
	Sig. (2-tailed)	0.983	0.325	0.386
INTERNATIONAL	Kruskal-Wallis (chi-square)	2.814	1.953	**5.003**
	df	4	2	**2**
	N	26	22	**26**
	Sig. (2-tailed)	0.589	0.377	**0.082*****
* Correlation is significant at the 0.01 level (2-tailed).				
** Correlation is significant at the 0.05 level (2-tailed).				
*** Correlation is significant at the 0.1 level (2-tailed).				

The other significant relationship (at 95% confidence level) was between SUPPLIERS and REVENUE; once again it explains only a small portion of the variability in REVENUE (15% or eta = 6.395/43-1). Follow-up pairwise comparisons can be conducted to obtain a more detailed understanding of the relationship between these variables. However, follow-up efforts may be better spent finding variables with a greater degree of covariance.

4.2. Test Results for Proposition 2

The externalities perspective on clustering and the resource-based view of management both hold the development of resources and capabilities as central to successful performance. As such it is proposed that *the externalities perspective is related to the resource-based view of management*. This relationship is operationalized by four dichotomous variables (LABOUR, ASSETS, SERVICE, and CONSULTANTS) representing the externalities perspective and one dichotomous variable (INNOVATION) representing the resource-based view.

Given that all of the variables are dichotomous the analysis was done via contingency tables (2x2). The Chi-square test statistic was calculated for each of these crosstabs. The Chi-square statistic compares the proportion of respondents in each category to the proportion expected in

each category. As a rule of thumb, the expected cell frequencies should all exceed 5 when analyzing 2x2 tables. The Chi-square statistic tests the null hypothesis that the two variables are independent. If the alternative hypothesis is accepted, additional tests (phi, Cramer's v, gamma, etc.) should be calculated to determine the magnitude of the relationships.

For the smaller sample of biotechnology firms (N=49) no valid results were generated because the sample was too small. This says nothing about the relationships being tested but does emphasize the limitations of the Chi-square test of independence.

In order to minimize the effects of a small sample size, the new media cases were added to the sample population (bringing N=92) and all of the tests were conducted a second time. The larger sample size improved the validity of 3 of the 10 tests (table 4.2). In these three cases no correlation was observed. The variable INNOVATION is not significantly related to either of the cluster-related variables LABOUR or ASSETS. In addition, the variables LABOUR and ASSETS are not significantly related. The remaining relationships were not testable as the sample size was too small.

Table 4.2: Test Results for Proposition 2

Chi-square test of independence		INNOVATION	LABOUR	ASSETS	SERVICE	CONSULTANTS
INNOVATION	Pearson Chi-Square		0.001	0.156	0.416 (NV)	1.868 (NV)
	Sig. (2-tailed)		0.980	0.693	0.519	0.172
	N		80	70	82	21
LABOUR	Pearson Chi-Square			0.407	2.411 (NV)	1.112 (NV)
	Sig. (2-tailed)			0.524	0.120	0.292
	N			67	77	21
ASSETS	Pearson Chi-Square				2.468 (NV)	1.163 (NV)
	Sig. (2-tailed)				0.116	0.281
	N				70	21
SERVICE	Pearson Chi-Square					0.463 (NV)
	Sig. (2-tailed)					0.496
	N					21
* Correlation is significant at the 0.01 level (2-tailed).						
** Correlation is significant at the 0.05 level (2-tailed).						
*** Correlation is significant at the 0.1 level (2-tailed).						
NV = not valid						

4.3.   Test Results for Proposition 3

The territorial perspective on clustering and the knowledge-based view of management both emphasize the potential for positive-sum wealth creation and a limitless future where knowledge

is the driving force behind success. This shared focus led to the proposition that *the territorial perspective is related to the knowledge-based view of management*. Five variables (INTERACTION, EXCHANGE, BENEFITS, NETWORK, and ASSOCIATION) were developed to represent the territorial perspective and tested for a correlation to one variable (RESEARCH) representing the knowledge-based view of management.

This proposition was first tested by looking at the smaller data set of biotechnology respondents (N = 49) and calculating a Spearman rank correlation coefficient (Rho) for the cluster-related variables, INTERACTION, EXCHANGE and BENEFITS and the management-related variable, RESEARCH. The Spearman rank correlation simply assigns a rank to each score and proceeds to determine if each variable is in either perfect agreement or perfect inverse agreement with the other variables. In this case, none of the cluster-related variables are significantly related to the management variable (table 4.3) even though significance levels were relaxed to the 90% confidence interval.

Table 4.3: Test Results for Proposition 3 – small sample (Spearman rank)

Spearman Test of Correlation		RESEARCH	INTERACTION	EXCHANGE	BENEFITS
RESEARCH	Correlation Coefficient	1			
	Sig. (2-tailed)	.			
	N	23			
INTERACTION	Correlation Coefficient	-0.159	1		
	Sig. (2-tailed)	0.470	.		
	N	23	49		
EXCHANGE	Correlation Coefficient	0.313	0.154	1	
	Sig. (2-tailed)	0.147	0.291	.	
	N	23	49	49	
BENEFITS	Correlation Coefficient	0.040	**0.386**	**0.389**	1
	Sig. (2-tailed)	0.857	**0.006***	**0.006***	.
	N	23	**49**	**49**	49
* Correlation is significant at the 0.01 level (2-tailed).					
** Correlation is significant at the 0.05 level (2-tailed).					
*** Correlation is significant at the 0.1 level (2-tailed).					

Correlation was however detected between several of the cluster related variables. The variable BENEFITS appears to be related to the variable INTERACTION ($r_s = 0.386$, p = 0.006, n = 49), as well as the variable EXCHANGE ($r_s = 0.389$, p = 0.006, n = 49). This suggests that the measure BENEFITS shares variance with each of these measures. Presumably, more interaction or more exchange types will be related to a greater variety of benefits. This correlation is

expected as all the cluster-related measures were selected as proxies for trust-based relationships and other social constructs associated with territorial-style clustering.

The remaining variables, NETWORK and ASSOCIATION, are dichotomous variables for which the spearman rank correlation is not an appropriate test. Since these variables each separate the sample into two groups (networked versus non-networked firms and association members versus non-members) the appropriate test is the Mann-Whitney U test.[17] This test is a measure of location; as opposed to the Spearman rank correlation which is a measure of association.[18] The Mann-Whitney U test calculates whether the mean ranks for the two groups differ significantly from each other.

Table 4.4: Test Results for Proposition 3 – small sample (Mann-Whitney U)

Mann-Whitney U rank-sum test		RESEARCH	INTERACTION	EXCHANGE	BENEFITS
NETWORK	Mann-Whitney	47.500			
	Sig. (2-tailed)	0.792			
	N	23			
ASSOCIATION	Mann-Whitney	30.500			
	Sig. (2-tailed)	0.514			
	N	23			
* Correlation is significant at the 0.01 level (2-tailed).					
** Correlation is significant at the 0.05 level (2-tailed).					
*** Correlation is significant at the 0.1 level (2-tailed).					

Evaluating the hypothesis that firms connected to a network would, on average, have higher research and development expenditure than unconnected firms generated results that were not significant (z = -0.263, p= 0.792). Firms that were part of a network had a mean rank of 11.79 while non-networked firms had a mean rank of 12.58. The hypothesis that firms with membership in local associations will have higher research and development expenditures than firms without membership also generated non-significant results (z =-0.653, p = 0.514). Firms with association memberships generated a mean rank of 11.61 while firms without membership generated a mean rank of 13.88. The Mann-Whitney scores are reported in table 4.4. These

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[17] The Mann-Whitney U test is also known as the Wilcoxon rank sum test.

[18] "Measures of association assign a numerical value to the degree of association or strength of relationships between variables. Two variables are associated when the behaviour of one affects the behaviour of the other" (Gibbons, 1993: 1). Measures of location are concerned with the value of a measure of central tendency (location). In other words they attempt to find a typical or central value that best describes the data.

findings indicate that there is no systemic difference between firms that are networked and those that are not or firms that participate in associations and those that do not.

Non-significant results, in some cases, can be attributed to small sample sizes. In order to test the sensitivity of this model to the sample size an additional set of respondents from the new media sector have been added to the sample. This brings the new sample population to 92. The same test statistics were calculated and the results are presented in table 4.5.

Table 4.5: Test Results for Proposition 3 – large sample (Spearman rank)

Spearman Test of Correlation		RESEARCH	INTERACTION	EXCHANGE	BENEFITS
RESEARCH	Correlation Coefficient	1.00			
	Sig. (2-tailed)	.			
	N	41			
INTERACTION	Correlation Coefficient	0.06	1.00		
	Sig. (2-tailed)	0.71	.		
	N	41	82		
EXCHANGE	Correlation Coefficient	**0.37**	**0.43**	1.00	
	Sig. (2-tailed)	**0.019****	**0.000***	.	
	N	41	82	92	
BENEFITS	Correlation Coefficient	**0.28**	**0.61**	**0.60**	1.00
	Sig. (2-tailed)	**0.074*****	**0.000***	**0.000***	.
	N	41	82	92	92
* Correlation is significant at the 0.01 level (2-tailed).					
** Correlation is significant at the 0.05 level (2-tailed).					
*** Correlation is significant at the 0.1 level (2-tailed).					

The spearman rank correlation coefficient for the pairing of cluster-related variables, EXCHANGE and BENEFITS, and the management-related variable RESEARCH, were both weak ($r_s = 0.37$ and $r_s = 0.28$ respectively) and only marginally significant (at 95% and 90% confidence respectively). The relationship between the variable INTERACTION and the variable RESEARCH was not significant. All correlations are positive suggesting that an increase in the score of one variable will correspond with an increase in the score of another variable.

The strongest relationships occur between the measures of territorial clustering. This is a reflection of the larger sample sizes (n =+80) associated with these relationships. These variables are compared to ensure they were appropriately specified. The positive correlation coefficient suggests a relationship between INTERACTION and EXCHANGE ($r_s = 0.43$ p = 0.000, n = 82) and a relationship between INTERACTION and BENEFITS ($r_s = 0.61$ p = 0.000, n = 82) as well

as EXCHANGE and BENEFITS $r_s = 0.60$ p = 0.000, n = 92). This observation confirms that each of the variables does, to some degree, measure the same thing. However, the fact that the measures are only moderately related (r_s between 0.43 and 0.61) suggests that each is somewhat unique and thus offers an acceptable level of insight when used on its own. If these measures were more highly correlated it could be argued that they are redundant and only one need be used.

The Mann-Whitney U tests, which measure the difference in mean ranks of two groups, returned non-significant results for both the relationships tested (table 4.6). Neither being connected to a network nor an association is related to a higher level of research and development expenditure even with the larger sample size.

Table 4.6: Test Results for Proposition 3 – large sample (Mann-Whitney U)

Mann-Whitney U rank-sum test		RESEARCH	INTERACTION	EXCHANGE	BENEFITS
NETWORK	Mann-Whitney	167.000			
	Sig. (2-tailed)	0.779			
	N	40			
ASSOCIATION	Mann-Whitney	71.500			
	Sig. (2-tailed)	0.403			
	N	41			
* Correlation is significant at the 0.01 level (2-tailed).					
** Correlation is significant at the 0.05 level (2-tailed).					
*** Correlation is significant at the 0.1 level (2-tailed).					

4.4. General findings

In an effort to complete the theory building framework this chapter looked to a sample of firms assumed to be in a cluster to see if a relationship could be observed between three cluster perspectives and three views on management

The proposition which tests the relationship between the competitiveness perspective and the product-based view of management generated only 2 significant relationships out of 12 tests. Both of these relationships had a magnitude that was very small relative to the scale of the dependent variable. The small sample size posed the greatest problem in detecting the potential relationship between variables.

The model used to test the proposition that the externalities perspective is related to the resource-based view of management also struggled with the sample size. Only when testing the larger sample (biotechnology and new media respondents) did 3 of the 10 relationships tested produce results that did not violate the sample size assumption. None of these three relationships is considered significant.

The model used to test the proposition that the territorial perspective is related to the knowledge-based view of management responded as expected to the sensitivity analysis. When testing the smaller sample of biotechnology firms, no significant relationships were observed between the cluster-related and management-related variables. However, when the sample size was increased 2 out of 5 relationships generated weakly significant results. The cluster-related variables, EXCHANGE and BENEFITS, are the only ones that correlate with the management variable RESEARCH; and even then, the correlation was modest (0.37 and 0.28 respectively)

In addition to testing the cluster-related variables against the management variable, the cluster-related variables were compared to one another. When tested within the smaller biotechnology sample, only 2 out of 3 relationships generated significant but weak relationships. When tested in the large sample, all of the cluster-related measures produced significant relationships ranging from weak to moderate in strength. The observation of more significant relationships and an increase in the magnitude of some of those relationships confirms the model's responsiveness to sample size. The presence of multicollinearity is attributed to the fact that each cluster-related variable measures the social mechanisms associated with territorial clustering. The weak to moderate magnitude of the correlations suggest that the each measure retains enough uniqueness to be considered on its own.

The emergence of primarily non-significant results or weak relationships, if correct, suggests that for this sample the three perspectives on clustering are not statistically related to the three views of management. In order to ensure that these observations are correct, efforts were made to minimize the occurrence of misspecified observations (poor proxy measures) and the use of inappropriate tests.

The possibility of selecting inappropriate measures to represent various cluster attributes is increased for two reasons. First, cluster attributes are difficult to observe and thus proxies have to be developed. Developing proxies is a subjective process that can introduce bias into the study. Second, there are few sources of data that focus on measuring the theoretic cluster attributes. Much of the data focuses on aggregate regional measures that do not provide the firm-level detail desired to test the perspectives on clustering established in chapter two.

For these reasons several steps were taken to determine if the measures used were appropriate. The data was stratified into the smaller subset of biotechnology firms as well as the larger set incorporating new media respondents. While these two sectors are fundamentally different, the theories on clustering are expected to be sufficiently robust to apply to firms in all sectors. By testing two sample sizes one is able to gauge how sensitive the analysis is to an increase in sample size. The presence of more results as the sample size increased suggests the models and measures are working appropriately. Furthermore, the emergence of any significant results at all also suggests that the measures do effectively represent some aspects of the cluster theory. In particular, the co-variance amongst measures of territorial clustering confirmed that the model worked as desired.

The data and selected measures ultimately determine what tests can be used. The small sample size and limited amount of empirical work surrounding cluster theory suggested the need for tests with few parameters. As mentioned early in the chapter, non-parametric tests are selected according to the sample structure and the hypothesis to be tested. Two types of non-parametric tests emerged in this analysis. Measures of association were used in cases where two variables measured a firm's actions and those actions were thought to be related. Measures of location were used when a firm's actions qualified that firm to be placed into a group and that group was thought to have a different relationship to various performance measures. In most cases, the tests used met the required assumptions. As a result, it can be argued that both appropriate measures and tests were utilized and the non-significant results are attributable to the management perspectives not being the correct explanation of the operational context for each perspective on clustering. The following chapter discusses what this observation of little or no correlation

between the cluster perspectives and the views on management means to the theory building effort.

CHAPTER 5

Following is a summary of the research and findings as well as a discussion of its implications. Section 5.1 provides an overview of the results and explains what they mean in terms of supporting or rejecting the hypotheses. Following this, section 5.2 identifies the limitations of this project. Section 5.3 concludes by addressing the project's contribution to the study of clustering and identifying future avenues for investigation.

5.1.   Summary and Discussion

At the outset of this project, industrial clustering was understood as a rich mix of multidisciplinary concepts and mechanisms that explain the ways in which similar organizations tend to grow or shrink together. However, within that rich mix of concepts and mechanisms the central importance of firms has diminished as interest has increasingly been on non-firm organizations like government agencies, associations and service providers. In an effort to restore the importance of firms, this project proposed that each of the three perspectives of clustering corresponds to a specific management philosophy characterized by distinct strategic motivations and performance objectives.

The proposed model implies that clusters rely on the opposing forces of cooperation and competition to generate a degree of economic coordination that enhances the ability of individual firms to perform successfully over longer time periods. Depending on the cluster perspective, economic coordination happens via different relationship structures and leads to unique types of benefits. Each type of clustering is expected to co-exist with one of the management styles.

This co-existence was operationalized and tested on an existing data set of companies believed to operate within an industrial cluster. Through a variety of proxy measures each respondent indicated whether or not each type of cluster was present as well as whether or not they subscribed to one of the management views. The variables representing the cluster perspectives were tested for correlation to the variables representing the management approaches. The observation of correlations can be considered a confirmation of the proposed relationship

between types of clustering and approaches to management. However, a lack of correlation indicates that the proposed relationship between clusters and management does not exist in this sample and may not be an appropriate theoretic link. The results and their implications are as follows.

Based on their common focus on value-chain concepts and business-to-business linkages it was proposed that *the competitiveness perspective on clustering is related to the product based view of management*. The findings presented in chapter 4 (table 5.1) initially suggest that this is true in some of the cases. In the smaller sample, 4 out of 12 tests produced significant correlation with 3 of these relationships being weak and 1 being virtually non-existent.[19] In the larger sample, only 2 of the 12 tests produced significant correlation and both of these relationships were considered virtually non-existent. While the statistically significant observations are encouraging, the weak and virtually non-existent categorization of their magnitude suggests they are not substantial relationships. As a result, these findings collectively provide little evidence to support the theoretical argument that the competitiveness perspective is related to the product-based view of management in this particular sample.

These results tell us a number of things. First, the fact that some correlation was observed suggests that something was in fact measured. This means the model and its metrics were not completely irrelevant. As a result, one must focus on the theoretical implications of non-observation. In other words, in the Saskatoon and Vancouver biotechnology clusters as well as the Vancouver new media cluster the presence of variance provides some evidence of a relationship between competitiveness clustering the product-based view of management but this relationship is not compellingly strong. The use of non-parametric statistics means that this result can not be extend to the general population but nonetheless, the result certainly suggests that one should reconsider if the proposition is logically valid and worth recreating in subsequent studies.

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[19] The classification of significant relationships into the categories of 'virtually non-existent', 'weak', 'moderate', and 'strong' is highly subjective. Within the statistics literature it is commonly argued that interpreting the magnitude of a relationship should be done on a case by case basis.

Table 5.1: Summary of test results for Proposition 1

Proposition 1: the competitiveness perspective is related to the product-based view	Smaller Sample (Accept/Reject)	Complete Sample (Accept/Reject)
H$_1$: The local presence of key customers (CUSTOMERS) is related to a firm's revenues (REVENUES).	**Reject**	**Reject**
H$_2$: The local presence of key suppliers (SUPPLIERS) is related to a firm's revenues (REVENUES).	Accept (v/n)	Accept (v/n)
H$_3$: The local presence of key competitors (COMPETITORS) is related to a firm's revenues (REVENUES).	**Reject**	**Reject**
H$_4$: The local presence of key customers (CUSTOMERS) is related to a firm's growth (GROWTH).	Accept (w)	**Reject**
H$_5$: The local presence of key suppliers (SUPPLIERS) is related to a firm's growth (GROWTH).	**Reject**	**Reject**
H$_6$: The local presence of key competitors (COMPETITORS) is related to a firm's growth (GROWTH).	**Reject**	**Reject**
H$_7$: The local presence of key customers (CUSTOMERS) is related to a firm's domestic sales (DOMESTIC).	**Reject**	**Reject**
H$_8$: The local presence of key suppliers (SUPPLIERS) is related to a firm's domestic sales (DOMESTIC).	**Reject**	**Reject**
H$_9$: The local presence of key competitors (COMPETITORS) is related to a firm's domestic sales (DOMESTIC).	Accept (w)*	**Reject**
H$_{10}$: The local presence of key customers (CUSTOMERS) is related to a firm's international sales (INTERNATIONAL).	**Reject**	**Reject**
H$_{11}$: The local presence of key suppliers (SUPPLIERS) is related to a firm's international sales (INTERNATIONAL).	**Reject**	**Reject**
H$_{12}$: The local presence of key competitors (COMPETITORS) is related to a firm's international sales (INTERNATIONAL).	Accept (w)	Accept (v/n)
(v/n) = virtually no relationship, (w) = weak relationship, (m) = moderate relationship, (s) = strong relationship * Pair-wise follow up tests found this relationship significant		

It was proposed that *the externalities perspective is related to the resource-based view of management* because both place an emphasis on the development of resources and capabilities in order to achieve successful performance in the long run. The findings presented in Chapter 4 (table 5.2) do not provide strong evidence in support of this proposition. Four different proxy measures were used to represent the externalities perspective on clustering. In the smaller sample set only one of these measures was correlated to the proxy measure of resource-based management (innovation index). However, this result must be ignored because all of the tests

from the smaller sample of biotechnology firms violated the sample size assumption. The larger sample yielded 3 valid tests out of 10 but none of those observed statistically significant correlation. This means that in the sample of firms from Saskatoon and Vancouver there is no observable relationship between the measures of externality-style clustering and the resource-based approach to management. Once again this result can not be considered representative of the general population but does cast some doubt on the validity of the theoretic proposition as well as the way in which it was operationalized. For this particular proposition the wide spread occurrence of invalid sample size errors suggests that better variables could provide a more reliable result.

Table 5.2: Summary of test results for Proposition 2

Proposition 2: the externalities perspective is related to the resource-based view	Smaller Sample (Accept/Reject)	Complete Sample (Accept/Reject)
H$_{13}$: The presence of a specialized labour force (LABOUR) is related to a firm's innovativeness (INNOVATION).	**Reject**	**Reject**
H$_{14}$: The presence of unique local assets and capabilities (ASSETS) is related to a firm's innovativeness (INNOVATION).	Accept (w)	**Reject**
H$_{15}$: The use of local specialized service providers (SERVICE) is related to a firm's innovativeness (INNOVATION).	**Reject**	**Reject**
H$_{16}$: The use of local consultants (CONSULTANT) is related to a firm's innovativeness (INNOVATION).	**Reject**	**Not Applicable**
(v/n) = virtually no relationship, (w) = weak relationship, (m) = moderate relationship, (s) = strong relationship		

It was proposed that *the territorial perspective on clustering is related to the knowledge-based view of management* because each theory emphasizes positive-sum growth and a central role for knowledge assets. The findings presented in chapter 4 (table 5.3) generally suggest that this is not true. Five different measures of territorial clustering were compared to one measure of knowledge-based management. In the smaller sample set (biotechnology firms) none of the cluster measures were observed to be significantly correlated to the measure of knowledge-based management. When the larger sample was tested, 2 of the 5 measures of territorial clustering produced statistically significant correlation to the measure of knowledge-based management. However, despite statistical significance the magnitude of these relationships is only considered

small. As a result, one can once again interpret the results as an indication that territorial clustering is not substantially related to knowledge-based management in this particular sample. Yet, since some minor correlation was observed one can feel confident that the measures were indeed effective.

Table 5.3: Summary of test results for Proposition 3

Proposition 3: the territorial perspective is related to the knowledge-based view	Smaller Sample (Accept/Reject)	Complete Sample (Accept/Reject)
H$_{17}$: A firm's frequency of interaction (INTERACTION) with knowledge creation institutions (research institutes and technology transfer centres) is related to a firm's research and development expenditure (RESEARCH).	**Reject**	**Reject**
H$_{18}$: The number of knowledge exchange types (EXCHANGE) a firm is involved in is related to a firm's research and development expenditure (RESEARCH).	**Reject**	Accept (w)
H$_{19}$: The number of knowledge exchange benefits (BENEFITS) a firm derives from its relationships is related to a firm's research and development expenditure (RESEARCH).	**Reject**	Accept (w)
H$_{20}$: Being part of a network (NETWORK) is related to a firm's research and development expenditure (RESEARCH).	**Reject**	**Reject**
H$_{21}$: Being part of an association (ASSOCIATION) is related to a firm's research and development expenditure (RESEARCH).	**Reject**	**Reject**
(v/n) = virtually no relationship, (w) = weak relationship, (m) = moderate relationship, (s) = strong relationship		

All together 21 hypotheses were tested on two versions of the sample for a total of 42 tested relationships (table 5.4). Out of these only 9 hypotheses could be accepted. In other words, in 33 of the tests the null hypothesis, that no relationships exist, was accepted. Furthermore, all nine of the statistically significant relationships registered an unsubstantial magnitude of either 'virtually non-existent' or 'weak'. This clearly tells us that in this sample the proposed relationships between clustering and the views on management are not as prominent as the theory or rhetoric would suggest .

Table 5.4: Results according to the theory development framework

			Competitiveness Perspective	Externalities Perspective	Territorial Perspective
What?					
How?			Exchange Relationships & Traded Benefits	Location Factors & Untraded Benefits	Relational Capital & Extra-Economic Benefits
Why?	**Existence**				
	Extension				
	Exhaustion				

Are the perspectives on clustering related to the views on firm management?

When/Where/Whom? (context)	**Product-based View** Competitive Dominance via Value Chain Control	**Resource-based View** Creative Destruction via Internal Develop.	**Knowledge-based View** Value Creation via Knowledge Assets
	↓	↓	↓
	Proposition 1: 12 hypotheses (24 tests) 6 correlations	**Proposition 2:** 4 hypotheses (8 tests) 1 correlation	**Proposition 3:** 5 hypotheses (10 tests) 2 correlations

The fact that one did not observe the desired relationships is not an outright rejection of the theory but does suggest that the theory and the model should be revisited and redeveloped before conducting additional testing. The reason the theory is not outright rejected is that the use of non-parametric tests means the results only apply to this sample. In this case, it is possible that the relationships could not be observed because the initial assumption that the respondents were located in a cluster is false. If this is in fact the case the cluster-related measures would have been ineffectual, essentially producing scores too small to reasonably be tested for an overlap with the scores on management perspectives. By this same logic one might argue that the relationships could not be observed because the respondents actually pursued a management philosophy altogether different from the three included in the test. Simply put, there is no possible way to detect a relationship when either the cluster perspectives or the views on management are not present within the sample. This explanation would also apply if the proxy measures did a poor job of representing either the cluster perspectives or management views and thus made it seem as though one or the other was not present. Essentially, the relationships should be more prominent and detectable in a well-functioning cluster and less prominent and detectable in a less-developed

cluster. If these respondents are not in a cluster or in a poorly-functioning cluster then the relationships will be much less pronounced. This is precisely what was observed.

These explanations as to why the relationships were not observed focus on technicalities of measurement and sampling while hiding the most obvious explanation – that the theory is flawed, at least as far as the firms in this sample are concerned. In terms of the theory development framework, it is possible that the cluster perspectives were incorrectly matched to the management philosophies. For instance, the operational context of the competitiveness perspective may be best explained by either resource-based management or knowledge-based management. These possibilities were not tested and thus represent a potential gap in the model. One could stretch this logic even further by reconsidering if the three views on management truly explain all strategic motivations or if the firms of the sample actually employ a different approach to management. Regardless of how the null results are interpreted one has to acknowledge that both the theory and the model need to be reconsidered.

5.2. Limitations

As with any research project there are limitations. In this case most relate to the modeling of the theory. Nonetheless the limitations do not preclude this project from making valuable insights and conclusions related to industrial clustering.

Since the propositions attempted to extend all three cluster perspectives at once to include a specific management context there was a limited amount of space to delve into the detail of each relationship. Additional theorizing could produce some detailed examples of how the cluster – management relationships manifest themselves and thus provide additional ways to measure each proposition. Furthermore, each cluster perspective was matched against its most logical management counterpart. This simplified the testing but may have overlooked the potential relationship amongst each cluster perspective and the other two approaches to management. Some exploratory testing may help determine the appropriate match between the cluster perspectives and management views.

In order to ensure adequate sample sizes, respondents from three distinct clusters at two locations were included. These respondents were combined under the assumption that any cluster-based company will provide scores on one of the three cluster perspectives and one of the three management views. This ignores the possibility that each region will exhibit the proposed relationships in varying degrees. As a result subsequent research could do a better job of accounting for location-specific variations in the proposed relationships between clustering and management. This may include giving consideration to the use of time series data that better reveal how these relationships change over time.

Both the cluster perspectives and management views are broadly scoped concepts that are difficult to comprehensively measure. The inherent limitation of the proxy measures used for each of these concepts is that they are incompletely represented. Future research can draw on a variety of statistical techniques such as factor analysis and the construction of scales and indices to assist in the development of more comprehensive metrics.

Finally, the adoption of the ISRN survey and data was convenient and cost effective but yielded responses that can be considered imperfectly relevant. The survey was lengthy as it was designed to meet the needs of many different researchers, sectors and regions. The length may have reduced the quality of some respondents' answers. Furthermore, many of the questions were open-ended, enabling the respondents to make their interpretation of the cluster concepts being investigated and potentially introducing some biased response. The construction of a survey instrument designed to address the theory and model introduced in this project would likely produce a better quality of data.

5.3.   Contribution to the literature

At the outset of this project the focus was on re-establishing the importance of firms in the literature related to industrial clustering. The incomplete theory development framework presented the opportunity to propose a theory-based link between clusters and firms. By using the three views on management to complete this framework and explain when each perspective on clustering is relevant as well as when one perspective should yield to another this project takes an

important step toward defining a causal pathway that links clusters through firms to economic performance.

The results of the empirical analysis should simply be interpreted as an indication that the propositions need additional refinement. One should avoid the urge to over interpret the non-observation of relationships as an indication that clusters do not exist in the locations studied or that the general link between clusters and firms is not valid. These results speak more to the quality of the borrowed data and the need for better metrics than anything else. Hence, it would be advised that subsequent research spend more effort defining the attributes and mechanisms that define each cluster-management relationship so as to support the development of better metrics.

In the process of exploring the cluster-management relationship several interesting considerations arose. First, one should consider how well each cluster perspective matches up to all of the approaches to management. It could be possible that the structures and benefits associated with each perspective offer some benefit to firms with all types of management philosophies. Additionally one may consider if there is a lifecycle component to the emergence of each perspective on clustering. For instance, does the territorial cluster foster firm discoveries that evolve into engineering platforms to be developed by firms within an externalities cluster. The externalities cluster may then in turn help firms produce commodity products that require the support of a competitiveness style cluster. Finally, the profits that firms harvest from a star product may be reinvested in research that draws on the benefits of a territorial cluster structure. In other words, overtime there may be an evolutionary pathway between the various perspectives on clustering.

Regardless of where subsequent research heads, this project has served its purpose of recasting firms as the central focal point of industrial clustering.

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ISRN Cluster Study – Company Interview Guide

Name of Interviewee:
Name of Interviewee Company:
Number of Employees:

Part A: Company Background

The purpose of this section is to gain a sense of the background factors that underlie the presence and growth of the company in a specific cluster.

1.1 What events stimulated the founding of this company?

1.2 Who were the key individuals and or organizations inside and outside the company who played a role in its development?

2. If your company is a subsidiary or branch of another firm, what role does it play within the overall corporate structure?

3.1 Are there any other companies in Saskatoon that your company is associated with?

3.2 Do you have a strategic relationship with any particular company?

3.3 Were you spun-off from any other companies? Have you spun out any companies from your firm?

4. Why is your company located in Saskatoon?

5. What are the current advantages of Saskatoon for your firm?

Part B-Company Strategy

The purpose of this section is to gain some insight into the way the company positions itself to innovate within the context of its cluster.
Innovation can be related to: Products, Processes, Markets, Business Structures, Materials and Inputs

1.1 During the last three years, did your company offer new or significantly improved **products** (goods or services) to your clients?

1.2 During the last three years, did your company offer new or significantly improved **production/ manufacturing processes**?

2.1 Were these innovations:
___ New to the World?
___ New to Canada?
___ New to your Firm?

2.2 Does your firm hold an existing or pending patent on this or other products and processes? (if so how many)

2.3 Is your firm currently developing a new product or process? (Please describe)

2.4 If yes, is this new product/process likely to reach the market in the next three years? (If a therapeutic product undergoing regulatory review: at what stage is this product in the regulatory process?)

3. Please indicate the relative importance of the following **local** sources of innovative ideas for your product, service and process development.

	Not Applicable	Not Important	Somewhat Important	Important	Very Important	Most Important
R&D (In-house)						
Marketing Department						
Suppliers						
Competitors' Products						
Fed or Provincial agencies or Research Institutes						
Venture Capitalists or other Financial Services						
Production or Engineering Staff						
Management						
Customers/clients						
University Researchers						
Consultants (Academic or Professional)						

4. Please indicate the relative importance of the following **non-local** sources of innovative ideas for your firm.

	Not Applicable	Not Important	Somewhat Important	Important	Very Important	Most Important
Parent or Affiliated Companies						
Customers						
University Researchers						
Fed or Provincial agencies or Research Institutes						
Venture Capitalists or other Financial Services						
Suppliers						
Other Public Research Institutes						
Competitors Products						
Consultants (academic or professional)						

Part C: Networking, Relationships, Suppliers, Customers and Competitors

These questions are designed to probe the role of supply and demand factors in the formation and strength of the cluster. We are interested in the extent to which co-location may be a critical factor in grounding the cluster.

1.1 Where are your key customers/clients located – locally (within 100km), in the rest of the country, North America or the world?

1.2 How important is it for you to be located close to them?

1.3 Would your company consider relocating to these key customers?

2. Are your relations with local customers different from your relations with non-local customers? If yes then how are they different?

3.1 What are the most important inputs to your company? *Allow respondent to answer and fill in boxes below:*
[   ] knowledge/IP; [   ] resources; [   ] raw materials; [   ] components; [   ] services; [   ] designs; [   ] knowledge and information

3.2 Are your key suppliers located locally (within 100kn) or non-locally?

3.3 How important is it for you to be located close to them?

3.4 Would your company consider relocating to these key suppliers?

4. Are your relations with local suppliers different from your relations with non-local suppliers? If yes then how are they different?

Caution: Suppliers can come in two different forms; Knowledge suppliers and Component suppliers

How important is the location of your supplier in the current location of your firm?

5.1 Who are your primary competitors and where are they located?

5.2 What is their comparative size and market share?

5.3 Is it important for you to be located near them?

6. How does your company keep track of the activities of your (current and potential) competitors? Or to monitor competitive products, services or process innovations?

Part D: Locational/Infrastructure Factors

The purpose of this section is to test for some of the classic factors identified in the cluster and RIS literature as influencing the development of clusters.

1.What are the most important factors in the local/ regional economy that contribute or inhibit the growth of your firm?

	N/A	Inhibit	Contribute
Co-location with other firms in related industries			
Supply of workers with particular skills			
Physical, transportation or communication infrastructures			
Availability of Financing			
Specialized research institutions and universities			
Specialized training or educational institutions			
Presence of key suppliers or customers			
Government policies or programs			
Other			

2. Of the factors mentioned above which are the two or three most important for the growth of your firm?

3.What are the main sources of new employees in the following categories?

Employee Categories	Post secondary	Specialized Training	Other Firms				
Mgmt				non-local/local			
Sci/Tech,Eng				non-local/local			
Design				non-local/local			
Marketing/Sales				non-local/local			
Production				non-local/local			
Freelance/ contract							

4. Does the labour force in your locality or region possess any distinctive skills, knowledge or capabilities that are an asset to your company?

Do you use consultants? Are they local/non-local?

5.1 Tell us about employees who have left your firm within the last three years.

5.2 How many have been employed by other firms within Saskatoon? *Prompt: competitors, partners, other firms within the sector*.

5.3 If your KEY employees were to quit how easily could you replace them from within your local region?

What type of employees are you hiring right now?

Part E: Role of Research Institutions/Technology Transfer Centers

This part of the guide is designed to explore the importance of knowledge flows within the cluster and the role that research and tech transfer centers, including IRAP ITA's play in grounding the cluster. Is the knowledge base so valuable that firms are willing to relocate here to gain access to it? *Be sure to explicitly mention IRAP*

1. How frequently do you or others in your company interact with public research institutes or technology transfer centres (local or non-local), including federal or provincial government institutes, universities and colleges to gain access to new sources of knowledge?

2. What types of knowledge exchange are you (or others in your company) involved with?

[   ] Formal collaborative research projects
[   ] University faculty working in, or consulting with the company
[   ] Participation in research consortia
[   ] Licensing of your own firm's technologies
[   ] Licensing of other companies' technologies
[   ] Licensing or patenting of public research inventions
[   ] Development or adoption of new technology
[   ] Development of specialized training program with a college or university
[   ] Company personnel working with a college or university

3. Tell us more about how these relationships were developed or evolved?

4. What primary benefits do you derive from these relationships?

[   ] Leveraging R&D expenses
[   ] Access to technical expertise/IP
[   ] Source of new product ideas
[   ] Information about the knowledge frontier
[   ] Connection to larger research community
[   ] Market credibility
[   ] Lower overhead costs on research
[   ] Access to equipment and material
[   ] Problem solving
[   ] Improvement of in house R&D
[   ] Hiring and retention of employees
[   ] Coops and Interns

5. How many of these are locally based and what benefits do you derive from the close proximity?

6. Would you consider relocating or establishing another facility to be located by such a center or institute? (If it is not local)

Part F: Local Cluster Characteristics/Social Capital

This section is designed to get at the underlying dynamics of the local cluster, the role of associations, civic entrepreneurs, etc and the underlying significance of social capital within the cluster.

1. Do you consider your company to be part of a network of related firms in your region/locality, (i.e. a cluster)? What evidence is there of this?

2. Are there any specific events that played an important role in the development of your local industry or cluster? If yes, explain.

3.Are there any key business, community, or government leaders who played an important role in the development of your local industry or cluster? If yes, explain.

4. Are there any UNIQUE Saskatoon assets or capabilities that have contributed significantly to the development of your local industry or cluster? If yes, explain.

5. Does your company employ any specialized service providers (law firms, underwriters, accountants, business or technical consultants) located in this region?

6. What were the most important sources of funding used to develop your firm?

[   ] Angel Investors; [   ] Internally Generated Funds; [   ] Funds from Parents or Affiliated firms; [   ] Banks; [   ] Venture Capitalists; [   ] Equity Investment (Private); [   ] Equity Investment (Public Capital Markets, (IPO's); [   ] Gov't Loans and or Subsidies; [   ] Other. How many of these are local (located within 100km)?

7. How has this financing changed over the life of your firm? Describe the challenges you faced in obtaining the finances needed for your establishment to grow.

8. Does your company (or key individuals in it) belong to any formal or informal associations at the local or regional level? **If yes**, which are the most valuable and why? **If no**, why not? Are there any significant networking events that you attend regularly?

9. Did any associations play an important role in the development of your local industry?

10. Did any of your present relationships with suppliers, customers, collaborators, research institutes develop from your participation in associations, conferences, trade shows etc?

11. Are there any government programs that contributed significantly to the development of your local industry? (Are there any programs that undermined its development?)

Part G: The Future

1. What are the key trends (challenges or opportunities) that will most influence the growth of your business in the next five years?

2. What are the most important challenges or opportunities facing the Saskatoon network?

3. What factors, external supports or policies would be most helpful in growing your local industry network? Or your company?

Can you suggest any other contacts in this field (within your company outside your company) that would be interested in participating in this study?

Appendix: Intellectual Property (Companies and Research Organizations)

1. Do you have an Intellectual Property strategy? Is it formal or informal?

2. What intellectual property rights are you protecting?
   ___ Patents
   ___ Trade Secrets
   ___ Plant Breeders Rights
   ___ Copyrights
   ___ Other

3. Who in your company makes the decisions regarding Intellectual Property and at what capacity?
   What department are they located in?
   Where are they located?

   a) Who does all the work surrounding Intellectual Property? Is it external or internal?
   ___ Research staff
   ___ Business office
   ___ In-house attorney
   ___ Domestic attorney
   ___ Out of country attorney
   ___ Other

4. What mechanisms do you have in place to determine the value of Intellectual Property?
   (Prompt: Scientist, Management, Accountant, Attorney, Consultant…)
   Are they local or non-local?

5. Have you engaged in efforts to commercialize your technology?
   Who did it?
   Who took the lead? (Prompt: Scientist, Management, Accountant, Attorney, Consultant…)

6. Do you have a formal policy to share benefits with employees? What is it?

7. What types of contracts do you have with your employees? And at what sort of timeline for each?

	6 Months	1 Year	3 Years	Full - Time	Other Please Specify
Technicians					
Scientists					
Management					
Support Staff					

a) What type or format of confidentiality agreements do you put in place with your employees?

b) Do the confidentiality agreements extend beyond employment? How long and what measures do you take to enforce it?

Appendix: Consumer Acceptance

1. How do you determine what consumers think about your organization's product, service or research?
   _ Media   local?___ national?____ international?____
   _ Industry organization   local?___ national?____ international?____
   _ Directly from customers   local?___ non-local?____
   _ Other (Please specify)

2. What impact does consumer response have on your business?
   _ Location decisions
   _ Investment plan
   _ Production plan
   _ IP strategies
   _ Other (Please specify)

3. What research networking activities is your organization currently involved in? (Prompt: Genome Prairie, Hybrid Wheat Consortium, CropLife Canada, Council for Information on Biotechnology, other)

   Are they primarily local, national or global? Who is your representative, and what is their position?

4. In what way does your organization respond to negative consumer perception? (Prompt: through media, organization initiatives, direct with customers)

   In particular, who responds? (ex. CEO, Chief Scientist, Communications Officer, collective organization (i.e. – Ag West Biotech), hire a consultant, in-house / non-local personnel (i.e. – someone in a parent company)

ISRN Questionnaire: Organization Fact Sheet

Company/Organization Name:
Contact Name/Title:
Phone No
Fax No
E-mail:

Note on Terminology
The term 'firm' refers to your company as a whole (worldwide) while the term 'establishment' refers to the branch or subsidiary in which you are located if distinct from the former.

1. Firm ownership (please check all that apply):

    __Public   __ Private   __ Foreign   __ Domestic

Year this establishment was founded: _____

Type of business:

    __ Service   Please specify: _____

    __ Manufacturing Please specify: _____

What is the number of employees	Permanent	Contract
At this establishment:	_____	_____
In this region:	_____	_____
In your firm (if different):	_____	_____

How many of your employees at this establishment are in:

	Permanent	Contract
Management	_____	_____
Marketing/Sales	_____	_____
Logistics/Distribution	_____	_____
Production:	_____	_____
Research and Development	_____	_____
Other	_____	_____

What were your firm's R&D expenditures for the most recent fiscal year?

    __ N/A __<$.5M __$0.5M-$1M __$1M-$10M __$10M-$100M __>$100M

Approximately what proportion (percentage) of your total R&D activity takes place at *this location*? _____

What percent of your establishment's sales are in the following markets?

Local (within 100km)		_____%
Rest of the province:		_____%
Rest of Canada:		_____%
United States:		_____%
Europe:	_____%	
Pacific Rim:	_____%	
Rest of world:	_____%	

Please estimate, in approximate percentages, the importance of the following regions as sources of your supplies/inputs.

Local (within 100km)	_____%
Rest of the province:	_____%
Rest of Canada:	_____%
United States:	_____%
Europe:	_____%
Pacific Rim:	_____%
Rest of world:	_____%

Over the past 3 years has your establishment's volume of production (gross revenues):

_ Increased   - approximate percent: _____%

_ Decreased   - approximate percent: _____%

_ No change

Please indicate your establishment's gross revenues for the most recent fiscal year:

_ None (i.e. development phase)

_ Less than $500,000

_ $500,000 to $1,000,000

_ More than $1,000,000 to $10,000,000

_ More than $10,000,000 to $100,000,000

_ More than $100,000,000

Thank you for your participation! Please fax to:

Table A1: Data for Proposition 1 - the competitiveness perspective and product-based view

Company	CUSTOMERS 1 (local); 2 (Canada); 3 (North America); 4 (Global);	SUPPLIERS 0 (local); 1 (non-local); 2 (both)	COMPETITORS 0 (local); 1 (non-local); 2 (both); 3 (no competitors)	GROWTH 0 (decreased); 1 (unchanged); 2 (increased);	REVENUE 0 (no revenue); 1 ($1 million or less); 2 (over $1 million);	DOMESTIC %	INTERNATIONAL %
			N.R. (no response); M.V (missing values)				
1	N.R.	1	1	N.R.	2.00	N.R.	N.R.
2	4	2	2	2	2.00	N.R.	N.R.
3	1	0	3	N.R.	N.R.	N.R.	N.R.
4	4	2	1	N.R.	N.R.	N.R.	N.R.
5	2	2	1	2	1.00	90.00	N.R.
6	2	1	2	N.R.	N.R.	N.R.	N.R.
7	2	2	2	2	2.00	90.00	N.R.
8	2	0	1	2	1.00	5.00	90.00
9	N.R.	2	1	N.R.	0.00	N.R.	N.R.
10	3	1	1	N.R.	1.00	20.00	70.00
11	3	1	1	N.R.	N.R.	N.R.	N.R.
12	2	N.R.	2	2	2.00	90.00	N.R.
13	4	1	1	1	0.00	N.R.	N.R.
14	3	1	1	2	2.00	15.00	75.00
15	3	1	1	N.R.	N.R.	N.R.	N.R.
16	4	2	1	2	0.00	N.R.	85.00
17	3	1	2	2	2.00	105.00	5.00
18	2	0	2	2	0.00	85.00	5.00
19	3	1	2	2	1.00	95.00	5.00
20	4	0	2	2	1.00	70.00	15.00
21	4	2	1	2	1.00	30.00	55.00
22	4	1	1	N.R.	N.R.	N.R.	N.R.
23	3	1	1	N.R.	2.00	N.R.	N.R.
24	3	1	N.R.	N.R.	N.R.	N.R.	N.R.

Company	CUSTOMERS	SUPPLIERS	COMPETITORS	GROWTH	REVENUE	DOMESTIC	INTERNATIONAL
25	4	N.R.	1	N.R.	N.R.	N.R.	N.R.
26	1	N.R.	1	0	1.00	85.00	5.00
27	4	1	1	N.R.	N.R.	N.R.	N.R.
28	4	2	1	N.R.	N.R.	N.R.	N.R.
29	N.R.	M.V.	0	N.R.	N.R.	45.00	35.00
30	2	0	1	2	0.00	85.00	10.00
31	4	2	1	N.R.	2.00	N.R.	N.R.
32	4	1	1	N.R.	N.R.	N.R.	N.R.
33	3	N.R.	1	0	N.R.	15.00	55.00
34	4	1	1	N.R.	N.R.	30.00	60.00
35	4	2	1	N.R.	1.00	N.R.	90.00
36	4	1	1	N.R.	N.R.	N.R.	N.R.
37	3	1	1	N.R.	N.R.	20.00	70.00
38	3	1	1	2	N.R.	5.00	85.00
39	3	0	1	N.R.	N.R.	N.R.	N.R.
40	3	2	1	N.R.	N.R.	N.R.	N.R.
41	4	1	1	N.R.	N.R.	N.R.	N.R.
42	N.R.	2	1	N.R.	N.R.	N.R.	N.R.
43	2	0	1	N.R.	N.R.	N.R.	N.R.
44	3	2	1	N.R.	N.R.	N.R.	N.R.
45	4	1	1	N.R.	1.00	N.R.	N.R.
46	4	2	1	N.R.	N.R.	N.R.	N.R.
47	4	1	1	N.R.	N.R.	N.R.	N.R.
48	N.R.	1	1	N.R.	N.R.	N.R.	N.R.
49	N.R.	1	1	N.R.	N.R.	N.R.	N.R.
Biotechnology Firms Above, New Media Firms Below							
50	3	M.V.	3	N.R.	N.R.	N.R.	N.R.
51	1	M.V.	3	N.R.	N.R.	N.R.	N.R.
52	1	M.V.	3	2	1.00	N.R.	N.R.
53	3	1	0	N.R.	N.R.	N.R.	N.R.
54	1	0	2	N.R.	N.R.	N.R.	N.R.
55	3	0	0	N.R.	N.R.	N.R.	N.R.
56	4	1	3	N.R.	N.R.	N.R.	N.R.
57	4	1	1	0	1.00	N.R.	N.R.
58	4	1	1	N.R.	N.R.	N.R.	N.R.
59	3	M.V.	0	N.R.	N.R.	N.R.	N.R.

Table A1 Continued …

Company	CUSTOMERS	SUPPLIERS	COMPETITORS	GROWTH	REVENUE	DOMESTIC	INTERNATIONAL
60	1	1	0	N.R.	N.R.	N.R.	N.R.
61	1	1	3	N.R.	N.R.	N.R.	N.R.
62	3	M.V.	2	N.R.	N.R.	N.R.	N.R.
63	3	M.V.	1	N.R.	N.R.	N.R.	N.R.
64	3	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
65	1	0	0	N.R.	N.R.	N.R.	N.R.
66	2	0	0	N.R.	N.R.	N.R.	N.R.
67	3	1	2	1	1.00	20.00	60.00
68	4	M.V.	1	2	1.00	95.00	N.R.
69	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
70	M.V.	N.R.	M.V.	N.R.	N.R.	N.R.	N.R.
71	3	0	1	1	1.00	95.00	N.R.
72	2	2	2	2	2.00	70.00	15.00
73	3	0	1	2	1.00	N.R.	N.R.
74	4	2	M.V.	N.R.	N.R.	N.R.	N.R.
75	3	M.V.	1	2	1.00	N.R.	N.R.
76	3	0	1	2	2.00	N.R.	N.R.
77	3	M.V.	1	N.R.	N.R.	N.R.	N.R.
78	4	M.V.	3	N.R.	N.R.	N.R.	N.R.
79	4	1	2	2	2.00	60.00	10.00
80	3	M.V.	2	2	2.00	45.00	45.00
81	3	1	2	2	1.00	N.R.	15.00
82	3	0	1	2	2.00	95.00	N.R.
83	3	0	1	2	1.00	90.00	5.00
84	2	0	1	2	1.00	10.00	95.00
85	4	M.V.	2	N.R.	N.R.	N.R.	N.R.
86	N.R.	M.V.	N.R.	N.R.	N.R.	N.R.	N.R.
87	3	0	1	1	0.00	85.00	5.00
88	3	0	M.V.	2	2.00	95.00	N.R.
89	1	N.R.	2	N.R.	N.R.	N.R.	N.R.
90	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
91	3	0	1	2	2.00	80.00	15.00
92	3	M.V.	1	N.R.	N.R.	N.R.	N.R.

Table A2: Data for Proposition 2 - the externalities perspective and resource-based view

Company	INNOVATION 1 (non-innovative); 2 (innovative)	LABOUR 0 (no); 1 (yes)	ASSETS 0 (no); 1 (yes)	SERVICE 0 (no); 1 (yes)	CONSULTANTS 0 (no); 1 (yes)
	N.R. (no response); M.V (missing values)				
1	1.00	1	1	1	1.00
2	2.00	1	1	0	0.00
3	1.00	0	1	1	0.00
4	2.00	1	1	1	1.00
5	2.00	1	1	1	1.00
6	2.00	1	1	1	1.00
7	2.00	1	1	1	1.00
8	2.00	1	0	1	1.00
9	1.00	1	1	1	0.00
10	2.00	1	1	1	1.00
11	1.00	0	1	1	1.00
12	1.00	0	0	1	1.00
13	2.00	1	1	0	1.00
14	2.00	0	0	1	1.00
15	2.00	0	0	1	1.00
16	2.00	1	1	1	1.00
17	2.00	1	1	1	1.00
18	2.00	1	1	0	1.00
19	2.00	1	1	1	1.00
20	2.00	1	1	1	1.00
21	2.00	0	1	1	0.00
22	1.00	0	N.R.	1	N.R.
23	2.00	0	1	1	N.R.
24	2.00	1	0	1	N.R.
25	2.00	0	1	1	N.R.
26	1.00	1	N.R.	1	N.R.
27	2.00	N.R.	N.R.	0	N.R.
28	2.00	1	1	1	N.R.
29	2.00	1	1	1	N.R.
30	1.00	1	0	1	N.R.
31	2.00	1	1	1	N.R.
32	2.00	0	1	1	N.R.
33	1.00	1	N.R.	1	N.R.
34	2.00	1	1	1	N.R.
35	1.00	0	1	1	N.R.

Company	INNOVATION	LABOUR	ASSETS	SERVICE	CONSULTANTS
36	1.00	0	0	1	N.R.
37	2.00	1	1	1	N.R.
38	2.00	0	0	1	N.R.
39	2.00	0	1	1	N.R.
40	2.00	0	1	1	N.R.
41	2.00	1	1	1	N.R.
42	2.00	1	1	1	N.R.
43	1.00	1	1	0	N.R.
44	2.00	N.R.	1	0	N.R.
45	2.00	1	1	1	N.R.
46	1.00	1	0	1	N.R.
47	2.00	0	1	1	N.R.
48	2.00	1	1	1	N.R.
49	2.00	N.R.	N.R.	1	N.R.
Biotechnology Firms Above, New Media Firms Below					
50	2.00	1	0	1	N.R.
51	1.00	1	1	1	N.R.
52	2.00	0	0	1	N.R.
53	2.00	1	N.R.	N.R.	N.R.
54	1.00	1	M.V.	1	N.R.
55	1.00	1	M.V.	1	N.R.
56	2.00	0	N.R.	1	N.R.
57	2.00	1	0	1	N.R.
58	2.00	0	1	1	N.R.
59	1.00	M.V.	0	1	N.R.
60	2.00	1	1	1	N.R.
61	1.00	0	N.R.	1	N.R.
62	1.00	0	1	1	N.R.
63	1.00	1	1	1	N.R.
64	1.00	M.V.	N.R.	M.V.	N.R.
65	1.00	1	1	1	N.R.
66	1.00	1	1	1	N.R.
67	2.00	1	0	1	N.R.
68	2.00	1	0	1	N.R.
69	1.00	N.R.	N.R.	N.R.	N.R.
70	1.00	N.R.	N.R.	N.R.	N.R.
71	2.00	1	0	1	N.R.
72	2.00	1	N.R.	1	N.R.
73	2.00	1	0	1	N.R.

Table A2 Continued …

Company	INNOVATION	LABOUR	ASSETS	SERVICE	CONSULTANTS
74	2.00	1	N.R.	N.R.	N.R.
75	2.00	1	0	1	N.R.
76	2.00	0	1	1	N.R.
77	2.00	M.V.	N.R.	N.R.	N.R.
78	2.00	0	N.R.	1	N.R.
79	1.00	1	0	1	N.R.
80	2.00	0	1	1	N.R.
81	2.00	0	0	1	N.R.
82	2.00	0	0	1	N.R.
83	2.00	0	1	1	N.R.
84	2.00	1	1	1	N.R.
85	1.00	1	N.R.	N.R.	N.R.
86	1.00	N.R.	N.R.	N.R.	N.R.
87	2.00	0	M.V.	1	N.R.
88	2.00	1	1	1	N.R.
89	1.00	N.R.	N.R.	N.R.	N.R.
90	1.00	N.R.	N.R.	N.R.	N.R.
91	2.00	M.V.	0	1	N.R.
92	2.00	1	1	1	N.R.

Table A3: Data for Proposition3 - the territorial perspective and knowledge-based view

Company	RESEARCH 0 (none); 1 ($1 million or less); 2 (>$1 million up to $10 million); 3 (>$10 million)	INTERACTION 1 (never); 2 (rarely); 3 (regularly); 4 (frequently);	EXCHANGE 1 (3 or less); 2 (4 to 6); 3 (7 or more)	BENEFITS 1 (0 to 3); 2 (4 to 7); 3 (8 to 11)	NETWORK 0 (no); 1 (yes);	ASSOCIATION 0 (no); 1 (yes)
	N.R. (no response); M.V (missing values)					
1	2.00	2	2.00	2.00	0	1
2	3.00	3	1.00	3.00	0	1
3	N.R.	2	2.00	2.00	1	0
4	N.R.	3	2.00	3.00	1	1
5	1.00	3	1.00	1.00	1	1
6	N.R.	3	2.00	3.00	1	0
7	3.00	4	3.00	3.00	1	1
8	1.00	3	1.00	2.00	1	1
9	1.00	4	2.00	3.00	1	0
10	N.R.	3	1.00	2.00	1	0
11	2.00	2	2.00	2.00	0	1
12	3.00	2	1.00	1.00	1	0
13	2.00	3	2.00	2.00	1	0
14	2.00	3	2.00	3.00	1	0
15	N.R.	1	2.00	1.00	0	1
16	N.R.	3	1.00	2.00	0	1
17	2.00	3	2.00	2.00	1	1
18	3.00	3	2.00	3.00	1	1
19	1.00	3	1.00	2.00	1	1
20	2.00	3	3.00	3.00	1	1
21	1.00	4	1.00	3.00	0	1
22	N.R.	3	1.00	1.00	N.R.	1
23	N.R.	4	1.00	2.00	0	1
24	N.R.	4	2.00	3.00	1	1
25	N.R.	2	3.00	2.00	1	1
26	N.R.	3	3.00	3.00	1	1
27	N.R.	2	1.00	2.00	0	1
28	N.R.	4	2.00	3.00	1	1

Table A3 Continued …

Company	RESEARCH	INTERACTION	EXCHANGE	BENEFITS	NETWORK	ASSOCIATION
29	1.00	3	1.00	2.00	1	1
30	1.00	3	2.00	3.00	1	1
31	N.R.	2	2.00	2.00	1	1
32	N.R.	4	2.00	2.00	0	1
33	2.00	4	3.00	3.00	0	1
34	3.00	4	3.00	2.00	1	1
35	1.00	3	3.00	3.00	1	1
36	N.R.	2	1.00	2.00	1	1
37	2.00	4	3.00	3.00	1	1
38	1.00	4	2.00	2.00	0	1
39	N.R.	3	1.00	3.00	0	1
40	N.R.	2	2.00	3.00	0	1
41	N.R.	4	1.00	3.00	1	1
42	N.R.	3	2.00	3.00	1	1
43	N.R.	3	1.00	2.00	0	1
44	N.R.	3	1.00	1.00	0	1
45	N.R.	3	2.00	1.00	0	1
46	N.R.	3	2.00	2.00	1	1
47	N.R.	3	2.00	3.00	1	1
48	1.00	4	2.00	3.00	1	1
49	N.R.	4	2.00	2.00	1	1
Biotechnology Firms Above, New Media Firms Below						
50	N.R.	M.V.	1.00	1.00	1	0
51	N.R.	1	1.00	1.00	1	1
52	1.00	4	1.00	1.00	1	1
53	N.R.	2	1.00	1.00	1	N.R.
54	N.R.	1	1.00	1.00	0	1
55	N.R.	2	1.00	1.00	1	1
56	N.R.	3	1.00	3.00	1	1
57	1.00	2	1.00	1.00	0	0
58	N.R.	2	1.00	2.00	0	1
59	N.R.	M.V.	1.00	1.00	0	0
60	N.R.	N.R.	1.00	2.00	1	0
61	N.R.	M.V.	1.00	1.00	1	1

Table A3 Continued ...

Company	RESEARCH	INTERACTION	EXCHANGE	BENEFITS	NETWORK	ASSOCIATION
62	N.R.	M.V.	1.00	1.00	0	1
63	N.R.	1	1.00	1.00	1	1
64	N.R.	M.V.	1.00	1.00	M.V.	N.R.
65	N.R.	2	1.00	1.00	1	0
66	N.R.	3	1.00	2.00	1	1
67	1.00	3	3.00	2.00	1	1
68	1.00	2	1.00	2.00	0	1
69	N.R.	N.R.	1.00	1.00	N.R.	N.R.
70	N.R.	1	1.00	1.00	N.R.	N.R.
71	1.00	2	1.00	1.00	0	1
72	1.00	3	1.00	2.00	0	1
73	1.00	1	1.00	1.00	0	1
74	N.R.	2	1.00	1.00	1	1
75	1.00	1	1.00	1.00	1	1
76	1.00	1	1.00	1.00	1	1
77	N.R.	1	1.00	1.00	0	0
78	N.R.	3	1.00	1.00	1	1
79	2.00	2	1.00	2.00	1	1
80	2.00	2	1.00	1.00	0	1
81	2.00	2	1.00	3.00	1	1
82	1.00	1	1.00	1.00	1	1
83	1.00	2	1.00	2.00	1	1
84	1.00	1	1.00	1.00	0	1
85	N.R.	2	1.00	1.00	M.V.	N.R.
86	N.R.	N.R.	1.00	1.00	M.V.	N.R.
87	1.00	3	1.00	1.00	1	1
88	1.00	3	1.00	2.00	1	1
89	N.R.	N.R.	1.00	1.00	N.R.	N.R.
90	N.R.	N.R.	1.00	1.00	N.R.	N.R.
91	3.00	1	1.00	1.00	M.V.	1
92	N.R.	2	1.00	1.00	1	1