Roles of Universities in Clusters:

The University of Otago and the Dunedin ICT Cluster

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Abstract

Cluster actors have the advantage of face-to-face interaction due to geographical proximity, which allows knowledge exchange with universities within clusters. The co-location of cluster actors provides an environment that builds social capital and develops cognitive proximity. In general, small and medium-sized businesses lack absorptive capacity, as they lack resources and skills. To overcome their limited absorptive capacity, businesses in clusters can use consulting, technical support services, and human resource mobility for knowledge exchange. This is best done through face-to-face interaction, which is encouraged by the geographical proximity of cluster actors. Hence, small and medium-sized businesses in clusters with universities have an opportunity of overcoming their lack of absorptive capacity by engaging in consulting engagements with universities. Technology transfer offices (TTO) work with businesses with higher absorptive capacity, and are therefore typically not a suitable channel for interacting with small and medium businesses. Literature shows that curriculum-based programmes such as capstone projects and postgraduate thesis studies have had students successfully interacting with businesses through consulting as well as generating spinoffs. Engaging students in university–business activities will fulfil all three missions of universities: teaching, research, and economic and community development. These activities provide services to local businesses, create a better student learning experience, and produce graduates with real world experience. In addition, engaging with businesses provides universities with tacit knowledge for research purposes.

An exploratory approach, using qualitative methods, was taken to investigate university–cluster activities affecting local businesses. It incorporated (a) case study techniques for selection of case units, and rigour in managing the structure, reliability, and validity of the study, and (b) grounded theory techniques for data preparation and analysis to emerge theory.

Twenty-five in-depth interviews were done with university academics and administrators, businesses, intermediaries of the information and communication technology (ICT) cluster in Dunedin, New Zealand, and participants external to the ICT cluster in Dunedin. Following the grounded theory approach, data analysis was done in parallel with data collection, which emerged a new concept of university students' participation in university–business activities. This required additional literature review and additional interviews to develop the new concept.

The findings of this study show that student-centred extracurricular activities provide opportunities for students to engage in entrepreneurial ventures and consulting engagements, while student-centred curriculum-based activities have the potential to improve cluster outcomes. By engaging student-centred activities, there is an opportunity for more university–cluster interaction supporting local businesses, student skill enhancement, and potential research data for academics and students, thus fulfilling universities' missions of teaching, research, and economic and community development.

Preface

I wish to express my gratitude to Professor André Everett and Dr Conor O'Kane for their guidance and encouragement through the learning process of my master's thesis.

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Table of Contents

List of Figures

List of Tables

List of Abbreviations

ASO	Academic spinoff
CAS	Complex adaptive system
CFI	Centre for Innovation
ICT	Information and communication technology
IP	Intellectual property
IT	Information technology
KTO	Knowledge transfer office
MBA	Master of Business Administration
MIT	Massachusetts Institute of Technology
OIL	Otago Innovation Limited (within University of Otago)
PBRF	Performance Based Research Fund
R&D	Research and Development
R&E	Research and Enterprise (within University of Otago)
SSO	Student spinoff
TTO	Technology transfer office

List of Definitions

Absorptive capacity
The ability of firms to recognise new information from external sources, assimilate, and use it to derive commercial benefits (Cohen & Levinthal, 1990).

Academic commercialisation
Includes patents, licenses, and spinoffs (Perkmann et al., 2013). TTOs support these activities.

Academic engagement
Includes joint research, contract research, and consulting, and also informal activities such as ad hoc advice and networking (Perkmann et al., 2013). It is also sometimes referred to as informal technology transfer.

Academic-led
Academics undertaking a primary role in university activities.

Coding
"The analytic processes through which data are fractured, conceptualized, and integrated to form theory" (Strauss & Corbin, 1998, p. 3).

Cognitive proximity
The cognitive dimension refers to knowledge that cluster actors have before collaboration starts, and cognitive proximity is required so that cluster actors can understand each other and be able to assimilate the knowledge exchanged (Mattes, 2012).

Knowledge Transfer Office (KTO)
Includes academic commercialisation (TTO) and academic engagement.

Boundary spanners
Individuals who communicate knowledge across internal and external boundaries of organisations (Youtie & Shapira, 2008).

Brokers
Individuals or organisations that facilitate transactions between two or more parties when there is a lack of trust between these parties (Gould & Fernandez, 1989).

Connected University
University model that covers more university activities (as compared to the Entrepreneurial University model) and also small and medium-sized businesses in supporting economic and community growth.

Curriculum-based activities	Includes activities that are part of the university course curriculum such as capstone projects, assignments, and postgraduate thesis studies. Is a part of non-KTO activities.
Direct university	Activities based on university research and IP or resulting from joint ventures (Bathelt, Kogler, & Munro, 2010)
Entrepreneurial University	Commercially-oriented university model resulting from the introduction of the third mission of economic and social development, and pressure of reduced funds for traditional activities.
Extracurricular activities	Includes student-run consulting and entrepreneurial programmes.
Gatekeepers	Organisations that have access to extra-cluster knowledge and flow this knowledge into clusters (Giuliani, 2011).
Serendipitous University	Represents the traditional university where university–business activities happen in a sporadic manner by chance.
Social capital	Refers to the familiarity, trust, common objectives and understanding, and long-term commitment to collaboration, which are important to university–industry linkages (Philbin, 2008).
Spinoffs	"New firms created to exploit commercially some knowledge, technology or research results developed within a university" (Pirnay, Surlemont, & Nlemvo, 2003).
Student-centred	Activities involving students in business interfacing role.
Technology transfer office (TTO)	Organisations responsible for intellectual property (IP) related activities (spinoffs, patents, and licenses).
University-related	Activities generated through decentralised ideas by individuals or teams developed while at the university but not based on university's research projects (Bathelt et al., 2010).

1 Introduction

Clusters are a collection of businesses, related customers, suppliers, distributors, educational institutions, research and standards organisations, and government and regulatory bodies in a particular industry that are geographically close together (Porter, 1998a). The geographical proximity among these cluster actors enables pooling of skilled resources, having specialised suppliers, and sharing information, knowledge, and infrastructure. Universities, as key custodians of knowledge, are a natural choice to enable knowledge flow into clusters, given that they also have a third mission of economic and social development in addition to their first two missions of teaching and research. Based on this premise, the chosen research question is:

How can university–cluster activities result in better outcomes?

Addressing the above research question requires an understanding of (a) the unique features of a cluster and how they affect outcomes, (b) the types of knowledge and how it is created and exchanged, and (c) university activities within a cluster that enable successful outcomes.

These concepts will be introduced in this chapter, and examined in more detail in subsequent ones.

1.1 Background and Context

Geographical proximity of the cluster actors leads to social capital that generates trust and provides an environment of cooperation, and cognitive proximity that enables businesses to learn from as well as compete with each other (Malmberg & Maskell, 2002). As cluster actors share and exploit knowledge, the cluster develops and the businesses within it grow.

There are two types of knowledge that can be transferred or exchanged between cluster actors. There is explicit knowledge that is documented and can be transmitted without face-to-face interaction (Nonaka, 1994). There is also tacit knowledge, which is best transmitted through experiential learning, and is often difficult to document. Tacit knowledge requires face-to-face interaction, and therefore co-location of cluster actors is an advantage (Storper & Venables, 2004) for its transmission. Different cluster actors have different types of knowledge, thereby contributing to knowledge heterogeneity within a cluster. Over time, as knowledge within the cluster continues to be exploited, the heterogeneity of accessible knowledge reduces, and the cluster can potentially decline. For clusters to sustain growth,

new knowledge from outside the cluster needs to flow in. Individuals or organisations that enable this flow of new knowledge into clusters are called gatekeepers (Giuliani, 2011). Universities, with their extensive access to knowledge institutions worldwide, and their continuous learning process, are well positioned to be gatekeepers for knowledge flow and diffusion into clusters. Boundary spanners are individuals who communicate knowledge across internal and external boundaries of organisations (Youtie & Shapira, 2008) and are required to diffuse knowledge to the businesses.

Absorptive capacity, which is the ability of businesses to assimilate and use knowledge to drive commercial benefits (Cohen & Levinthal, 1990), is needed to take advantage of this inflow of knowledge. Larger firms typically have skills and resources to invest in collaborations with universities, but small and medium-sized businesses have limited resources for assimilation and application of knowledge (Geuna & Muscio, 2009). These small and medium-sized businesses require consultancy or technical support services, or can achieve the same objectives through mobility of human resources from universities (Ramos-Vielba & Fernández-Esquinas, 2012). Consulting involves tacit knowledge exchange and typically occurs through face-to-face interaction, which is facilitated by the geographical proximity of cluster actors.

The first mission of universities is teaching, which produces skilled graduates for the workforce (Etzkowitz, 1998, 2003). Universities' second mission is research, which generates explicit knowledge in the forms of publications. With the introduction of the third mission of economic and social development, and pressure of reduced funds for traditional activities, universities have adopted the Entrepreneurial University model (Etzkowitz, Webster, Gebhardt, & Terra, 2000). With this came the technology transfer offices (TTOs) that generate intellectual property (IP) related outcomes (such as spinoffs, patents, and licenses) and other commercial activities (such as consulting, joint research, and contract research).

The Serendipitous University model represents the traditional university where university–business activities happened serendipitously by chance. Studies show that with the Entrepreneurial University model, there are a few big successes with significant returns, but many do not even recover their costs (Geuna & Muscio, 2009; Kitson, Howells, Braham, & Westlake, 2009). It is now recognised that more university activities including interactions with small and medium-sized businesses should be incorporated in supporting economic and

community growth. This is referred to as the Connected University model (Kitson et al., 2009).

Figure 1-1 depicts these evolving roles of universities, indicating the wider industry interactions possible in the Connected model compared to the Entrepreneurial model, while still considering the teaching and research missions as in the Serendipitous model.
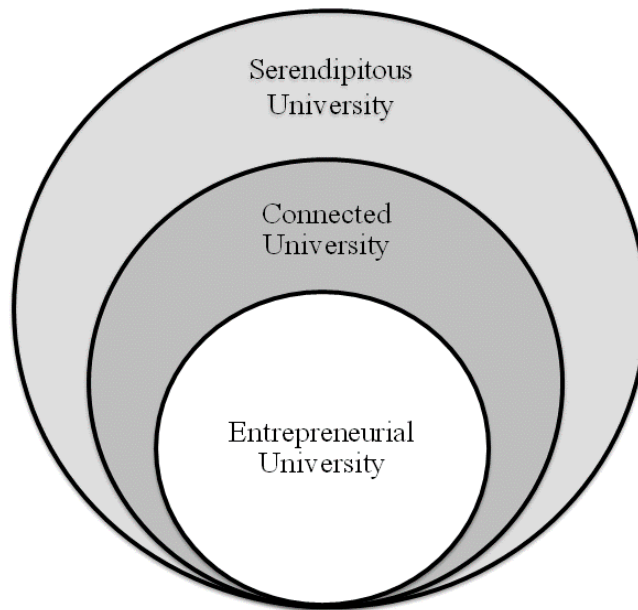
Figure 1-1: Evolving Roles of Universities
(Based on Kitson et al., 2009)

Larger firms typically have the resources and absorptive capacity to engage in activities with TTOs (Laursen & Salter, 2004). Small and medium-sized businesses that have limited absorptive capacity, with the exception of businesses that are based on technology innovations, may not be suitable for TTO activities (Geuna & Muscio, 2009). Literature shows that while both academics and students contribute to entrepreneurial activities, students generate more spinoffs than those generated by academics through TTOs (Bathelt et al., 2010).

The purpose of this study is to investigate university activities that result in spinoffs, patents, licenses, consulting, joint research, contract research, publications, and skilled graduates as applicable to businesses within the cluster. This research study focuses on all university-

generated outcomes and not only on spinoffs, with attention to the difference that cluster features bring to the situation.

An exploratory approach was used with case study techniques for rigour and management of the study, and grounded theory techniques for data collection and analysis. A framework for the study was drawn up based on initial literature review. This was followed by initial data collection, with data analysis being done in parallel, which emerged new concepts as per grounded theory techniques. Further literature was reviewed regarding these new concepts and corresponding data collected.

1.2 Thesis Structure

This thesis contains six chapters followed by references and appendices. This is Chapter One, which gives an introduction and describes the purpose of the study, the background and context, the research approach, and the thesis structure.

Chapter Two covers literature reviewed. The first three sections explain the concepts of knowledge, clusters, and universities, which are then drawn together to present the framework for the study. This is followed by further literature reviews on concepts emerging during the course of the study, followed by the chapter summary.

Chapter Three explains the research design and methods used. The purpose of this study is described first, followed by an explanation of the use of case study techniques for the research design, including the case study protocol, and database. The next two sections explain data collection methods and data analysis using grounded theory techniques, followed by two sections on validity and reliability. The seventh section describes ethical considerations; the eighth identifies limitations and delimitations of this study; and the chapter ends with a summary.

Chapter Four presents the findings of this study, grouping university activities under two categories: KTO (knowledge transfer office) and non-KTO. Curriculum-based activities and extracurricular activities are discussed under non-KTO activities. KTO activities cover infrastructural support, challenges faced by academics, and cluster interactions with the university. The chapter ends with a summary.

Chapter Five provides a synthesis of the findings and the literature reviewed, considering the impact of geographical proximity of cluster actors, the limited absorptive capacity of small and medium-sized businesses, and the appreciation of clusters as complex adaptive systems

in initiating university–business activities. The revised framework of the study is presented next, and the chapter summary follows this.

Chapter Six concludes the thesis, providing a summary of the thesis contents followed by the contribution of this study, recommendations for practice, policy, and further research, and limitations of the study.

This is followed by the references section and appendices, which include:

a. Ethics approval documents

b. Interview-related documents

c. Case study protocol

d. Case study database structure

e. List of categories, subcategories, and open codes

2   Literature Review

The literature review for this study was conducted in two stages, in accordance with grounded theory techniques, where there is continuous comparative analysis of emerging concepts, for which further literature review is required. Figure 2-1 provides the overall sequence of literature reviewed. The research question was formulated after the initial literature on knowledge, and its flow between clusters, and universities was reviewed. After data analysis during data collection stage, an emerging concept was identified. Further literature review was done based on the emerging concept.
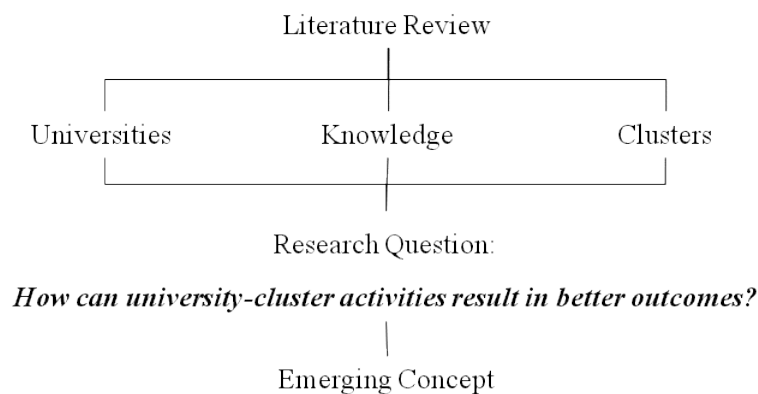
Figure 2-1: Literature Review Map

The organisation of this chapter is shown in Figure 2-2. Section 2.1 is a short section that describes knowledge concepts, which forms the foundation for Sections 2.2 and 2.3 on clusters and universities respectively. The fourth section presents the conceptual framework of this study, and includes the research question. The fifth section describes the emerging concept identified based on data analysis done during data collection. The final section provides the chapter summary.
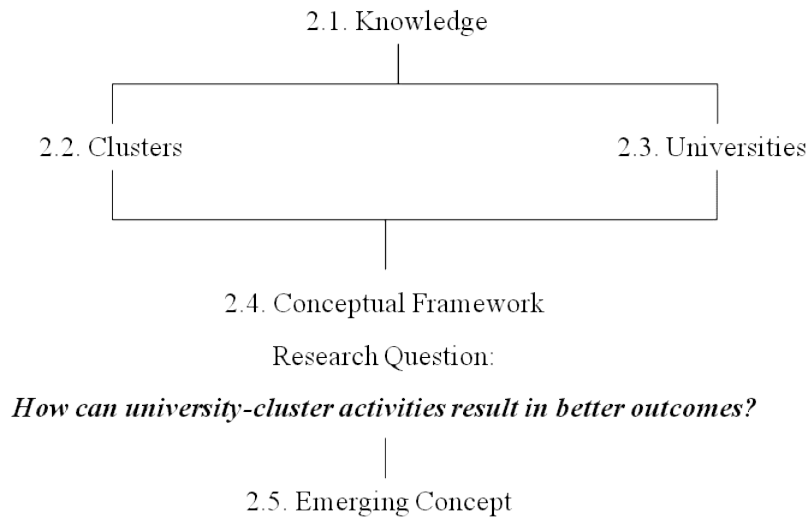
Figure 2-2: Chapter Structure

2.1 Knowledge Creation and Exchange

Effective knowledge exchange requires an understanding of how knowledge is created and processed (Nonaka, 1994). This section provides a theoretical description for knowledge creation and exchange as the foundation for discussion of knowledge in relation to clusters and universities in the following two sections.

Tacit and explicit knowledge are two dimensions of knowledge creation (Nonaka, 1994). In describing tacit knowledge, Polanyi (1966) states that, "we can know more than we can tell". A person may have the ability intuitively to solve problems, but may not be able to document the thinking process and the steps required to solve the problem. Tacit knowledge is personal and involves a person's experience, actions, values, and emotions (Nonaka & Takeuchi, 1995). Intuition, gut feeling, and insight are part of it and it is difficult to document (Girard & Girard, 2009). Explicit knowledge is codified knowledge that is captured as records such as documents, and databases. Explicit knowledge can be communicated in a formal manner, but tacit knowledge is difficult to formalise as it needs active participation and can vary depending on the given context (Polanyi, 1973).

An understanding of the interaction of tacit and explicit knowledge is useful in deciding the kind of learning required under different circumstances. Knowledge creation and conversion can be described in four modes (Nonaka, 1994) as shown in Figure 2-3. *Socialisation* happens when tacit to tacit knowledge transfer occurs through social interaction such as on-the-job training or in apprenticeship mode, or when groups work together sharing experiences

and insights. It is possible that new tacit knowledge is created in the process. *Combination* happens during explicit to explicit knowledge transfer and new knowledge can be created by combining explicit knowledge that has already been documented. *Externalisation* involves the conversion of tacit to explicit knowledge. This may involve the shadowing of an expert to deduce the highly personal knowledge to enable creation of explicit knowledge. *Internalisation* happens when an expert engages explicit knowledge together with experience and intuitive capabilities to generate more tacit knowledge. These four modes do not work in isolation but build upon each other, and in so doing, create a spiral of organisational knowledge within organisations and also between organisations as in the case of clusters. Tacit knowledge created during socialisation can lead to externalisation of tacit to explicit knowledge. In working together in groups, combination of existing explicit knowledge happens, and subsequently internalisation as the group uses the known knowledge and learns from using it.

	Tacit Knowledge	**To**	**Explicit Knowledge**
Tacit **Knowledge** **From**	**Socialisation**		**Externalisation**
Explicit **Knowledge**	**Internalisation**		**Combination**

Figure 2-3: Modes of Knowledge Creation

(Modified from Nonaka, 1994, p. 19)

The importance of knowledge within clusters, and its impact on knowledge creation and exchange during university–cluster activities is further described in the next two sections.

2.2   Cluster Characteristics

Clusters are a collection of businesses, related customers, suppliers, distributors, educational institutions, research and standards organisations, and government and regulatory bodies in a particular industry that are geographically close together (Porter, 1998a). They innovate and grow as they work on competing and complementary ideas from industry and academia,

within a supportive environment enabled by the government. An element of chance often also contributes to the growth of clusters. The cluster actors can be grouped into cooperating and competing firms, customers providing demand, supply or input conditions, and any other supporting industries (Motoyama, 2008) as depicted in Porter's (2000) well-known four factors of the diamond framework (Figure 2-4). Interconnectedness between the actors affects competition by improving productivity of the businesses in the cluster, driving innovation, and stimulating new business growth (Porter, 1998a). Clusters contribute towards economic development and competitive advantage (Martin & Sunley, 2003; Porter, 1998b).

Context for Firm Strategy and Rivalry

Factor (Input) Conditions

Demand Conditions

- A local context that encourages appropriate forms of **investment** and **sustained upgrading**
- Vigorous competition among **locally based rivals**

- Factor (input) **quantity and cost**
  - natural resources
  - human resources
  - capital resources
  - physical infrastructure
  - administrative infrastructure
  - information infrastructure
  - scientific and technological infrastructure
- Factor **quality**
- Factor **specialization**

Related and Supporting Industries

- Presence of capable, locally based **suppliers**
- Presence of competitive **related industries**

- **Sophisticated and demanding** local customer(s)
- Customers' needs that **anticipate** those elsewhere
- Unusual local demand in **specialized segments** that can be served globally

Figure 2-4: Sources of Locational Competitive Advantage
(Porter, 2000, p. 20)

Key individuals take on leadership roles in well-functioning clusters and nurture knowledge sharing and cooperation among cluster actors (Morosini, 2003). Well-developed clusters also share a common code of behaviour, common technological and business terminology, and a common approach to developing skills. The shared knowledge enables firms to combine different pieces of knowledge and resources resulting in innovation (Bathelt, Malmberg, & Maskell, 2004). However, there are also disadvantages such as poaching of skilled resources; faster technology and product imitation; and shared market intelligence leading to

competitiveness (Morosini, 2003). Such competitiveness, however, is seen as an advantage as individual firms innovate to differentiate themselves.

Firms in strong clusters innovate and show stronger growth (Baptista & Swann, 1998). Marshall (1890) describes the concept of industrial clusters, of the benefits of co-location through sharing information and infrastructure, specialised suppliers, and having a pool of skilled resources. However, it was the cluster theory originated by Porter that became popular with the business community and academics (Martin & Sunley, 2003). Porter's overarching focus on competitiveness of firms, nations, and now including locations resonates well with policy makers and politicians, besides conveying the content in terms of business strategy rather than academic theories. His international profile and authoritative style lend further authenticity. Although Porter's cluster theory has been considered vague and difficult to measure, this is seen by some as its strength as practitioners have greater flexibility in combining other concepts in developing clusters (Lazzeretti, Sedita, & Caloffi, 2013).

The rest of this section describes the impact of geographical proximity among cluster actors, the importance of knowledge heterogeneity within clusters, and clusters as complex adaptive systems.

2.2.1   Impact of Geographical Proximity

Geographical proximity of businesses within a cluster allows face-to-face interaction, contributing to greater trust in their relationships through social capital, and making information exchange easier (Malmberg & Maskell, 2002). Explicit information can be easily transmitted and understood as it exists within a symbol system in which it is defined, but tacit information is best understood when the two parties are face-to-face permitting depth and immediate feedback (Storper & Venables, 2004). Face-to-face communication is multidimensional engaging verbal, physical, and contextual levels, which are deemed essential for communication of tacit knowledge. Competing or collaborating firms within a cluster exchange tacit knowledge and tend to learn and innovate within a local culture through formal and informal means enabled by their co-location.

Clusters can be viewed in two dimensions, horizontal and vertical, (Malmberg & Maskell, 2002) as shown in Table 2-1.

Table 2-1: Cluster Dimensions and Learning Dynamics

(Adapted from Malmberg & Maskell, 2002, p. 442)

Dimensions	Dynamics		
	Capabilities of Local Firms	Institutional Precondition	Knowledge-enhancing Mechanism
Horizontal	Similar	Cognitive Proximity	Rivalry Observation Comparison Differentiation
Vertical	Dissimilar Complementary	Trust (Social Capital)	Specialisation Interaction Exchange Coordination Collaboration

The *vertical dimension* of clusters refers to firms specialising in different stages of the production process, and requires coordination amongst them as output from one firm becomes input to another (Malmberg & Maskell, 2002). The firms in the vertical dimension possess knowledge for dissimilar but complementary processes. Specialisation of various production processes and collaboration generates a cooperative environment with mutual help and improvement. Businesses in the vertical dimension work together in their day-to-day operations influenced by the social capital that exists within the cluster, which reflects trust among the businesses.

The *horizontal dimension* of a cluster is made up of firms producing similar products or services (Malmberg & Maskell, 2002). Whereas firms in the vertical dimension collaborate, firms in the horizontal dimension compete and are rivals. However, for mutual improvement, knowledge dispersed among the organisations within a cluster needs to be reassembled. The cognitive dimension refers to knowledge that cluster actors have before collaboration starts, and cognitive proximity is required so that cluster actors can understand each other and be able to assimilate the knowledge exchanged (Mattes, 2012). Learning among businesses depends on both (a) thresholds, before the differences in knowledge bases among the businesses grow sufficiently apart for learning to happen, and (b) ceilings, where learning stops because the cognitive distance is too great for businesses to bridge. An environment that shares common beliefs, values, and language helps in the reassembling of knowledge.

Co-location of businesses within a cluster makes it easier to bridge knowledge gaps resulting from heterogeneous knowledge available. Cognitive distance is reduced as businesses cooperate to evolve the dispersed knowledge and generate innovative outputs. Being in close geographical proximity, businesses naturally observe their competitors and compare, and are able to imitate and also differentiate themselves, generating greater growth than a single large business. While a single large business can enjoy cost reduction in production as compared to multiple small businesses, efforts at differentiation are restricted as they share a common vision and goals (Marshall, 1890).

Businesses sharing social capital come together and this in turn this attracts entrepreneurs to form businesses within that cluster (Malmberg & Maskell, 2002). There is interdependence between the economic structure of the cluster and social capital (Lundvall & Maskell, 2000). While the knowledge learnt within the cluster is affected by the cluster's economic activities, how it is learnt depends on social capital within the cluster, amongst other things. As social capital is specific within clusters, the cognitive distance between firms within clusters reduce (Malmberg & Maskell, 2002). There is, of course, a danger that learnt habits that served well at a specific point in time may not continue to do so later, but continue to be defended.

There is more to it than being co-located for cluster success. Literature on clusters has focused more on geographical proximity, social capital, and cooperation and competition among firms (Pitelis, 2012). However, it is only worthwhile for firms to operate within a cluster if their part of value created that can be appropriated is higher than if they had appropriated it on their own.

As discussed earlier in this section, geographical proximity harnesses heterogeneity of knowledge to enable growth in clusters, but an understanding of the changes in heterogeneity of knowledge within clusters is crucial for sustainability of clusters.

2.2.2 Importance of Knowledge Heterogeneity to Clusters

The continued success of clusters depends on an understanding of the cluster life cycle, as depicted in Figure 2-5, and recognition that clusters face decline unless transformation occurs (Menzel & Fornahl, 2010). Clusters go through (a) an emergence phase with a few but growing number of firms; (b) a growth phase, which sees an increase in the number of employees; (c) a sustainment phase during which the cluster is able to maintain its

employment levels; and (d) a declining stage during which the cluster may diminish and decline.
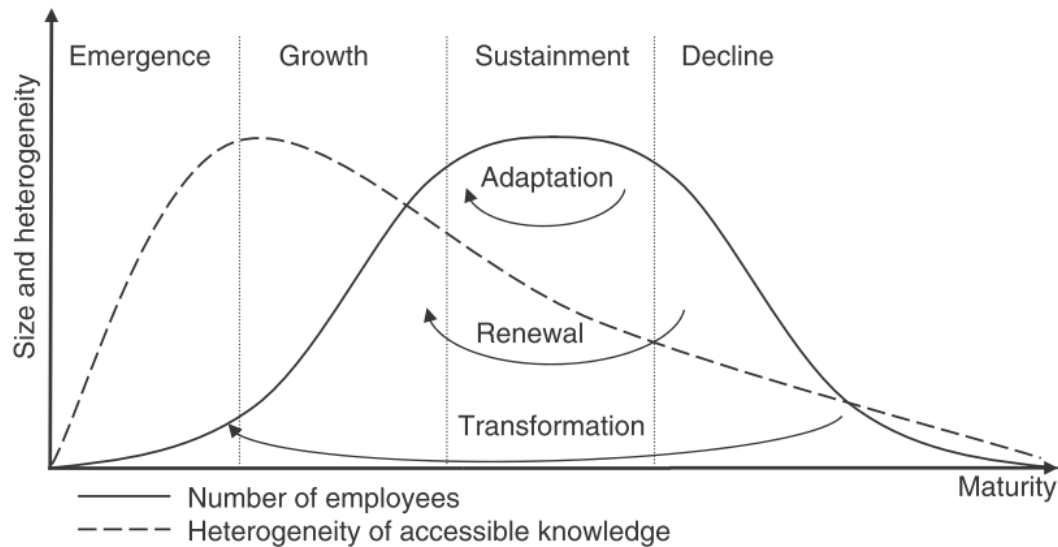
Figure 2-5: Quantitative and Qualitative Dimensions of the Cluster Life Cycle
(Menzel & Fornahl, 2010, p. 218)

The growth of clusters is measured by the number of firms and employees, a quantitative measure, while its health is measured using heterogeneity of knowledge within clusters, a qualitative measure (Menzel & Fornahl, 2010). While external actors perceive cluster growth through quantitative measures, the innovative and learning capabilities of firms within the cluster are a reflection of knowledge heterogeneity and therefore, cluster health. Heterogeneity shows the strongest growth during the cluster's emergence stage when businesses focus on different innovative ideas and technologies. The diversity of knowledge within clusters gives the cluster a larger absorptive capacity, enabling the firms to access more diverse knowledge and cover wider technological distances as opposed to firms that are distant. Learning within a cluster results in technological convergence. However, over time this results in a drop in heterogeneity, which can lead to the decline of the cluster if not recognised in time and action taken. As Figure 2-5 shows, the number of employees is highest when heterogeneity is dropping, which can potentially mislead businesses into thinking that they are succeeding. Over time with continual interaction among the businesses,

the heterogeneity of the cluster starts declining through the growth, sustainment, and the decline stages.

Creative destruction through responses that are outside existing practice (Schumpeter, 1947) is needed besides traditional responses based on past experiences. Failure to maintain a balance between technological convergence (exploitation of knowledge among cluster firms) and divergence (injection of knowledge from outside the cluster) can negatively affect the firms in the cluster (Menzel & Fornahl, 2010). Not all firms are linked to knowledge sources external to the cluster. Giuliani (2011) describes firms that have access to extra-cluster knowledge which they diffuse into and recombine with knowledge, within clusters, as gatekeepers. They are able to search for new ideas, products, or techniques that can be introduced to cluster firms, helping those firms that do not have the extra-cluster connections.

Managing heterogeneity of knowledge within clusters is a challenge as clusters are not managed by any one cluster actor.

2.2.3   Clusters as Complex Adaptive Systems

Clusters are complex, but unlike organisations, they are naturally self-organising with no guidance from a central 'management' (Rullani, 2002). They happen spontaneously over time, evolving rules that are a result of collective learning. "Clusters are *localized ecosystems* of relationships created through history and organized in accordance with an internal logic that is largely inaccessible to observation" (Rullani, 2002, p. 51). They are *living systems*, where cluster actors have chosen to live within a cluster where both their economic and non-economic needs have to be met. They are *complex adaptive systems* (CASs).

CASs involve heterogeneous agents interacting and producing new processes, structure and order over time (Holland, 1998). Agents are the basic elements of CASs and are independent units that evolve over time in their efforts to improve results. Dealing with other agents and responding to the environment gives rise to complex behaviour. Agents in CASs self-organise while interacting with one another. The resulting output is greater than the sum of the parts, and studying the individual parts may not help understand the output. An understanding of the properties of CASs will help in generating effective actions in developing clusters.

Clusters are complex because many different cluster actors communicate and interact with each other with none having the power to force the others to be aligned to a common

framework (Rullani, 2002). While clusters theoretically have the components to generate competitive advantage, there is no guarantee that the existence of such an environment will be successful in doing so. The cluster actors adapt to the environment that they are in and evolve as necessary. In engaging these actors for a cluster's economic growth, the complexity of a cluster must be embraced and it must be recognised that standard management practices and strategies may not apply. There is a need to employ other means to effect changes in a cluster.

Metcalfe (2010) highlights that businesses, and universities are part of a complex adaptive system, and this should be considered in university–business interactions.

2.3 Roles of Universities in Clusters

The original mission of universities is teaching, and research was added on to this as the second mission (Etzkowitz, 1998, 2003). With the advent of the knowledge economy, a third mission of economic and social development was included, which required universities to be directly involved in economic growth activities besides the production of graduate students and research. The Triple Helix recognises universities, besides industry and the government, as integral to economic growth because of the increased importance of knowledge (Etzkowitz, 2003). Universities within clusters can play a significant role in knowledge creation and knowledge exchange with local businesses, which is explained later in this section.

The inclusion of the third mission and reduced funding led to the Entrepreneurial University model (Etzkowitz, 1998, 2003; Gulbrandsen & Slipersaeter, 2007). *Technology transfer offices* (TTOs) are at the forefront in enabling this model, and are responsible for academic commercialisation involving intellectual property (IP) related activities such as spinoffs, patents, and licenses (Perkmann et al., 2013). Other activities (not under TTO) are consulting, contract research, and joint research, which are covered under academic engagements. These initiatives, however, face a few challenges. Academics have a long-term research orientation as opposed to the short-term, profit-oriented outlook of industry and not all TTOs are able to return a profit or even recover the cost of putting up such structures (Kitson et al., 2009).

The first part of this section discusses the evolving roles of universities, and the challenges of the entrepreneurial model due to the different outlooks of academics and businesses. The second part elaborates on knowledge transfer and exchange among cluster actors, with the third section covering factors that affect university–cluster relationships, namely, absorptive

capacity, social capital, institutional structure, and researcher characteristics. The fourth section discusses university-business collaboration channels.

2.3.1 The Evolving Role of Universities

The first mission of universities was teaching, followed by research after the first academic revolution, and then economic and social development as a third mission after the second academic revolution (Etzkowitz, 1998, 2003; Gulbrandsen & Slipersaeter, 2007). With growing social pressure to go beyond traditional missions and contribute to regional development, universities took on an integral role working closely with government and industry in economic and social development (Etzkowitz, 1998). Meanwhile, reduction in funding from public and private sources, and the provision of funds based on commercial growth pushed universities to the Entrepreneurial University model (Etzkowitz et al., 2000; OECD, 2003).

The increased importance of knowledge has elevated the role of universities in the Triple Helix of university-industry-government and "Industry operates in the Triple Helix as the locus of production; government as the source of contractual relations that guarantee stable interactions and exchange; the university as a source of new knowledge and technology" (Etzkowitz, 2003, p. 295). The university's status has been raised to that of equal importance of industry and government, indicating an overlap in participation by the three. With knowledge becoming an important component of innovation, universities are expected to take on an entrepreneurial role focusing on economic development, in addition to their teaching and research roles, hence the Entrepreneurial University model.

Much of the focus of the Entrepreneurial University model is on IP-related activities such as spinoffs, patents, and licenses, and does not capture the variety of collaboration possibilities that can cover a larger set of businesses (Kitson et al., 2009). Of investments made to protect IP, many made losses with only a few experiencing significant returns (Geuna & Muscio, 2009). Many take long to recover their costs (Kitson et al., 2009). Breznitz and Feldman (2012) argue that only a few businesses experience large commercial successes with big returns for a few universities.

Hence, the introduction of the Connected University model shown in Figure 1-1, which focuses on a wider set of interactions with industry and considers knowledge exchange rather than knowledge transfer (Kitson et al., 2009). The Serendipitous University model focused on

16

the traditional missions of universities, teaching and research. However, academics have been known to collaborate with firms as early as the nineteenth century (Meyer-Thurow, 1982). This collaborations happened in a sporadic manner by chance in a serendipitous manner (Kitson et al., 2009). The University of Cambridge, which is central to the Cambridge high-tech cluster, was not strategically planned and is one example of the Serendipitous University model.

Although the Entrepreneurial University activities range from IP-related activities to consulting, joint research, and contract research, there has been a greater focus on IP-related activities (D'Este & Perkmann, 2011). Kitson et al. (2009) referred to the Entrepreneurial University model as the Commercial University model, and concurs that focus is more on IP-related activities, prompting them to define the Connected University model. They further explain that there is a need to go beyond cutting-edge research for high-tech businesses, and include activities that will involve using established knowledge to benefit other businesses as well.

Studies have shown that some universities engaging the Connected University model are using the kind of systematic approach used for technology transfer to help develop skills of local businesses and build networks that businesses can draw upon. Besides economic benefits, university activities covering a wider range of businesses are seen as useful sources of input for academics' research and teaching. These activities can use established research knowledge with new users in new ways including consulting, secondment, and equipment-sharing, rather than for research alone. This is especially useful for businesses that are small or not technologically sophisticated.

The Connected University model also has issues to address. Most small businesses lack specialised staff with the knowledge to work with universities. There is also a lack of demand from businesses to interact with universities but this could be due to a lack of understanding of what can be achieved, and also due to difficulty in interacting with universities. Besides this, academics lack boundary spanning skills, which may not traditionally exist in universities, and are required to promote interactions with clusters, and better networks. Youtie and Shapira (2008) define boundary spanners as those who communicate knowledge across internal and external boundaries of organisations.

University outcomes include spinoffs, patents, licenses, consulting, contract research, joint research, publications, and producing skilled graduates (Philpott, Dooley, O'Reilly, &

Lupton, 2011). There are different terminologies used in defining groups of outcomes with slight differences, and two are listed below.

Perkmann et al. (2013):

- Academic commercialisation includes patents, licenses, and spinoffs (academic entrepreneurship). These activities are supported by TTOs.
- Academic engagement includes joint research, contract research, and consulting, and also informal activities such as ad hoc advice and networking. It is also sometimes called informal technology transfer.

Breznitz and Feldman (2012):

- Formal mechanisms include spinoffs, patents, licenses, and sponsored research and are covered by TTOs.
- Informal mechanisms include industry hiring of graduates, academic consulting, and knowledge exchange in friendship networks and are not covered by TTOs although they also do technology transfer.

While academics take a lead role in the above activities, graduate students also play a role in university–industry interactions by extending the academics' capacity to take on and succeed in collaborations (Ponomariov, 2009). The interactions may be exploratory requiring experiments, testing, and other activities that are too advanced for technicians but too mundane for academics. Industrial partners are also motivated by the availability of qualified postgraduate students working on their project and the opportunity to identify potential future employees.

Knowledge transfer and knowledge exchange are fundamental to university–business activities.

2.3.2 Knowledge Transfer and Exchange between Universities and Clusters

There are three ways that knowledge transfer happens between universities and industry, which are preparation of students for future employment, research and the deployment of research output, and active participation in industry and community (Hermans & Castiaux, 2007; Van Looy, Callaert, & Debackere, 2006). The term knowledge transfer can be applied to activities that are one or two-way. In the case of two-way activities, the term knowledge exchange is more appropriate. Knowledge exchange enables tacit and explicit knowledge

sharing while knowledge transfer is a one-way flow of explicit knowledge. Being in close proximity, local businesses are able to collaborate with universities, which is especially advantageous when it involves tacit knowledge.

Knowledge transfer can be described in two broad perspectives of targeted and untargeted knowledge transfer (Hermans & Castiaux, 2007) as shown in Table 2-2. Untargeted knowledge transfer is a one-way flow of explicit knowledge from universities to unidentified targets. Knowledge is a resource for which consumption does not restrict further consumption. Untargeted knowledge transfer is done traditionally through publications. Patents are also included as they require mandatory publication, but cease to be so when the university sets up an exclusive license with a private firm. The instruments of untargeted knowledge transfer are considered public, as their access is not restricted to any specific agents.

Table 2-2: University–Industry Knowledge Transfer

(Modified from Hermans & Castiaux, 2007, p. 44)

	Untargeted Knowledge Transfer	**Targeted Knowledge Transfer**
Direction	➔	←➔
Nature of Knowledge	Public, explicit knowledge	Private, explicit, and tacit knowledge
Instruments	Publications Patents	Consulting Joint research projects Exclusive licenses

Targeted knowledge transfer is a two-way process between a university and one or more businesses or other partners for licensing, joint research, contract research, and consulting (Hermans & Castiaux, 2007). It is considered private as other partners may be excluded due to the specific nature of the knowledge appropriated and also due to contractual agreements between the parties. Tacit knowledge involved in targeted knowledge transfer also makes it difficult for such knowledge to be replicated for other parties.

Untargeted knowledge transfer can be measured using quantitative methods due to its explicit form through publications and patents. On the other hand, targeted knowledge transfer is

better explored using qualitative methods as quantitative methods are not well-suited for capturing its tacit component.

Universities deal with explicit knowledge through their teaching and research activities, and also by studying tacit knowledge and converting it to explicit knowledge through the creation of publications. These unique processes performed by universities enable them to play the gatekeeper role between the external world and clusters by channelling relevant knowledge into clusters. Universities, besides firms, or individuals can take on the gatekeeper role within clusters, linking it to external sources of knowledge (Graf, 2011).

2.3.3   Factors Affecting Relationships between Universities and Clusters

Ramos-Vielba and Fernández-Esquinas (2012) describe four factors that affect university–industry interactions, namely absorptive capacity, social capital, institutional structure of the university, and characteristics of researchers. They argue that more focus is given to academic commercialisation than academic engagement. The factors, which are covered in the literature reviewed at an industry level, are evaluated in this study for application within clusters.

Importance of Absorptive Capacity in University–Business Interactions

The first factor affecting relationships between universities and businesses is absorptive capacity. Absorptive capacity is the ability of firms to recognise new information from external sources, assimilate it, and use it to derive commercial benefits (Cohen & Levinthal, 1990). A firm must have internal staff with relevant competence and knowledge of the firm's unique requirements to integrate sophisticated technological knowledge. Larger firms typically have skills and resources to invest in collaborations with universities (Geuna & Muscio, 2009). However, small and medium-sized businesses have limited resources and skills to engage in IP-related activities. The exception here is small businesses that are formed with technology as the basis of the business. Firms with investments in research and development (R&D) and technological activities have a higher absorptive capacity and are able to draw from collaborations with TTOs (Laursen & Salter, 2004). Other firms require consultancy or technical support services, or can achieve the same objectives through mobility of human resources from universities (Ramos-Vielba & Fernández-Esquinas, 2012). Breznitz and Feldman (2012) state that universities cannot contribute to the economic development of regional players who have limited ability to absorb knowledge transfer that universities can provide.

Enhancing Social Capital

The second factor affecting relationships between universities and clusters is social capital. Social capital refers to the familiarity, trust, common objectives and understanding, and long-term commitment to collaboration, which are important to university–industry linkages (Philbin, 2008). In the old model, referred to as the Serendipitous University model (Kitson et al., 2009), knowledge transfer activities happened based on personal relationships between academics, industry, and government (Geuna & Muscio, 2009). With the introduction of the third mission, knowledge transfer evolved from student placements, managing and supporting research agreements, and liaising with society to primarily technology transfer focusing mainly on IP-related activities such as spinoffs, patents, and licenses (Geuna & Muscio, 2009). The interactions between universities and other cluster actors foster greater confidence leading to more exchanges between universities and industry and longer lasting relationships.

Participation in community activities and student exchanges with local firms also helps build social capital and expands on possible links with businesses. Universities being within clusters have a positive influence through knowledge exchange (Zucker, Darby, & Armstrong, 1998).

Institutional Structure of the University

The third factor affecting relationships between universities and clusters is the supporting institutional structure. This applies to the Entrepreneurial University model and is reflected in the strategic directions of universities that have adopted the model (Ramos-Vielba & Fernández-Esquinas, 2012). Structural factors that support the Entrepreneurial University model are well-established university facilities staffed by experienced personnel, and incentive systems that support staff involvement in technology transfer. Policies affecting university financing are also important considerations. Kitson et al. (2009) discuss case studies that take the systematic approach that has been used by the Entrepreneurial University model to nurture clusters and develop local businesses within the Connected University model.

Characteristics of Researchers

The fourth factor affecting relationships between universities and clusters is the characteristics of individual researchers, research teams, and faculty (Ramos-Vielba & Fernández-Esquinas, 2012). The size of teams, their experience, funding availability, teamwork, and team leadership are additional factors. Team leaders play an especially crucial

role as their prestige internal and external to the university, experience, and seniority affects the extent of interactions with industry. The orientation of the research work, and the time commitments between teaching and research influence knowledge transfer activities as well.

There are also barriers to overcome when dealing with academic engagements and academic commercialisation due to the different outlook of academics and businesses. Academics face two types of barriers in working with industry: (a) 'Mertonian' or orientation barriers, which refer to the long-term, research-oriented outlook of academics versus the short-term, profit-oriented outlook of businesses, and (b) 'Williamson' or transactional barriers, which refer to the costs of commercial engagements through the university's rules and regulations (Tartari, Salter, & D'Este, 2012). Academics with previous industry experience face lower barriers as they are used to the norms of industry, have their own social networks, and are able to manage transactional barriers due to their exposure to industry. Mutual trust between academic researchers and their industry partners is also crucial for collaboration success, with face-to-face interaction and personal relationships playing an important role. Although academics' involvement in interactions with businesses is driven by desire for commercialisation and/or academic research (D'Este & Perkmann, 2011), they often have difficulties agreeing on topics and release of findings for publications (Tartari et al., 2012).

2.3.4 Extending the University–Business Collaboration Channels

University–industry collaborations can happen through a variety of channels, which can be evaluated against cluster features for use in university–business interactions. This section discusses two different studies on spinoffs formed through channels besides TTOs. Although these studies apply to spinoffs, the methods used can potentially also be used for consulting.

Bathelt, Kogler, and Munro (2010) show that more information technology (IT) firms in the cluster of the Kitchener and Guelph metropolitan areas established as outcomes from the university were university-related spinoffs as opposed to direct university spinoffs. The Kitchener and Guelph metropolitan is often called the Waterloo region partially due to the role of the University of Waterloo's contribution to spinoffs from the university research since the 1970s. *Direct university* spinoffs are based on university research and IP, or spinoffs resulting from joint ventures, while *university-related* spinoffs are generated from decentralised ideas developed by individuals or teams while at the university but not based on university's research projects as shown in Table 2-3. Of forty-one IT firms, only thirteen

(32%) were university spinoffs, and the remaining twenty-eight (68%) were university-related start-ups.

Table 2-3: Typology of Direct University and University-Related Spinoffs

(Adapted from Bathelt et al., 2010, p. 523)

University involvement		
Direct university Spinoffs		University-related Spinoffs
University research	University–industry joint ventures	Decentralised idea development

Another study highlights the role played by academics and students in the generation of spinoffs, based on the type of knowledge (Pirnay et al., 2003) as shown in Figure 2-6. Spinoffs are "new firms created to exploit commercially some knowledge, technology or research results developed within a university" (Pirnay et al., 2003, p. 356). This definition implies that spinoffs can be founded both by academics and by students.

Individual Status

	Academic (Academic Spinoff)	Student (Student Spinoff)
Explicit (Codified) (Product-oriented)	• Spinoffs • Patents • Licenses	• Spinoffs
Tacit (Uncodified) (Service-oriented)	• Consulting • Contract research • Joint research	• Spinoffs • Consulting

Nature of Knowledge Transferred

Figure 2-6: Typology of University–Industry Interactions (Participants and Knowledge)

(Adapted from Pirnay et al., 2003, p. 361)

23

The participants are academics and students, and types of knowledge are tacit and explicit. Typically, academic spinoffs (ASOs) are formed to exploit research done by academics, assistants, and students, whereas student spinoffs (SSOs) are usually formed by recent graduates to exploit a business opportunity that is normally not a result of extensive research. Unlike ASOs that are done through TTOs, SSOs do not need infrastructural support. The success of SSOs depends much more on the founders and their tacit knowledge, with such businesses terminating when the founders are no longer with the company. Students face difficulties when establishing spinoffs due to a lack of an entrepreneurial background and credibility required in acquiring financial assistance. Universities can support students through entrepreneurship courses. SSOs typically face lesser barriers to entry in forming their businesses.

These studies (Bathelt et al., 2010; Pirnay et al., 2003) focus only on spinoffs. Ramos-Vielba and Fernández-Esquinas (2012) argue that IP-related activities such as spinoffs are more visible and favoured compared to consulting, joint and contract research, and other forms of knowledge exchange. More research has been done on IP-related activities than other collaborative activities, possibly because studies on IP-related activities face less methodological difficulties. However, the focus on a small range of metrics related to spinoffs and patents through TTOs could be encouraging related activities at the expense of other forms of knowledge exchange. Focus on IP-related activities ignores other university activities, and there is a need for further research on different types of links between universities and businesses (D'Este & Patel, 2007; Laursen & Salter, 2004). Furthermore, IP-related activities are concentrated in some disciplines, and affect only a portion of academics, whilst many academics collaborate in other ways with businesses. For example, some specialities in social sciences and natural sciences transfer tacit knowledge than explicit knowledge.

Knowledge exchange among universities and other cluster actors underpin university–cluster activities. The conceptual framework of this study is designed to incorporate activities that involve both academics and students, and cover more than the activities that are directly driven by universities.

2.4 Conceptual Framework and the Research Question

The literature reviewed describes (a) the underlying knowledge flow between clusters and universities, (b) the value of face-to-face interaction due to geographical proximity of

businesses within clusters enabling exchange of tacit knowledge, and (c) the roles of universities in interacting with cluster actors in generating outcomes varying from IP-related to consulting to producing graduate students. Extant literature has a greater focus on academic commercialisation than academic engagement.

The framework of this study adopts Bathelt et al.'s (2010) definitions, as described in Section 2.3.4, to apply to all university activities, not just spinoffs. The framework of the inter-relationship between direct university and university-related activities is depicted in Figure 2-7. All university activities are university-related and a sub-set of them are direct university activities.
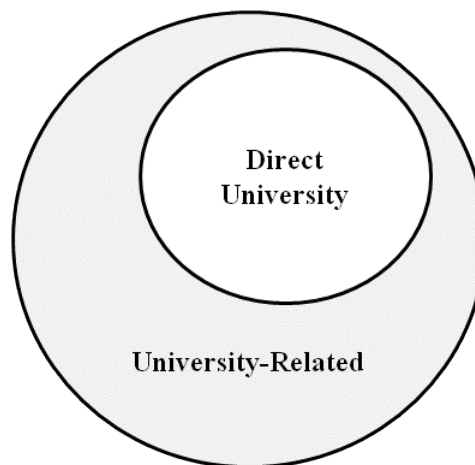
Figure 2-7: Framework of University Activities

The study was conducted within this framework to respond to the research question:

How can university–cluster activities result in better outcomes?

This question can be refined in several directions, two of which are followed in this thesis research. The following constitute sub-questions arising from the research question, helping to clarify the intentions of this study:

- ***How can existing university–cluster activities be improved?***

- ***What new university–cluster activities can be generated?***

Outcomes include spinoffs, patents, licenses, consulting, contract research, joint research, publications, and producing skilled graduates (Philpott et al., 2011). Both direct university and university-related activities were considered in this study. This was the framework for the study involving the University of Otago and the ICT cluster in Dunedin, New Zealand. The intent of the study was to investigate ways in which activities can be improved or new activities identified to benefit both local businesses and the university, which in turn will help the community.

Based on grounded theory techniques, analysis was done in parallel with data collection, which showed that student involvement in consulting activities helped improve businesses, in addition to spinoffs. The initial set of literature reviewed only considered student involvement through spinoffs and not consulting (Bathelt et al., 2010; Pirnay et al., 2003). This led to further literature review on the emerging concept on student involvement in university–business activities.

2.5   Emerging Concept: Student Involvement in University–Business Activities

In reviewing literature on university activities, a common finding was that students play a substantial role in generating spinoffs (Bathelt et al., 2010). In fact, the students generate a higher number of spinoffs than academics. Literature also highlighted the greater focus on spinoffs, patents, and licensing as opposed to service-oriented activities such as research and consulting (Perkmann et al., 2013). Furthermore, IP-related activities resulted in a few big successes by a few universities, while other universities suffered losses or took long to recover (Kitson et al., 2009). Taking these into consideration, the concept that emerged was the engagement of students in consulting activities, as an addition to other existing activities.

Further literature review on the emerging concept uncovered information on how students are engaged in different ways to generate spinoffs at three universities, and using capstone projects and assignments for university activities with businesses and community. Both spinoffs and consulting projects were reviewed to study the techniques for their application possibilities in consulting activities.

The literature discussed in Section 2.3.4 above described student spinoff activities (Bathelt et al., 2010; Pirnay et al., 2003). Åstebro, Bazzazian, and Braguinsky (2012) concur that students generate more spinoffs than do academics. Data showed that approximately twenty-four percent from MIT (Massachusetts Institute of Technology) (Hsu, Roberts, & Eesley, 2007), between twelve and thirty-six percent from Halmstad University (engineering

programme) in Sweden (Eriksson, 1996 as cited by Åstebro et al., 2012), and forty-two percent from Chalmers University (entrepreneurship school) in Sweden were from alumni start-ups (Lindholm Dahlstrand & Berggren, 2010).

MIT's entrepreneurial environment started with its collaboration with industry, including consulting, and faculty entrepreneurship even in the twentieth century (Roberts & Eesley, 2009). This environment attracts entrepreneurially oriented students, faculty, and staff, and is further enhanced by other institutional elements. Alumni initiatives encouraging entrepreneurship began in the 1970s. This led to the formation of the MIT Enterprise Forum, which builds links between entrepreneurs and communities, and also provides entrepreneurial education support. The MIT Entrepreneurship Center supported these efforts by launching new entrepreneurship courses, and assisting student entrepreneurship clubs. The resulting increase in networking amongst students has been identified as the primary factor influencing the generation of spinoffs. Classes that are taught by discipline-based academics, successful entrepreneurs, and venture capitalists provide a good combination of learning through theory and practice. Mixed team classes include both management students, and engineers and scientists.

While MIT may be considered to be well-endowed with favourable conditions, Halmstad University in Sweden with lesser advantages also produced many new businesses (Åstebro et al., 2012). Halmstad's permanent population is about 90,000, which doubles during the tourism season (Berggren & Lindholm Dahlstrand, 2009). There are not many large businesses and the largest private company has about 600 employees, while 75% of its inhabitants work in companies with ten or less employees. Halmstad University's early Innovation Engineering programme, which combined broad engineering with business and market knowledge, built a reputation and attracted students from the all over country, many with work experience from different fields. Together with the varying backgrounds, and experience of the students, this provided an environment for new ideas and student bonding that generated some spinoffs with fellow students. The director of studies was a driving force for many years. Next came the Mechatronic programme, followed by the Computer Engineering programme, and as at 2008, Halmstad University has some forty degree programmes, and an enrolment of 7,000 students.

Halmstad University has a number of factors that contribute to its success. It is an attractive city, to which people like to return. Their Innovation Engineering Programme attracted

students, and there is a labour market for its graduates. There is a continuous renewal due to collective learning, which involves networking and social interaction. There are key individuals who helped develop the university, with a few acting as gatekeepers and brokers, who connect people and transfer knowledge among participants. While gatekeepers introduce and diffuse new knowledge into clusters (Giuliani, 2011), brokers facilitate transactions between two or more parties when there is a lack of trust between these parties (Gould & Fernandez, 1989).

In 1997, Chalmers University created an Entrepreneurship School (E-school) in which students could create a market for ideas based on the commercialisation of IP created by Chalmers faculty and staff (Lindholm Dahlstrand & Berggren, 2010). Students and graduates could also effectively commercialise the university's IP. The E-school one-year programme combines formal coursework with the creation of real businesses. In 2007, it was converted into a two-year International Master programme. Incoming students for the E-school had undergraduate degrees. Funding, which is raised from local public seed funds, is allocated for patenting, legal, and other costs. A third of the ownership goes to the inventor, one third to Chalmers, and another third to the student on condition of continuing the project after graduation.

These three cases highlight different ways that university students and graduates can affect entrepreneurship. While MIT's success is based on its entrepreneurial ecosystem and alumni start-ups, Halmstad University and Chalmers University succeeded through innovative programme designs.

Capstone projects are also geared towards engaging with businesses. Final year senior projects or capstone projects are geared towards providing professional skills to students as well as technical knowledge and skills (Bruhn & Camp, 2004; Robinson, Sherwood, & DePaolo, 2010). The students receive professional experience, while the businesses have their objectives met, and the academics manage to expose their students to real world experience, preparing them for their future careers. Companies with information technology (IT) requirements that match the course objectives provide sponsors who work with different teams of students, supported by academics.

Capstone projects are also being run as student-run consulting companies providing consulting services to non-profit organisations and small businesses (Robinson et al., 2010). Students take on the leadership role while academics move from leading classes to coaching

students. Topics are presented when students need it with the just-in-time approach. An industry advisory committee (made up of local industry leaders) helped source the projects (Bruhn & Camp, 2004). Businesses were also able to evaluate students on their potential for employment, with some of them continuing to work in the organisations where they did their projects.

Faculty are also able to make business contacts with potential for future research. The projects provided useful information on software widely used in businesses, other business knowledge, and transferable skills to be included in the curriculum. While the goal of industry-university projects is to acquire practical experience for students, a second goal is also to collaborate with businesses and transfer new software concepts and methods to businesses and also be informed of real-world business needs (Schilling & Klamma, 2009). Academics have also used internship programs that are completely dedicated to software development with no other workload (James, 2005). The increasing workload of academics due to the introduction of new techniques in implementation was identified as a challenge faced in the student-centred activities. However, the resulting positive outcomes offset the increased workload. Students gained a deeper appreciation of their subject as compared to classroom-based activities and assignments, improved academically, and obtained better starting jobs upon graduation. Such projects even involved interdisciplinary teams within the university engaging skills that are not available within their discipline. Another benefit was the publicity for the faculty based on such projects.

Besides literature based on studies of university–business activities, literature for cluster-related practitioners also suggest extending the role of students to include practical student projects involving both undergraduate and postgraduate students, joint development of curricula and delivery through student placements and internships, and students working on real business case problems (Ffowcs-Williams, 2012).

Student-centred curriculum-based activities provide a great opportunity to involve existing university programmes to expand university–business activities. There are many advantages as curriculum-based programmes are already part of student learning and more students can be involved, giving them a better learning experience and producing graduates with real world experience. Academics are likely to face fewer challenges as opposed to engaging with KTOs because curriculum-based activities are part of the university's teaching mission and

there is also opportunity for students and academics to use these as research topics to produce publications.

Taking this approach of using curriculum-based programmes to engage with businesses fulfils universities' first mission of teaching, has the opportunity to fulfil the second mission of research, while positioning them for economic and community development as in the third mission. Due to the greater possibilities with curriculum-based activities and time constraint, this study focuses more on curriculum-based activities than extracurricular activities.

2.6 Chapter Summary

Knowledge is an important link between universities and other cluster actors belonging to the same cluster. Universities, with their access to worldwide knowledge and their own creation of new knowledge, are in a unique position to be gatekeepers of knowledge enabling the flow of new knowledge into clusters. However, while larger businesses and those with R&D resources have a higher absorptive capacity, small and medium-sized businesses have limited absorptive capacity. This makes it necessary for tacit knowledge exchange among cluster actors in addition to explicit knowledge flow into clusters, which can be achieved through consulting, technical support services, and human resource mobility.

Universities have three missions: teaching that produces skilled graduates for employment, research from which publications can be generated, and economic and social development generating spinoffs, patents, licenses, and consulting. There were entrepreneurial academics even in the traditional university with its teaching and research missions, and any commercial outcomes were by chance, hence the term Serendipitous University model. With the advent of the knowledge economy, and reduced funds, universities moved to the Entrepreneurial University model, in which academics are the primary players in academic commercialisation activities such as spinoffs, patents, and licenses, and academic engagement activities such as consulting, joint research, contract research, besides ad hoc advice and networking. Academics have faced challenges interacting with businesses within the Entrepreneurial University model, as many academics are motivated towards an academic career. They face orientation barriers due to their research-oriented, long-term outlook, as opposed to the profit-oriented, short-term outlook of businesses, besides the lack of time due to teaching responsibilities.

Academic engagement has not received as much attention as academic commercialisation. In addition, larger businesses with higher absorptive capacity have the opportunities to interact

with universities, alienating small and medium-sized businesses, with the exception of those formed with technology as the basis of their business. This led to the Connected University model with a call for more focus on academic engagement, covering a wider set of business, and the application of established knowledge besides cutting-edge knowledge. These require tacit knowledge exchange among universities and other cluster actors.

Meanwhile, studies are showing that student activities are generating more spinoffs than activities led by academics through the Entrepreneurial University model. Other studies illustrate how student curriculum-based and extracurricular activities generate spinoffs and provide consulting services to local businesses and community organisations. Curriculum-based activities engaging local businesses actively engage in explicit and tacit knowledge exchange, resulting in business improvements, real world experience for students, and potential research data that can be used by academics and students for publications.

Clusters have the advantage of geographical proximity among its actors, allowing face-to-face interaction, which is crucial for tacit knowledge exchange, and building social capital.

Based on the literature reviewed, the focus of this study has been to discover university–cluster activities that contribute to local business success, student skill enhancement, and contribution to research, thereby achieving all three missions of universities.

Exploration for improvements in current activities and the possible discovery of new activities, as well as rigour in implementation were the motivating factors in deciding the research design and methods for this study.

3 Research Design and Methods

The purpose of this exploratory study is to investigate how to generate better outcomes within clusters through (a) direct university activities, resulting from university research activities and university–industry joint ventures, and (b) university-related activities, using knowledge produced or shared at the university. This is based on concepts introduced by Bathelt et al. (2010) as described in the previous chapter. Outcomes of university–industry collaborations include spinoffs, patents, licenses, consulting, contract research, joint research, publications, and producing skilled graduates (Perkmann et al., 2013; Philpott et al., 2011). The researcher believes that the University of Otago and businesses of Dunedin can be better connected resulting in a better business environment, by studying activities that contribute to the formation of businesses through spinoffs, and/or improvement of ICT businesses in Dunedin through consulting activities. This study involves techniques from case study method and grounded theory to emerge new concepts, using in-depth interviews as the main data collection method, and using observations, focus group, documents, and online research data for triangulation.

The research design centres on the research question, and related theories and concepts from reviewed literature. This study addresses the following research question:

How can university–cluster activities result in better outcomes?

The question was intentionally general to allow any kind of activities and any kind of outcomes to be considered without being influenced by previous known information.

A qualitative research design was chosen as the researcher's intention was to explore (Charmaz, 2006; Strauss & Corbin, 1998; Yin, 2011) how businesses had benefited from university collaborations, both directly and through university-related activities. Qualitative study is best suited for this type of research as it encourages participants to dig deep in providing information as opposed to the restrictive nature of quantitative studies such as questionnaires or laboratory-like settings (Yin, 2011). This study was intended to capture various views and perspectives of the participants with minimum direction from the researcher, and to inductively derive theory.

An exploratory method, informed by combining case study and grounded theory techniques, was used in developing the research design. In building theory from case study, a research

problem should be formulated and some potentially important concepts identified, with reference to some extant literature (Eisenhardt, 1989). A single case that can represent the concepts being considered is then selected with intent to extend emergent theory, rather than considering a random sample representative of the population, which is typical of case studies. Case study techniques were adopted for structured management of the study using case study design, case study protocol, and case study database (Yin, 2009). Data analysis was conducted using grounded theory techniques as it better explained the coding steps and subsequent analysis (Charmaz, 2006; Strauss & Corbin, 1998) as compared to case studies in which data analysis is considered quite difficult due to few specifications on coding (Eisenhardt, 1989). Grounded theory literature also explained the importance of keeping an open mind despite initial literature reviewed and personal experiences, and how coding steps assist this (Charmaz, 2006; Strauss & Corbin, 1998).

Despite differences, grounded theory elements can be combined with case study practice (Lehmann, 2010). Table 3-1 compares case study techniques with grounded theory elements, mapping the terminologies used, and showing how the two methods can be combined to emerge theory. Past studies have shown successful use of such combinations (Lehmann, 2010; Pandit, 1996).

Table 3-1: Comparison of Case Study Techniques and Grounded Theory Elements (Adapted from Lehmann, 2010, p. 58)

Case Study Techniques (Yin, 2009)	**Grounded Theory Elements** (Charmaz, 2006; Strauss & Corbin, 1998)
Construct validity: Multiple sources of evidence Chain of evidence	*Joint coding and analyzing:* Add data until theoretical saturation Transcripts, memos Add more data (if clarification needed)
Internal validity: (considered not applicable for exploratory studies)	*Constant comparative method:* Coding/comparing Identifying categories and establishing relationships
External validity: Use theory in single cases Use replication logic in multiple-case studies	Boundaries of 'substantive area' emerge from the data Theoretical sampling determines multiple cases, which could aim at the same or contrasting categories
Reliability: Case study protocol Case study database	Audio recordings and transcripts Memos Documents

This chapter discusses the purpose of this study, the research sample suited for such a study, data collection methods used, and data analysis considerations and steps. The choice of using techniques from case study method and grounded theory is explained within each of the methods, with further elaboration on the techniques used. Steps taken to inform the participants of the study, and the handling and use of information they provided is covered under ethical considerations. The limitations cover impact of the external constraints on the study, and delimitations explain the boundaries defined for the study.

3.1   Purpose of the Study

This section discusses the purpose of the study and the related approach, the units of analysis, the research sample and the basis of participant selection, the data collection methods, and data analysis techniques.

This is an exploratory study as information from past research is available, but more research is needed to develop a viable theoretical framework (Sekaran & Bougie, 2010) to improve and expand on the effectiveness of university activities with businesses in clusters. The intent of this study is to emerge theory as the data reveals new pattern(s). A qualitative study involving in-depth interviews, observations, a focus group meeting, document reviews, and online research was conducted to study university activities involving businesses to achieve this.

The study was undertaken in Dunedin, New Zealand. Recognised clusters in Dunedin include education, medical, engineering, tourism, and ICT. The ICT cluster was selected for this study as it is well-established and dynamic, with multiple participants of diverse organisational types and longevity, and is accommodating of academic research due to the connections formed between the employees within the cluster and the local educational institutions (from which many graduated). The University of Otago, which formed part of this research (and is a member of the cluster), was founded in 1869 and is the oldest university in New Zealand. It is a research-focused university covering sciences, health sciences, humanities, and commerce.

There were three levels of data collection units, the cluster at the highest, then groups, and participants within each group at the lowest level as shown in Figure 3-1. The groups (businesses, university, intermediaries, and independents) include cluster actors who are involved in university–business interactions with the exception of independents who are external to the Dunedin ICT cluster.
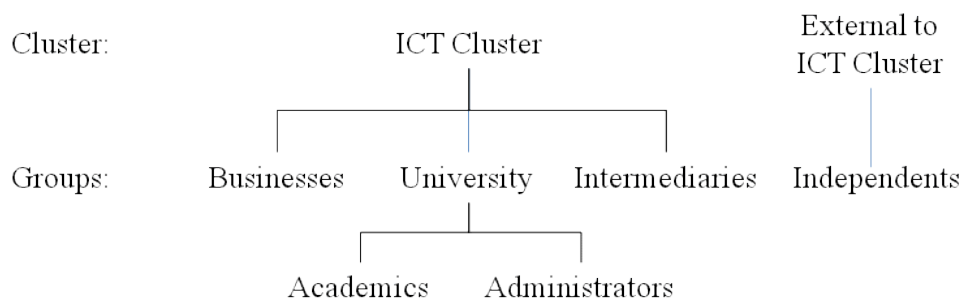
Figure 3-1: Data Collection Units

Businesses are central to this study as the focus is on university activities to improve businesses. The university has two sub-groups of participants: the administrators who facilitate university–industry collaborations, and the academics. The administrators were interviewed to understand the progress, processes, and challenges faced in facilitating university–industry collaborations. The administrators include facilitators of university commercialisation activities, university administrators, and faculty administrators. Intermediaries are organisations that the university works with in responding to requests from businesses. They include the city council, consulting organisations, and other support organisations that assist businesses. Independents are participants external to the Dunedin ICT cluster who provide an external perspective of what to expect from university–business interactions in clusters. The ICT cluster was chosen as it is an active cluster. The researcher's experience in ICT was deemed useful in better engagement with participants, but it also had the potential for bias. Only one cluster was chosen due to time constraint.

The initial sample was a purposeful sample of representative participants who were expected to provide input to answer the research question (Bloomberg & Volpe, 2012). The early interviews caused a snowballing effect, whereby some participants recommended additional participants. An initial data analysis evolved theory, which resulted in a theoretical sample involving participants who provided additional information towards the emerging concepts.

3.2 Research Design using Case Study Techniques

The overall research design flowchart (Figure 3-2) provides an overview of the data collection steps, iterative data analysis and synthesis, and the focus on validity and reliability throughout the study.
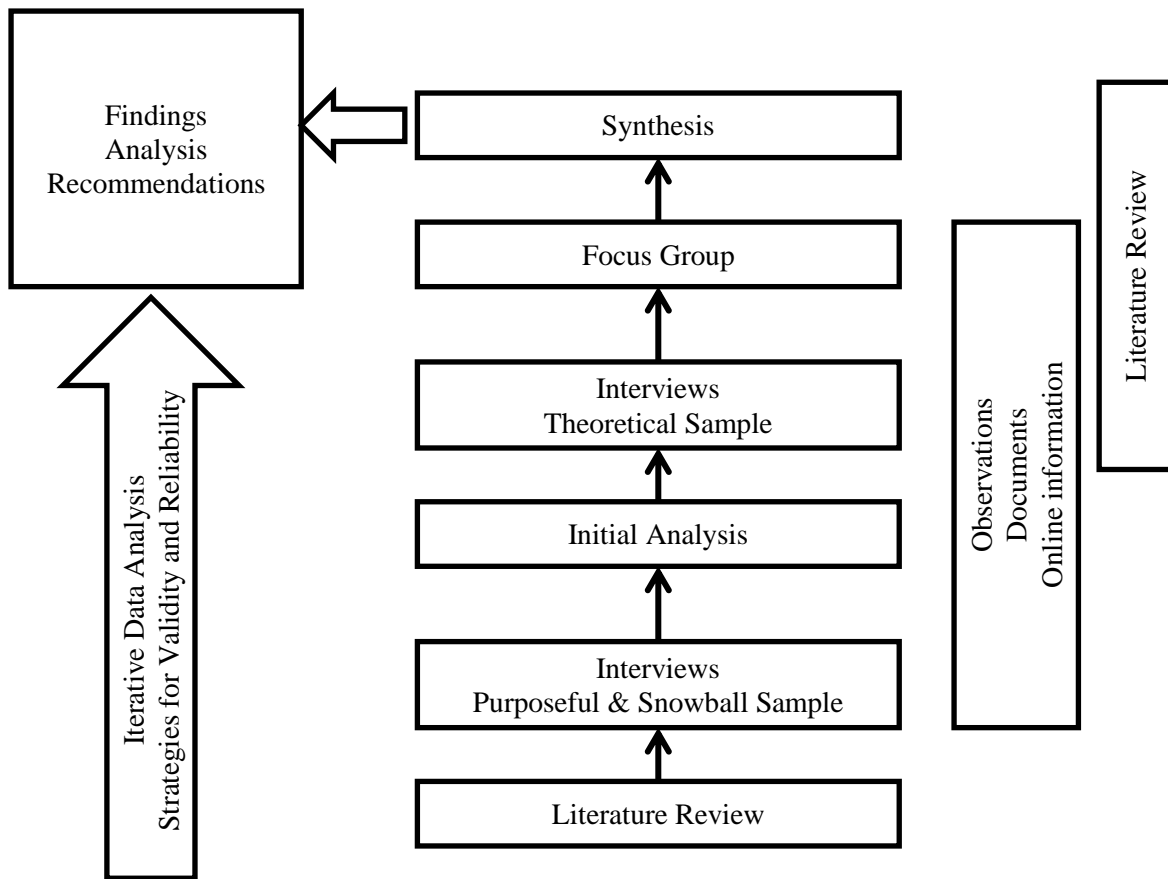
Figure 3-2: Flowchart of Research Design

(Adapted from Bloomberg & Volpe, 2012, p. 251)

Case study techniques were adopted for their structured management of the study and rigour in handling validity and reliability of the research study; additionally, this is a study of contemporary rather than historical phenomena (Yin, 2009) with the research attempting to understand how interactions among universities and other cluster actors can have better outcomes. In addition to its applicability to a qualitative study, the case study method also has strong techniques in selecting the units of analysis, managing the study process, and ensuring validity and reliability. The broad research question of '***How can university–cluster activities result in better outcomes?'*** allowed for an in-depth study that focused on detailed descriptions, interpretations, and explanations provided by different participants, looking into an explanation of how things happen rather than how often it happens. Starting with a broad research question, the researcher kept an open mind during data collection without having pre-determined conclusions based on literature reviewed and previous experience.

3.2.1 Preparatory Stage

An initial meeting with the ICT cluster coordinator provided a background of the activities and some key ICT businesses, and related people. This was followed by attendance at ICT cluster events, as described in Section 3.3.2 on Observations, providing opportunities to meet people from the ICT cluster in Dunedin, as well as to become familiar with some of the cluster activities. Based on these interactions, input from the cluster coordinator, and discussions with the thesis supervisors on university representatives, the initial purposeful sample of interviewees was drawn up using the case study design.

3.2.2 Case Study Design

Case studies are useful in qualitative studies of contemporary phenomena rather than historical events, and are well suited for answering 'how' questions as in the case of this research (Yin, 2009). Case study designs are well-documented with rigour in the approach to validity and reliability (Eisenhardt, 1989).

Case studies can be single or multi-case design, with a single or multiple units of analysis (Yin, 2009). A single-case design was selected due to the time constraint of a master's course. The ICT cluster was chosen, as it is an active cluster, and also due to the researcher's experience in the ICT industry. Within the cluster, participants were selected from more than one unit of analysis (business, university academics, university administrators, intermediaries, and independents) to provide a good representation of the various cluster actors involved (Table 3-2). This is referred to as an embedded case study. This case is taken as representative, and analysed, and can be used as a point of reference in carrying out similar studies for other clusters. It is not the intent of the study to generalise the findings across to other clusters or universities, rather to use this study as a starting point for other studies.

Table 3-2: Case Study Design

 (Adapted from Yin, 2009, p. 46)

	Single-case Design	**Multiple-case Design**
Single Unit of Analysis (Holistic)		
Multiple Unit of Analysis (Embedded)	Case: ICT Cluster Embedded units of analysis: 1. Businesses 2. University academics 3. University administrators 4. Intermediaries 5. Independents	

3.2.3   Case Study Protocol

The case study protocol, contained in Appendix 8.3, improves reliability of the case study research and can be used by another researcher to carry out a similar study (Yin, 2009). It includes the case study question, documents for use with the interviews, checklists, and procedures. Besides the protocol, a case study database containing information is very useful for a reader of the thesis report.

3.2.4   Case Study Database

The case study database is used to organise collected data for easy retrieval later (Yin, 2009). It applies to interviews, focus group meetings, transcripts, notes, literature review, and documents. All audio recordings of interviews and focus group meeting, related transcripts, and memos were stored in the computer notebook with a predefined directory structure (Appendix 8.4). Referenced journal articles, and documents from the study were stored using the EndNote application's features, which allowed capturing of keywords, research notes, and ranking of the items. EndNote also has a group feature where the items could be assigned, and groups were identified for clusters, universities, knowledge management, university–industry interactions, complex adaptive systems, and methodology. The software also has a search function that was useful in identifying articles related to specific topics.

3.3   Data Collection Methods using Grounded Theory Techniques

Data collection methods were based on grounded theory concepts and used techniques as described in grounded theory literature (Charmaz, 2006; Strauss & Corbin, 1998). Grounded

theory was initially developed by Glaser and Strauss (1967) to allow theory to be evolved from data. It is a way of researching social phenomena, and incorporates data gathering and analysing techniques (Corbin & Strauss, 2008). As opposed to testing theories, the central focus of grounded theory is to inductively generate ideas, which when generated from and supported by the data collected, is said to be grounded (Gibbs, 2007, p. 49). These generated ideas are then linked to existing theory. Grounded theory contains three stages of coding (Strauss & Corbin, 1990):

- Open coding, where relevant categories are identified as the transcripts are coded;
- Axial coding, where the categories from open coding are interconnected; and
- Selective coding, where the main theme that links the various categories together is identified and explained as a story.

Further discussion on coding is covered in Section 3.4 under Data Analysis.

This study used interviews, a focus group meeting, and observations as primary data collection methods where data is obtained directly from the original source and literature, documents, and publicly available information on the Internet for secondary data, which applies to data gathered by others from existing sources. Online information from company, university, and other websites helped in preparing for more informed interviews and generate questions specific to the participants.

3.3.1 Interviews

Interviews were the main data collection method. Twenty-five participants were interviewed, as described in Table 3-3. The participants represented businesses and both the academic and administrative aspects of the University of Otago. In addition, organisations that facilitated business growth were included as intermediaries, along with one independent who provided a balancing perspective from outside the cluster.

The initial purposeful sample contained eighteen participants in total from businesses, intermediaries, academics, and administrators from the University of Otago, and independents external to the Dunedin ICT cluster. A snowballing effect generated three more participants, with either participants volunteering more names or the researcher requesting for them. While the initial selection was expected to give a fair representation, interviews from snowballing were expected to clarify or provide additional information. After open coding and categorising of the first eight interviews, further information was needed to explicate the

categories, leading to the identification of a theoretical sample of four more participants (Charmaz, 2006). Two participants from the purposeful sample were interviewed for a second time to verify the conclusions that the researcher had drawn from the initial data analysis. New participants and additional interviews proceeded until saturation was reached, when gathering further data did not reveal new insights.

Table 3-3: Interview Groups

	Purposeful Sample	Snowballing	Theoretical Sample
Businesses	5		
University of Otago	7	2	3
Intermediaries	5		1
Independents	1	1	
	18	**3**	**4**

(Note: Two interviews that were conducted had two participants present, and one participant represented two groups.)

The overall management of the interviews and individual interviews are described below. Email invitations were sent out to the purposeful sample list first, followed later by the snowball list, and the theoretical sample list as they developed. The information sheet was attached to the email. A standard email (Appendix 8.2.1) was used but each of the emails had minor modifications and additions relating to the participant's contribution to the study. A docket containing the following items was prepared for each interview:

- Information sheet (Appendix 8.2.2)

- Consent form (Appendix 8.2.3)

- An interview preparation form (Appendix 8.3.5) containing the participant name, contact details, the date and time of interview, venue, and additional notes based on online research, and specific questions based on early findings as well as online research.

From the original purposeful sample, only one participant declined. Non-responses were handled by one of the following ways:

- The researcher approached participants if they were present at the same events,

- Email and attached documents were printed and left at the office of one of the participants, in the event that the participant had not received the email, which happened to be the case as the email had gone to the junk mail,

- Phone calls were made to persuade participants on their contribution and researcher's flexibility in meeting participant time schedule, and

- Skype and email exchange were used where face-to-face interviews were not possible.

The interview process was started by first going through the interview information sheet, and the consent form, followed by signing of the consent form. Participants who were interviewed through email or Skype, submitted their signed consent forms through email. Open-ended questioning during the interviews created an environment for the interviewees to dig deep when responding. The researcher kept in mind the research question during the whole interview to avoid being diverted. Supporting questions were either answered by the participants as they responded to the research question or were raised at appropriate points.

After the research question was posed to the participants, questions were raised only for further clarification of certain points made by the interviewees. There was an additional checklist of questions (Appendix 8.1.4) that was initially prepared. As the participant responded, this checklist was used to see if relevant information was forthcoming. Not all of the questions were relevant to all participants. Further questions were also added on during the preparation stage based on previous interviews, new literature read, and online research on the background of the interviewees as well as the organisations to which they belonged. Questions from this checklist were asked at appropriate points in the interview or at the end of the interview. Upon completion of the interviews, interviewees were asked if they had any questions that they might have. A number of interviewees indicated interest in the outcome of the study.

The interviews were audio-taped, enabling attentive listening and the ability to acknowledge, and to think on the feet to ask relevant questions. Only key points were written down as a reminder for questions to be raised during the interview. There was a remote possibility of the technical equipment failing, but having taken necessary precautions, the value of attentive listening was considered important, and copious notes were not made. An email was sent to the participants after the interviews thanking them for their participation. The interviews lasted an average of an hour. They were transcribed into 158 pages of notes.

The researcher personally transcribed all the interviews, which allowed in-depth familiarity of the interview contents. The Olympus Dictation Management System Transcription software module was used to play back the recordings during transcription. It allowed control of playback speed, and features such as pause, rewind, and fast forward. The feature to insert index marks allowed easy retrieval of key points when re-listening was needed. Foot pedals were used to speed up the transcription process. Backup copies were made of all the recordings.

3.3.2 Observations

Observations were initiated early in the study for the researcher to meet people in the ICT cluster and to get familiar with some of the activities in the ICT cluster. Brief descriptions of activities attended are provided below.

StartUp Weekend

StartUp Weekend is a programme run by a non-profit organisation headquartered in Seattle, Washington, with facilitators worldwide running weekend programmes during which aspiring entrepreneurs work with teams in developing start-ups.

Both students and workers participated in the StartUp Weekend programme. Representatives from local businesses and educational institutions participated as mentors and judges during the StartUp Weekend as a way of supporting entrepreneurial activities of both students and non-students. This programme starts on a Friday evening with participants pitching their business ideas, and a few being selected for further business planning. Participants form teams around the selected ideas and work over the weekend to generate their plans, with mentors providing support. The weekend concludes with presentations and selection of winners. The researcher also attended a follow-up review of the weekend, where the organisers reviewed the progress of the teams and provided feedback. Representatives from intermediaries and educational institutions (including the University of Otago) were also present at the review session.

ICT Cluster Breakfast Meeting

The monthly ICT Cluster Breakfast Meeting is facilitated by the ICT Cluster Coordinator from the city council. The attendees are from local ICT businesses, consultants, and the city council, and the event includes a presentation by one of the attendees. During the session attended by the researcher, the attendee who presented had just returned from attending a

short programme at the Massachusetts Institute of Technology (MIT). He briefed the attendees on the role of MIT in the entrepreneurial ecosystem, emphasising its importance to the success of MIT's entrepreneurial activities (beyond relying on smart people and/or their charisma). This presentation was followed by an active discussion on steps that can be taken to improve businesses.

D'Brief

D'Brief is a networking event, and was a vibrant event with attendees from businesses, consultants, and educational institutions. It gave the researcher an opportunity to meet cluster actors.

Create IT

The Create IT gathering had sixty-four attendees with a wide representation of businesses, academics, IT service providers, and students, amongst other groups. It was an interactive meeting with pitches made on projects to benefit the Dunedin community, followed by voting and selection of two.

Attendance at these events gave an indication of the active nature of the cluster as well as the desire of ICT businesses to contribute to the cluster. It also provided an opportunity to meet some future research participants, as well as acquire knowledge on such events that later became useful during interviews, and built researcher credibility. After the event, notes were made on perceptions of the ICT cluster involvement in promoting the cluster, people met and potential clarifications to be made during interviews, from documents or online information, and from literature. The varied nature of the different events reflected the role played by different cluster actors in promoting cluster activities.

In addition to ICT activities, the researcher also attended a community research forum on 'The benefits of student volunteering in community organisations'. It had conceptual overlaps to this study as both involved students, and while this study involved businesses, the other involved community organisations.

3.3.3   Secondary Data: Online Information and Documents

Background information on businesses, the university, and intermediaries, as well as some participants were available online, putting the researcher ahead in terms of knowledge even before the interviews. The information typically related to the history of how the businesses started and their progress, and/or information on the individual's involvement. Such

information provided a head start on interviewee and business background so that the researcher could interact more effectively with the interviewees. It also triggered questions that were specific to the participant, and these questions were listed in the interview preparation form.

More online research was conducted after interviews and data analysis to get more information related to the findings. Strategy documents, policy documents, and reports of the University of Otago and the city council were available online. During the course of the interviews, participants also identified relevant documents. These were useful in confirming strategic directions and actions being taken that are relevant to the ICT cluster in Dunedin. These documents were recorded and stored within the EndNote application together with literature.

3.3.4 Focus Group

Focus groups consist of a group of representative members who gather to focus and discuss a particular topic that they are involved in (Yin, 2011). Upon completion of the data analysis after all the interviews were conducted, the findings were presented to a focus group to validate and get feedback on the recommendation. The focus group of five people consisted of two university academics, one university administrator, one business participant, and one intermediary, which were representative of the initial purposeful sample. The researcher served as the moderator, allowing members to express their opinions but with minimum direction. There was agreement on the conclusions drawn from the findings. Possible ideas and difficulties in carrying out the recommendation were discussed.

The main issue highlighted is the difficulty faced in matching businesses to university activities as there lacks a central database of business contacts. Currently, the individuals who interact with businesses have their own contact lists. For curriculum-based activities, the challenge is in matching the course requirements to business needs, as well as the timeframe that is required by the course schedules.

3.3.5 Literature

In grounded theory, literature becomes another data source (Bloomberg & Volpe, 2012; Strauss & Corbin, 1998). Part of the literature was initially reviewed for the researcher to be informed on what has already been researched in the field and to position the study in context. Literature review is disputed in its use in grounded theory due to the potential for

researchers being influenced by it. It has been suggested that it be conducted later during the study so that researchers do not view their data through the lens of earlier studies (Glaser & Strauss, 1967). The intention is not to be influenced by previous work, and to articulate ideas without bias. However, researchers possess knowledge from their previous research and experiences, and have their own opinions and views (Charmaz, 2006) and the researcher also brings to the study professional experience and knowledge on disciplinary literature (Strauss & Corbin, 1998).

The issue here is about how to use previous and acquired knowledge through literature review to enhance theory development rather than constrain it (Strauss & Corbin, 1998). There are a number of uses of literature in grounded theory. At the beginning of the study, the initial research proposal only had literature as the basis to justify proceeding with the research study. Furthermore, the initial research questions were also guided by extant literature. Once the study is in progress, any emerging concept from the study data can be compared with literature to identify similarities and differences. While literature can block creativity, it can also increase sensitivity, which is about having insight into and giving meaning to the findings from data. Finally, at the analysis stage, extant literature can be used to confirm findings, and findings are used to critique literature as well as to extend or validate theory.

Literature review has a few roles. Firstly, the initial review provides context to the study, having identified the starting concepts based on studies already done, and helps decide the purposeful sample that is used for the first set of interviews. Not all literature relevant to the study is reviewed at this point, as new concepts emerge only when the interviews start. Although there was a danger that starting with known theories would have the possibility of finding data that fits the theories, conducting interviews from a blank sheet was not a chosen option, as the researcher needs to be informed on the aspect of study to hold informed discussions with participants.

Secondly, concepts derived from literature are needed for comparisons to data collected, and therefore literature itself becomes data. Concepts emerging from the study data can be similar or different to those from the literature. This process generates further questions, which then leads to reviewing more literature relevant to the discovered concepts, as well as identifying the theoretical sample for further interviews to collect relevant data. Comparative analysis is essential in grounded theory methodology.

Finally, when analysing the study findings, literature is useful in confirming findings, and also in highlighting where literature may not sufficiently explain phenomena. Reference to literature is necessary to demonstrate refining, and extending knowledge in the field.

Concepts of knowledge management and the way they link clusters and universities formed the background for this study, and related literature was reviewed to give context to the study and to raise relevant questions taking into consideration previous research that had already been done. Multiple sources were used to collect information for the literature review, including journal articles, books, dissertations, practice literature, and reports. Internet searches, input from experts, supervisors, and participants were used to access relevant literature for the study. While the initial search was limited to management and business journals, this was expanded to higher education journals that provided some key information that was not available through the management journals. Both historical and current literature was reviewed to understand the dynamics of clusters, the importance of knowledge exchange and the types of knowledge, and the changing roles and challenges faced by universities. No timeframe limitation was placed on the literature search to ensure that important relevant information was not excluded.

3.4   Data Analysis using Grounded Theory Techniques

In grounded theory, data collection and data analysis are reiterated throughout the study, as analysis also drives data collection (Strauss & Corbin, 1998). Constant comparison technique often generates additional questions, which requires a balance between objectivity and sensitivity. Grounded theorists often start with a general set of concepts, which sensitises the researcher to ask particular kinds of questions (Blumer, 1969). Sensitivity is a person's ability to perceive the subtleties and recognise emerging concepts and the connections (Strauss & Corbin, 1998). Objectivity, on the other hand, is arriving at an accurate and non-biased interpretation.

Grounded theory techniques were used in analysing the data. Open coding was done after the transcription of each interview, which provided the link between data collection and emerging theory. Open coding involves breaking down data and studying their similarities and differences. Coding was done by selecting segments of interview data, and labelling them. It linked data collection to emerging concepts. It was possible to analyse the large amounts of data generated from interviews by grouping the open codes first into subcategories and then grouping the subcategories into categories. This ensured that the value

of data at the lowest level was not lost, and helped the researcher to be open and avoid preconceived categories resulting from the initial literature review and the researcher's own experience and personal opinions. The categories were subsequently used in axial and selective coding. Constant comparison was done throughout the coding and categorising processes.

The open codes were updated into a Microsoft Access database together with information regarding the participant and the relevant segment of the interview. Subcategories and categories were identified after reviewing the codes. The database records with the open codes were then updated with the categories and subcategories. Use of the database made the extraction and display of data much easier. Memos were used to capture the researcher's thoughts, questions, and direction for subsequent actions and analysis.

The transcription format was based on techniques described by Hahn (2008) and includes the open codes together with the interview transcription, enabling easy transfer to an MS Access database that was used to store the codes and the interview segments. Colour coding was used to match the codes with the related data. A sample of the transcription is shown in Table 3-4. Colour coding used in the original transcript was replaced by italics and underlining for printing purposes. It includes the participant code (M01, shown under interview segments), the row number, and the open codes.

Table 3-4: Sample Transcript Row

Row Number	Open Code	Interview Segments
72.	*University is research-oriented and has different drivers and not incentivised* Success is when uni and businesses have mutual objectives *Businesses need to respond quickly to market needs*	**M01**: I think both parties have very very different objectives. And I know that *the university's drive is very much research-oriented and the output volume and quality of research that it can do, which is not necessarily the outcome that the business is looking for*. And if so, what is success is maybe its basic its simple, <u>when two individuals or two groups can get together and say that we have got a mutual project that we need to get a mutual benefit, mutual objectives aligned to create a change or a shift or a new product for a new market</u> but because and understandably, of course, the university has quite different drivers from business. It is not the university's fault; it is not the people at the university's fault. That is not how they are incentivised to relate to businesses. *<u>It is not the businesses' fault they need to have a much quicker ... to market than what is allowed by the university</u>*. We are talking of two different worlds trying to collaborate and aligning them is ...it's really a..

The open codes identified in the transcriptions together with the related interview lines were entered into an MS Access database using the data entry screen as shown in Figure 3-3. The

code source field is a combination of the participant code and the row number on the transcript. In this sample, the participant number is M01, and the notes are from row 72 of the transcript. Level 1 code applies to the open code; level 2 applies to the subcategories, and level 3 to categories.

Figure 3-3: Code Data Entry Screenshot

After the initial interviews were transcribed and entered into the database, a list of all open codes was extracted from the database. This was used to identify the subcategories (level 2 codes), and categories (level 3 codes). This was not a onetime effort, as the codes were periodically checked and updated as new codes were identified. There are fifty-two open codes, thirteen subcategories, and four categories. Table 3-5 contains the list of categories and subcategories.

Table 3-5: List of Categories and Subcategories

Categories	Subcategories
Outcomes	KTO (Knowledge transfer office)
	Non-KTO
Activities	Academic-led activities
	Student-centred: Curriculum-based activities
	Student-centred: Extracurricular programmes
Cluster actors	Businesses

Categories	Subcategories
	University
	Intermediaries
Challenges	Different outlooks
	Academics' aspirations
	Commercialisation issues
	University–business interaction issues
	Others

Axial coding is the process that reassembles data that was broken down during open coding, by relating categories to subcategories to present a complete picture of the phenomena (Strauss & Corbin, 1998). These are not necessarily sequential steps. Coding axially helps answer questions such as who, how, when, why, and provides a better understanding of the consequences. Selective coding, which is the next step, integrates and refines the theory. Integration is a process and evolves over time, and sometimes involves sudden insights. The first step in integration is deciding on the central or core category.

3.5 Validity

Multiple sources of information were used to ensure that findings and conclusions reflect the environment, and for triangulation (Yin, 2009). Case study refers to multiple sources of evidence (Yin, 2009), which grounded theory delivers by adding data until saturation through interviews, documents, further online research, and literature review through continuous analysis throughout the study (Charmaz, 2006; Strauss & Corbin, 1998). Data triangulation was done by corroborating information from these sources. Interviews also built one upon the other where questions raised from previous interviews as well as information collected were clarified or confirmed in subsequent interviews when appropriate. In this manner, it was possible to confirm conclusions that were being made by the researcher during the course of the study. As information unfolded through interviews, subsequent interviews also became sources of confirmation. Recording the interviews allowed re-listening of conversations to re-confirm conclusions drawn from the respective interviews.

3.6 Reliability

Reliability helps reduce errors and biases in the event that different researchers repeat the study using the same method (Yin, 2009). Three ways of achieving reliability are through a

case study protocol as described in Section 3.2.3, the development of a case study database as described in Section 3.2.4, and maintaining a chain of evidence.

The chain of evidence involves sufficient citation to different parts of the case database such as interviews, observations, and documents. The database components should also contain information on the circumstances under which the evidence was collected, such as date, time, and venue of interviews. There should also be consistency with the case study protocol and procedures. By reading the protocol, one should be able to see the link between the protocol contents and the initial research questions.

The thesis includes citations to journal articles, books, documents, and interviews, and references recorded in Endnote, within which journal articles and documents are stored. Interviews and transcripts can be accessed through the thesis folder in the computer system. The interviews subdirectory includes the interview preparation document (Appendix 8.3.5), which includes the date, time, and venue of interview. These are consistent with the case study protocol.

While case study method was used for the structure and overall management of the study, grounded theory was used for data collection and data analysis.

3.7   Ethical Considerations

Ethical considerations relate to protecting the participants of the study (Bloomberg & Volpe, 2012). This requires informing the participants of the study purpose, and how the information provided will be treated.

Upon completion of the initial literature review and research design, an ethical approval application (Appendix 8.1.1) was submitted to the University of Otago Human Ethics Committee for review and approval to ensure that ethical considerations were adhered to. An information sheet and a consent form for participants formed part of this submission. Following the approval (Appendix 8.1.2 and Appendix 8.1.3), the participants were sent an email invitation (Appendix 8.2.1) with the information sheet attached. At each of the interviews, the participants were requested to sign the consent forms before the start of the interview. Participants whose interviews were conducted through Skype or email sent their signed consent forms through email.

3.8   Limitations and Delimitations

Limitations refer to external conditions that may constrain the scope of the study or affect the outcome, and delimitations clarify the boundaries of the study that is intentionally imposed by the researcher to limit its scope (Bloomberg & Volpe, 2012).

This study contains certain limitations due to time constraint, possible researcher bias, and some that are inherent to qualitative research methodology. Thought has been given to these limitations and how their effects can be minimised or through suggested recommendations for future research. Due to the time constraint of the master's course, the study was restricted to a single case study involving the University of Otago and the ICT cluster in Dunedin. The findings may be different for other industry disciplines, in larger cities, and also depending on the type of universities. Generalisability, which is the extent to which the research findings can be applied to other settings is not the goal for case studies (Bloomberg & Volpe, 2012). Rather, transferability, which is the ability to apply the findings to other similar contexts, is important. This was addressed through the development of a case study protocol and case study database that can be used by other researchers to conduct similar studies.

The researcher's experience in the ICT industry has a potential for bias although it is also advantageous in dealing with the ICT cluster. This has been handled by focusing on the research question during interviews and analysis. Open coding, which looks at data at a detail level, also helped the researcher avoid preconceived categories of data.

3.9   Chapter Summary

This chapter provides an overview of the research study, the research design, the qualitative methods used, the ethical considerations, and limitations and boundaries of the study. The research design describes the purpose of the study, the research sample, the data collection methods, and the data analysis concepts and steps. Under methods, choice of techniques used from the case study method and grounded theory is explained followed by description of the use of the techniques in the study.

The next section contains the findings and analysis of the study.

4 Findings

The findings of this study are based on the four categories: activities, outcomes, cluster actors, and challenges that are derived from the open codes as listed in Table 3-5, resulting from the research question extended with sub-questions for greater clarity:

How can university–cluster activities result in better outcomes?
- *How can existing university–cluster activities be improved?*
- *What new university–cluster activities can be generated?*

This chapter is organised around the activities of the University of Otago that impact the businesses within the Dunedin ICT cluster. The activities are grouped under Knowledge Transfer Office (KTO) and non-KTO activities as shown in Figure 4-1. Perkmann et al.'s (2013) definition discussed in Section 2.3.1 has been adopted to define them. KTO consists of academic commercialisation and academic engagement. Academic commercialisation includes spinoffs, patents, and licenses. Academic engagement includes joint research, contract research, and consulting, as well as informal activities such as ad hoc advice and networking. Academic commercialisation is supported by TTO, which comes under KTO. Non-KTO activities include curriculum-based activities and extracurricular activities, both of which generate spinoffs and perform consulting.
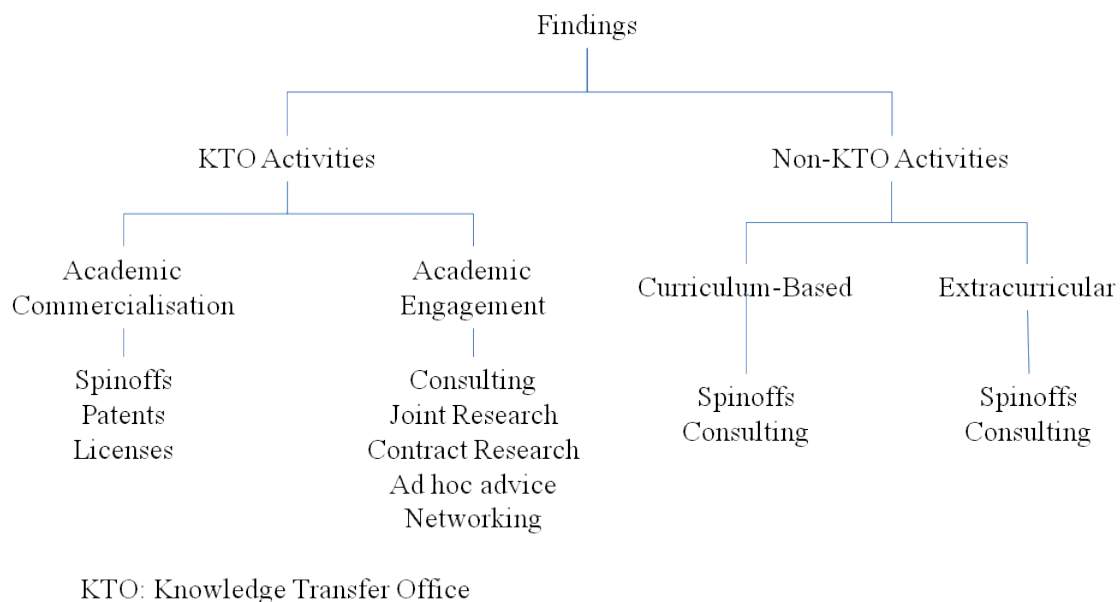
Figure 4-1: Structure of Findings Chapter

Related to these activities are the outcomes: (a) spinoffs, patents, and licenses from academic commercialisation; (b) consulting, joint research, contract research, ad hoc advice, and networking from academic engagement, and (c) spinoffs, and consulting from both curriculum-based activities and extracurricular activities. The findings from the study show that patents, licenses, joint research, and contract research are not outcomes from non-KTO activities. Outcomes of the traditional university, which are teaching and publications, will also be addressed within the sections below. As the focus of the study is non-KTO activities, they are presented first.

4.1 Non-Knowledge Transfer Office (Non-KTO) Activities

The findings of the study show that spinoffs and consulting engagements are generated from non-KTO activities by postgraduates and undergraduates. Some of these engagements also generate content that is used by both students and academics for publications. These student activities can be separated into curriculum-based and extracurricular activities.

4.1.1 Curriculum-Based Activities

Curriculum-based activities include postgraduate thesis studies, and undergraduate capstone projects and assignments. Findings show that postgraduate students have generated local spinoffs, and engaged in consulting activities as part of their thesis study. Undergraduate students have engaged in consulting engagements with local businesses through capstone projects and assignments.

Spinoffs

Postgraduate theses have shown to be a starting point for spinoffs. The founder of AD Instruments (ADI) did his Masters degree in Computer Science at the University of Otago, which involved developing software for the university's Physiology Department (AD Instruments, 2013). While the original software for ADI was developed when the founder was studying at the university, subsequent growth and development of the company was done by the founder himself. The University of Otago uses ADI products, and ADI interacts with the university to get feedback on the use of its products. Another example of postgraduate spinoff is NOMOS, which was the outcome of the founder's MBA (Master of Business Administration) thesis based on his experience while working in a law firm (Otago Business School, 2013c).

Spinoffs formed from student initiatives seem to depend on the founder's passion in forming and growing a business, as is reflected in this statement by Business 02:

"I think that entrepreneurial start-up companies are driven by the passion of the people who start the companies. I did not expect to get a salary for the first year. I did not expect a flash office space or anything like that."

Consulting Engagements

Study findings showed that consulting engagements happen through postgraduate research studies, and undergraduate capstone projects and assignments. These engagements are to an extent limited by the study requirements of the students, and the nature of activities varies from business consulting, to web applications.

Postgraduates have provided consulting services that are based on their research subject for businesses that have mutual interests. Commenting on postgraduate students who did an MBA project, Business 05 commented that it "was a good experience. Got together a market report and the report was good". However, such activities require time investment by businesses to brief students on their operations.

Businesses can benefit by participating in postgraduate projects, and the students gain knowledge and experience in a business environment. Efforts by the university to communicate with businesses can help identify matching businesses for project requirements. This is reflected in Administrator 01's comment:

> "... postgraduate students who are actually looking for projects... and it is a win-win kind of situation... Be a little bit smarter at marketing the university and making the university a little bit more approachable."

During their coursework year, postgraduate students have also worked on assignments involving businesses to improve effectiveness of the use of web applications as described by Academic 10.

Postgraduate students also generate journal articles using contents from these studies, which help deliver university outcomes while also delivering business outcomes. For example, the researcher has submitted a journal article based on this research study.

Undergraduate activities involve capstone projects and short-term assignments. The capstone projects mainly cover small and medium businesses, including local shops and clubs. Academic 14 explained that Information Science students do a "capstone paper, which brings together all the papers in terms of the Information Science major" and "they are actually

doing something that's real world" with mentoring from the university, and this gives them the opportunity to experience what they will be doing when they join the workforce. The undergraduates work with local businesses to develop prototype systems based on the business requirements. Some businesses have chosen to pursue this further and subsequently adopt computer systems to support their operations. Currently, the students are informed ahead of time to look out for a business that they will work with during the project. In the event that they are not able to source a business, the academic responsible for the programme helps to link them to appropriate businesses.

Academic 14 further explained that the students meet local Dunedin businesses and

> "They identify problems that the businesses may have and the way they operate. [It] could be they have problems with their inventory management. [It] could be they have problems with point-of-sale systems that they are operating. Alternatively, a lot of the times we find they actually have no actual computer-based systems whatsoever. They are still working on a manual paper-based system. So, with that in mind, what the students do is then come up with an information systems prototype that actually will demonstrate the proof-of-concept for that business".

Some businesses have been interested in converting the prototypes to working solutions.

Academic 10 described student assignments that engage local businesses. A couple of these were related to the use of social media. Some engagements were not related to ICT business per se, but they are still considered relevant as they used information technology, and ICT companies help deliver such services.

To a question on engaging students in business projects, Intermediary 02 responded:

> "I think it is a win-win. Something for their CV...[they] understand what it is to do something ... for business, it is often about getting jobs done that will otherwise not get done... and hire the ones that shine through the jobs."

Although such university–business interactions do happen, Business 06 said "[the] general perception is that the university is not into work-based teaching. [It is] more into theory." There is also the risk that some students underperform, for which careful management is needed.

Challenges

There are a number of challenges in matching businesses to non-KTO curriculum-based activities. The business needs must align with course requirements and the project period must match with the course schedule. Academics lack a central database from which they can find business contacts as well. These findings were confirmed at the focus group meeting.

The main challenge in matching businesses with student projects is in aligning business needs to course requirements. When asked if the city council can assist in identifying businesses for the capstone projects, Academic 14 said "It could be actually quite useful for us", and went on to clarify that identifying businesses for student projects must be based on matching businesses with course objectives that already exist and not the other way around by trying to fit course objectives with clients' needs.

In terms of how various cluster actors can work together in matching the business to student project requirements, Academic 03 said "I can do what I am good at but other people need to tell what they are good at and we need all these people to work together." Intermediary 03 commented that "it needs more to be business pulled than university pushed". Business 01 voiced that "Value would be, here are all the companies, here are our resources, here are the resources we are lacking, and here are the surplus resources. How can we help each other?" Academic 03 summarised:

> "It needs a group of people from government, industry, and university to get together to understand and model on successful models somewhere else in the world."

Another challenge is that the timing of availability of students is dependent on the university course schedule. This cannot be helped, as "this is the nature of the university. Students look for projects at a certain time of the year. [They are] not always available as companies want them" (Administrator 08). Being curriculum-based also means that business needs must match the course specifications, and adhere to its timeline. As Academic 10 said, collaborations are possible "as long as the client falls in line with some of my conditions".

During interviews, it was mentioned by both university academics and administrators that there is no central database from which academics can draw to source businesses. Sharing of contact information is mostly on a person-to-person basis. Business contacts and their interactions through projects are not captured centrally and remain with individual academics or administrators of student programmes managed through the faculty office. Businesses are

sourced either by students or academics. Academic 10 mentioned that they use their own network and contacts that they have and Administrator 09 described one academic who uses his "own network, which is pretty advanced in the business community". This presents further challenges because firstly, it takes up more of the academics' time than necessary, and secondly is the opportunity lost from not having a central database of contacts and their previous interactions with the university.

During the focus group meeting when the findings of the study were presented, the main issue for university–business collaborations through students was identified as the matching process. In discussing the role of brokers to facilitate the matching of businesses to student projects, the city council was identified as a candidate to play the role of a broker. Current activities by the city council with businesses have the potential of contributing towards matching.

4.1.2 Extracurricular Activities

Students also participate in extracurricular activities such as entrepreneurial programmes, student-organised programmes, and part-time employment. The University of Otago encourages entrepreneurial student activities and provides support for such initiatives.

Spinoffs

Students with entrepreneurial inclination take advantage of programmes such as Audacious and StartUp Weekend that allow students from any discipline to try their hands at entrepreneurial activities, which have resulted in a number of spinoffs.

Administrator 09 explained that Audacious provides a coaching service for students, and is supported by the University of Otago, Otago Polytechnic, and the Dunedin City Council. The top two winners of Audacious in 2012 have formed spinoffs, namely Globelet which produces reusable cups, and MeatMail which is a meat delivery business (Otago Business School, 2013a). PocketSmith, an entry in the 2008 Audacious programme, did not win but is now an established business for budgeting software (Rae, 2013). Administrator 09 pointed out:

> "But the thing about Audacious is that it is not just the competition... the goal was to have business coaching available for all students, not just business students who wanted to set up a business."

Startup Weekend, an intermediary, is a global non-profit organisation that runs a weekend programme for potential entrepreneurs. The University of Otago co-sponsors the programme in Dunedin, and a large number of attendees are students. During the weekend programme, teams are formed around selected ideas from the participants, and these teams go through a process of validating market viability, and then draw up a business plan. The researcher attended Startup Weekend programme as part of observing the ICT cluster activities.

Consulting Engagements

Consulting from extracurricular activities is in two types of student groups: those that focus on specific technologies of their choice supported by academics, and those that have formed consulting organisations.

Academic 07 spoke about student groups focusing on technology of their choice, and the possibility of the students working with businesses that have similar interests. He emphasised that these are not free development resources, and businesses need to sell their ideas to get acceptance from the students.

There are also student groups that have formed consulting organisations. One example is Ignite Consultants, a voluntary student organisation of undergraduates and postgraduates from the University of Otago, which provides free consulting services for not-for-profit organisations (Otago Business School, 2013b). Administrator 09 stated that "They pull together multidisciplinary teams from across the university. Projects for NGOs are mainly in Dunedin, but some of them are national". Students heading this organisation were also present at the community research forum on "The benefits of student volunteering in community organisations", and are recognised at a community level within the city. Orange Consulting, a commercial organisation originated by postgraduate marketing students, engages postgraduate students in providing consulting services. They see themselves as an alternative to direct university consulting services, providing rates that are more competitive.

Other Student Interactions

In addition to spinoffs and consulting, there are other student interactions with businesses, and these are described in this section.

Internships allow businesses to work with students with a possibility of employing them if there is a good fit. The students benefit from the work experience they receive as well as the possibility of employment. Two of the businesses interviewed also said that this allowed

them to evaluate the students' performance over a longer period before deciding whether to employ the student upon graduation. Business 02 said:

> "It is a good thing to do giving workplace experience (do they like this kind of workplace, deadlines, resource limitations), and second, it allows us to see whether this person can be hired."

Attendance at a forum for student volunteers in community activities highlighted student interactions such as (a) legal assistance provided by students from the law faculty (Faculty of Law at University of Otago, 2013), (b) accounting assistance by students from the business school (Council of Social Services, 2013), and (c) consulting by Ignite Consultants for not-for-profit organisations.

Student interactions include communications with alumni. Administrator 11 mentioned initiatives by the university in staying in touch with alumni, as they are potential organisations for university collaborations.

4.2 Knowledge Transfer Office (KTO) Considerations

KTO activities include academic commercialisation and academic engagement activities. These are established activities in the University of Otago. This section covers some of the considerations of the KTO.

4.2.1 Infrastructural Support

Findings of the study show that the University of Otago is well structured to guide its academics and support commercial engagements. The updated strategic direction of the university has a small but significant change where "promote knowledge" has been changed to "promote and apply knowledge"..."to enhance the understanding, development and well-being of individuals, society and the environment" (University of Otago, 2013b, p. 1) emphasising the application of knowledge. This is further clarified in the university's core values as knowledge encompassing "its application for public good and economic benefit" (University of Otago, 2013b, p. 2).

The acceptance and intention to proliferate this is echoed by Administrator 04 who stated that "applied research is important and we are interested in doing what will be of economic benefit. Economic development as well as the more traditional non-commercial outreach of the university". The university was also involved in the development of Dunedin's Economic

Development Strategy, in which growth of innovative and competitive clusters is identified for action (Dunedin City Council, 2013).

 The Centre for Innovation (CFI), through its facilitators (included in the administrators group in the interview sample), is responsible for the University of Otago's commercialisation activities, providing the environment for collaboration between the university's academic researchers, student entrepreneurs, and industry researchers in developing and enhancing products (University of Otago, 2013a).

The CFI houses:

- Otago Innovation Limited (OIL), a wholly-owned subsidiary of the University of Otago, which handles commercialisation of IP resulting from research activities within the university,

- The Research & Enterprise (R&E) Office, which works with the university's researchers in positioning competitive grant applications, promoting research collaborations between university researchers and innovative companies, and protecting discoveries that have commercial potential, and

- Tenant facilities.

The facilitators play a broker role by understanding the research performed by academics and putting this forward to relevant business in their terms. Facilitators with the appropriate academic backgrounds are responsible for the different departments and "over a period of time they build friendships with staff and get to know their research areas well. They get to know them in a non-specialist way. They tend to summarise quite simply for the lay people" (Administrator 11). This enables them to identify potential collaborations, and facilitate the interactions with businesses (local, national, and international) as well as ensure that the rights of the academics and the university are protected.

4.2.2   Challenges Faced by Academics

KTO activities experience the typical challenges faced by commercial orientation of universities, even when the support structure is in place. Findings show that the academics face challenges such as their academic aspirations versus commercially oriented requirements, lack of time, and different academic and business outlook.

Academics Aspirations

Academics vary in their aspirations when they make a career choice. Traditionally, the focus of the university was teaching and research, and many academics make a career choice based on this and not necessarily with focus on commercialising in mind. While there are academics that have a natural inclination to commercialising research ideas, at the other extreme are those who are primarily interested in pure research, and many fall in between these two extremes. As Administrator 13 explained, "There are entrepreneurial academics, and there are academics who do not see working with industry as part of their brief". Seeing it from an academic's viewpoint, Academic 05 said:

> " ...to market and earn money with it. But only [a] few of the academics are really capable of doing that. And have that inner drive to make profits. We are normally here because we are interested in academic research and new ideas. Not necessarily in driving a business."

The other challenge is that academics have their own area of research that they would like to work on and not necessarily to take on any type of business needs, as explained by Academic 06:

> "Industry partners think we are sitting here idling and waiting for topics to work on and that's not true. We develop our own ideas and we want to publish that work, and we want to do research, and often there is a mismatch."

On the other hand, as Academic 02 described:

> "If [we are] talking about ICT in general, it is a whole different kettle of fish. It could mean the local Mac shop, or could mean IT services shop that provides service to DCC. [It is] pretty much guaranteed academics won't have an interest. For software development houses, [it] depends on what end of the scale the development happens. Can be development with no research and is just programming."

There are also conflicts with businesses regarding publications. Administrator 11 said that "sometimes we get conflicts over how and when results are published..." and "...most academic researchers want to publish as soon as possible. For business, it is often better to publish later". Administrator 04 explained that "academics often focus on publications, which is sharing IP" whereas "business wants to lock IP" and that "there is fundamental tension there".

PBRF (Performance Based Research Fund) which is a publication driven measure that contributes to promotion is another motivator. PBRF is a promotion criterion, and gets more attention than other activities as was stated by Academic 03:

> "PBRF and promotion incentives in the university have become far more focused on theoretical research or PBRF-related research. I think that has had a detrimental effect."

Lack of Time

The priority of teaching often means that academics do not have sufficient time to respond to enquiries from businesses. Intermediary 01 commented on the long lead times in making decisions saying, "The time it takes to get something done can be quite inhibiting". Academic 02 said "... they have no understanding that you have a full-time job" referring to academics' teaching and research responsibilities.

Postgraduate students also provide added capacity to academics, who cannot handle all the workload on their own, and some of the work can be done by another person with lesser skills. An example of this is the inclusion of a postgraduate student in a project package as explained by Administrator 13.

Different Academic and Business Outlook

When businesses are able to contact an academic, there are problems related to the different objectives of businesses compared to the academics. While businesses want fast turnaround on their requirements, academics are not able to respond accordingly due to the teaching workload, which takes priority. As Academic 05 explained:

> "Issues though are workload and priority. There are a number of cases where there is opportunity but it is a challenge as we are all busy teaching and doing research, and doing services needs to carve off a chunk of time."

Academics have long-term, research-oriented outlook as opposed to the short-term, profit-oriented outlook of businesses. Independent 02 said that "they come from an academic organisation and they are not driven by the commercial outcome" and the value that one "might get from an academic organisation might be a lot less than interacting with another private company whose survival might be dependent on commercial activities". Administrator 04 elaborated that in many cases academics are trained to "develop their idea to perfection" while "business does not want perfection. Business wants enough to go to market". Academic 07 commented that:

"There is always tension in academic consulting with industry. For an academic to be engaged, the problem has to be interesting to the academic. And I think the expectations on both sides are sometimes unreasonable."

However, Administrator 13 gave an example of how this is handled by an academic who "runs a consultancy whereby they have sufficient long-term, big time contracts" and "he has sufficient funds coming in to pay for two full-time researchers who simply work on the commercial jobs. Therefore, if someone wants something in six weeks, ... [there is] no issue with having to teach ...". She said that the "barrier needs to be broken and they need to get one project big enough that they can hire a very good postdoc. And most of the work is done by the postdoc under tight supervision. And then they are rolling."

An example of this was the Black Albatross, the Computer Science Applied Research Centre, which was formed in 1994 (University of Otago, 2009). After a few years of successful projects, it was let go for a nominal sum. In terms of taking on projects, Academic 03 said "there is nothing stopping an academic from hiring a research assistant to do it in the timeframe that industry wants. The academics want to do it themselves, in their timeframe by themselves, but what is wrong hiring people and managing them?"

As illustrated by Independent 01, who has experience in working in university–industry collaborative activities in the UK, similar challenges are also faced by collaborations that she has seen, but communication difficulties are overcome if there are common objectives.

Prior collaboration experience with industry partners favourably influences academics' response to industry collaboration as explained by Academic 05:

"We were with the same company for a very long time period. And that worked well as we knew each other, we knew the people, we understood the problems we were

working on so you didn't have to rebuild the understanding of both the problem and the context of the individuals."

Academics are encouraged to work with businesses in consulting engagements, and there are businesses that would like to engage academics, but "the difficulty with the university system is as soon as you start offering a service outside, the overhead costs make it not competitive" (Academic 10). Administrator 13, however, disagrees with this statement. One interviewee stated that there are also situations where academics do consulting work outside of the university structure, which appears to run counter to university rules.

IP Rights Negotiation

IP rights negotiation is not regarded as a big challenge in the case of the ICT. Academic 06 explained:

> "That's not a big deal if you develop a software. We are pretty open about it. The IP evaluation process is necessary and we go through it. Go for Open Source, and if that is not possible, then we go for other models. Actually, we are rather flexible."

However, if the negotiation process takes too long, it can potentially delay the progress of the business especially if it needs investment for it to be viable. Open Source has also become a consideration in recent times, which may be in conflict with the focus on commercialisation. Academic 05 said:

> "It is an issue in that it needs to be thought about and discussed. And it can sometimes be a contentious point but in practice it is resolvable."

4.2.3 Interacting with the University

Businesses have difficulties prior to interacting with the university, as they are not sure whom they should contact when they want to work with the university. Business 05 commented that it is "difficult to contact because university is huge". Business 06 added that they "don't seem to be that bothered to interact with businesses. Maybe I talk to the wrong people". Business 02 further elaborated with suggestion for a single point of contact:

> "We try and help but the complexity at the university makes it hard for us non-university people to understand. University and departments and different people doing similar-sounding things are quite hard to negotiate."

"Complexity. Different schemes. Externally, it is difficult. [It] won't be if there is a single contact point. If we had a problem, they could say who we could see."

To a question on whether the easy accessibility to the University of Otago is an advantage to the ICT cluster, Intermediary 1 responded: "Physically, yes". But "It is how they perceive the university. Whether it's a place they can easily and comfortably go into and talk to people." Business 06 managed to make headway but got no follow through: "Yes. I got four different names. I sent that to four different people. [I] was never told if it went anywhere." Administrator 08 summed it up with "University is still a mystery to people outside". The university is aware of these issues and there are plans to respond to these issues.

There is however, an initiative as described by Academic 03 to "establish this closed loop" in "just connecting people". Different people from the university contact businesses and not being aware of the different threads of discussion leads to a loss in synergy and sometimes conflict, as explained by Administrator 09, who elaborated about a contact database that they "will start centrally, but hopefully in time we can put it out to the departments".

In terms of presentations by academics at seminars, Intermediary 03 stated that "in many cases, the presentation has been very academic. It hasn't been easily assimilated by businesses... and the reason for that is because the way academics think isn't the same as businesses think, and that's not a criticism. It is just a statement". Intermediary 03 also added that most academics do not know what businesses want to hear about, and "lot of business problems are not sufficiently academic" resulting in a challenge of how to do both.

There are also occasions when intermediaries such as UpStart, Distiller, or other incubators in Dunedin might be the right party for businesses to contact, but businesses are not clear which is appropriate for their requirements. Intermediary 04 commented on an initiative to resolve this issue.

4.3   Chapter Summary

This chapter discusses university–cluster activities affecting businesses under KTO and non-KTO activities.

Non-KTO Activities

- These include curriculum-based and extracurricular activities, both generating spinoffs and providing consulting.

- Curriculum-based spinoffs are generated through postgraduate programmes, while extracurricular spinoffs are triggered by participation in entrepreneurial programmes such as Audacious and StartUp Weekend.

- Curriculum-based consulting occurs through capstone projects, postgraduate thesis studies, and undergraduate assignments, while extracurricular consulting is by student-run consulting organisations.

- The main challenge faced in running curriculum-based projects is matching businesses with student projects course requirements.

- There are also other extracurricular activities such as internships, and student voluntary activities.

KTO Activities

- Infrastructural support for KTO activities is well established in the University of Otago.

- Consistent with extant literature, academics face orientation and transactional barriers, as many have varying aspirations when they choose an academic career.

- Teaching takes priority, leaving little time to engage in commercialisation activities.

- The IP rights process is not regarded as a big issue for ICT unless there is a long delay.

- Businesses are not clear on whom to contact in the university, and when they are able to make contact, they face communication difficulties because of differing outlooks.

5 Discussion

This chapter focuses on how existing university–cluster activities can be improved and new ones introduced to produce better outcomes for businesses, the university, and students. It synthesises the findings and literature, highlighting some fundamental concepts such as:

- Geographical proximity that allows face-to-face interaction (which is crucial for tacit knowledge exchange), contributes towards building social capital, and reduces cognitive distance.

- The limited absorptive capacity of small and medium-sized businesses, and how being within clusters enables learning through tacit knowledge exchange through university–business activities.

- The use of consulting techniques and just-in-time teaching to enhance student programmes.

- Understanding clusters as complex adaptive systems in matching businesses and university activities.

The findings of the study show that students and academics are involved in both KTO and non-KTO activities with local businesses.

KTO outcomes are generated through activities led by academics. These activities also generate publications (such as journal articles and conference proceedings). Postgraduate students work in a support role to the academics in KTO activities. Literature indicates that the students extend academics' capacity in taking on collaborative activities (Ponomariov, 2009).

Non-KTO activities by postgraduate and undergraduate students may lead to spinoffs and consulting engagements. Patents, licenses, joint research, and contract research are not applicable to non-KTO activities. Curriculum-based postgraduate thesis programmes have resulted in spinoffs. Capstone projects, assignments, and postgraduate programmes provide consulting. As indicated by literature, for non-KTO activities, academics design and facilitate the programmes for curriculum-based activities with students interacting with businesses (Åstebro et al., 2012; Berggren & Lindholm Dahlstrand, 2009; Lindholm Dahlstrand & Berggren, 2010).

There is opportunity for students to gain real world experience through non-KTO activities, enhancing their learning experience through their involvement in real world collaborations, which prepares them better for their future careers. Literature concurs that students involved in non-KTO curriculum-based programmes obtain professional working experience (Bruhn & Camp, 2004; Robinson et al., 2010). In addition, some of these engagements generate research content that is used by both students and academics for publications. Some articles referred to in this document are the result of student engagement with businesses (e.g. (James, 2005; Schilling & Klamma, 2009).

Extracurricular programmes have also been successful as in the case of MIT, which has an entrepreneurial culture, with alumni initiatives encouraging entrepreneurship starting in the 1970s (Roberts & Eesley, 2009). Findings from the present study show that extracurricular programmes such as Audacious and StartUp Weekend are targeted at creating a similar culture.

While there is extensive literature on KTOs and university commercialisation, activities where students interact with businesses are limited and spread over different threads of literature from different perspectives. Extant management literature reviewed discusses student involvement in spinoffs (Bathelt et al., 2010; Pirnay et al., 2003). Literature on higher education teaching programmes focuses on preparing students for future employment, while contributing to the community and economy and positioning students in the business-interfacing role (Bruhn & Camp, 2004; James, 2005; Schilling & Klamma, 2009). Practitioner literature for cluster activities includes practical projects with students working on real business problems, joint development of curricula and delivery through student placements and internships (Ffowcs-Williams, 2012).

Another thread of literature addresses university–industry collaborations, but no publications were identified that focus on university–cluster collaborations, specifically elaborating how cluster characteristics affect such collaborations. The main thrust of this chapter is to view the findings from this study (as well as those reported in cluster literature) from the perspective of cluster characteristics and how they can contribute towards better outcomes in university–cluster collaborations. Porter's cluster theory has been very influential in cluster activities, but it has been criticised for being vague and not measurable, but some see this as its strength because this has led to practitioners combining it with other related concepts that contribute towards strengthening clusters (Lazzeretti et al., 2013). This study takes on this concept and

combines cluster theory, knowledge and its learning modes together with higher education concepts in experiential learning involving real world businesses to achieve better cluster outcomes through university activities.

The Connected University model expands beyond the Entrepreneurial University model and captures a wider variety of university–business interactions, thinking in terms of knowledge exchange rather than knowledge transfer, and taking a systematic approach as was done for technology transfer in the Entrepreneurial University model (Kitson et al., 2009). Established research knowledge can be used in new ways and by new users, and includes consulting, secondment, and training, which will be useful for small businesses and those technologically less sophisticated. The Connected University model addresses the role of academics in expanding university–cluster interactions (Kitson et al., 2009), but does not clearly address the role of students.

The discussion is presented from a cluster perspective as the focus of this study is on university–cluster activities. Findings from KTO and non-KTO activities as described in Chapter 4, will be incorporated within cluster considerations. The first section considers geographical proximity based on its impact on tacit knowledge exchange, and social capital. The second section addresses how student activities can be engaged in responding to the limited absorptive capacity of small and medium-sized businesses. The third section discusses the matching of businesses to university student activities, and also how various university activities can be targeted to different types of businesses. Having completed the discussion, the fourth section presents the revised framework of this study, and the last section contains the section summary.

5.1 Impact of Geographical Proximity

Geographical proximity of cluster actors is one of the main features of clusters (Bathelt et al., 2004). The fact that the University of Otago is in the same location as the businesses in the ICT cluster of Dunedin makes it convenient for university–business collaborations and face-to-face interaction. Menzel and Fornahl (2010) argue that while geographical proximity enables closer collaboration among businesses and other cluster actors, this also causes a drop in heterogeneity of accessible knowledge over time. The ongoing capability of clusters to keep growing is dependent on their heterogeneity of accessible knowledge. Failure to maintain a balance between knowledge exploitation by clusters, and injection of new knowledge into clusters can have a negative impact. Creative destruction by employing

actions outside of current practice (Schumpeter, 1947) becomes necessary to continue cluster growth.

5.1.1 Engaging Tacit Knowledge

An appreciation of the types of knowledge and the relevant learning techniques is important for effective exchange. Tacit knowledge is about intuitively knowing and being able to solve problems, but not being able to explain it or document the thought process (Girard & Girard, 2009; Nonaka & Takeuchi, 1995; Polanyi, 1966). It is difficult to formalise as it needs active participation and depends on the given context unlike explicit knowledge that can be codified and communicated in a formal manner (Polanyi, 1973). Explicit or codifiable knowledge can be easily transmitted through known means of knowledge exchange. Tacit or uncodified knowledge exchange is however, more effective through face-to-face interaction. It permits in-depth and immediate feedback exchange as it engages verbal, physical, and contextual levels, which are deemed essential for communication of tacit knowledge (Storper & Venables, 2004).

This study demonstrates that curriculum-based projects involve students, who are prepared with explicit knowledge from their coursework. When they interact with businesses to understand business requirements, they pick up tacit knowledge. During the projects, further explicit knowledge comes into play through coaching and mentoring by the academics supporting the programme. The interchange between these knowledge types leads to a knowledge spiral (Nonaka, 1994) that enriches both students and businesses.

This study also found that students are able to respond to the issue of businesses' lack of absorptive capacity when they work on projects with firms. Students not only pick up knowledge internal to the firms (tacit knowledge) but also bring in external knowledge (explicit knowledge), thereby improving the knowledge capital of the firms as well as students. This means that the students take on the role of boundary spanners and communicate knowledge across internal and external boundaries of organisations (Youtie & Shapira, 2008). In this role, they are effectively providing consulting or technical services, and students are mobilised into client locations.

Consulting

Findings from this study show three possible ways of face-to-face interaction through consulting: KTO, extracurricular student consulting organisations, and curriculum-based student projects.

In terms of consulting via KTO, this study shows that academics find that the rates charged for consulting by the KTO are not competitive. This is consistent with literature describing this as 'Williamson' or transactional barriers referring to the costs of commercial engagements through the university's rules and regulations (Tartari et al., 2012). The study also finds that businesses turn away from consulting engagements with academics due to rates charged by the university.

The study findings show that there are extracurricular student-run organisations such as Orange Consulting that provides consulting services to local businesses, and Ignite Consultants that provides similar services for not-for-profit organisations. Curriculum-based programmes have been used as means of interacting with businesses.

Spinoffs

Spinoffs are being generated through extracurricular activities such as Audacious and StartUp Weekend programmes in Dunedin. The university supports these activities to encourage entrepreneurial activities among its students. Literature highlights MIT's environment that attracts entrepreneurial-minded students and academics, its alumni initiatives, and student entrepreneurship clubs resulting in networking among students as the main reason influencing the generation of spinoffs (Roberts & Eesley, 2009).

This study shows that curriculum-based postgraduate thesis research also generates spinoffs, based on the topics chosen by postgraduate students. Lindholm Dahlstrand and Berggren (2010) reported on how ideas from IP generated by Chalmers University's faculty and staff are used in the Chalmers University Entrepreneurial School programme involving master's students that create a market for those ideas. Some of these generate spinoffs, while other students use the knowledge to form businesses on other ideas. Åstebro, Bazzazian, and Braguinsky (2012) highlighted that even undergraduate programmes can lead to spinoffs as seen in the Halmstad University's engineering degree programmes that combine engineering with business and marketing. Based on these examples, it appears that there is potential to design postgraduate and final year undergraduate programmes with higher potential to generate spinoffs.

5.1.2 Developing Social Capital

Social capital plays an important role in knowledge sharing among cluster actors as there is interdependence between the economic structure of the cluster and social capital (Lundvall & Maskell, 2000). Social capital reduces cognitive distance between cluster actors, hence

contributing to learning (Malmberg & Maskell, 2002). As firms within clusters differentiate and specialise, more knowledge is created and spread over a number of organisations. Sharing this knowledge enables firms to combine different pieces of knowledge and resources, resulting in innovation (Bathelt et al., 2004). Key individuals take on leadership roles in well-functioning clusters and nurture knowledge sharing and cooperation among cluster members (Morosini, 2003).

The study findings indicate a certain degree of social capital among cluster actors from observations of the various ICT cluster activities. There are the beginnings of social capital being developed as seen by the attendance of academics at the Create IT event. The university administration is also represented in the city council strategic planning initiatives. There have also been attempts at engaging with businesses through seminars as in the case of the Entrepreneurs Club. However, study findings show that it is difficult for businesses to contact someone in the university who can address a particular requirement because of the complex university structure as mentioned in Section 4.2.3. The university is aware of these issues and there are plans to respond to them.

This study shows that often, even when contacts are made, businesses find conflicting objectives with the academics, and the level of communication is too technical for their understanding. However, two academics who have been involved in collaborations with businesses, and another academic who worked in the industry before taking on an academic position, do not face these issues. This is consistent with literature, which indicates that academics with prior collaboration experience with industry partners faced less barriers in working with businesses as the academics are used to the norms of industry (Tartari et al., 2012).

Participation in community activities and student exchanges with local firms also helps build social capital and expands on possible links with businesses (Ramos-Vielba & Fernández-Esquinas, 2012). The findings of this study show that university student volunteers provide legal support, accounting services support, and consulting services. Despite the University of Otago engaging in such community activities, which have the potential of developing social capital, there does not seem to be an active effort in pooling the contributions from these initiatives together towards building social capital.

5.2 Limited Absorptive Capacity of Small and Medium-Sized Businesses

Universities are in a unique position to be gatekeepers, who introduce and diffuse extra-cluster knowledge into clusters (Giuliani, 2011), as they possess worldwide access to other institutions, journal articles and conference participation. Parties receiving the knowledge must have absorptive capacity to assimilate and use it (Cohen & Levinthal, 1990). Laursen and Salter (2004) report that businesses investing in R&D have a higher absorptive capacity and are able to draw in working with TTOs. Based on the study findings, the University of Otago is well structured (with OIL and R&E) to work with businesses with a higher absorptive capacity. However literature indicates that many small and medium-sized businesses have limited absorptive capacity (Geuna & Muscio, 2009), and require other interaction channels such as consultancy, technical support services, or mobility of human resources (Ramos-Vielba & Fernández-Esquinas, 2012). It appears that the small and medium-sized businesses in the ICT cluster need an alternative means of knowledge infusion, and university curriculum-based activities have a potential to close this gap. The findings of this study show that university non-KTO curriculum-based consulting activities are conducted through capstone projects, undergraduate assignments, and postgraduate research projects, which however, have a limited scope due to course requirements. Kitson et al. (2009), who introduced the Connected University model, discuss partnerships between academics and businesses, and also all universities, not just traditional research-based universities, but fail to elaborate on how students can be involved.

At the University of Otago, capstone projects bring together what Information Science students have learnt into practical application for real world situations. The explicit knowledge they bring to the projects together with the tacit knowledge exchange with businesses addresses the issue of limited absorptive capacity of the small and medium-sized businesses. Extant literature shows that these projects have the potential to improve on the university–business interactions by engaging a number of techniques as discussed below. Robinson et al. (2010) incorporated service learning and problem-based learning approaches in their capstone programme, setting up a student consulting company to provide consulting for small businesses and non-profit community organisations. The academics took on a coaching role and provided just-in-time teaching, imparting knowledge when the students needed to apply it. Bruhn and Camp (2004) described how they involved industries to provide design projects for their student teams, resulting in students acquiring work experience, businesses gaining products, and faculty receiving experience in curriculum

development. They formed a 'mock' consulting team for the students to acquire a more realistic experience. Academics also benefited by getting contacts that resulted in research opportunities.

James (2005) reported capstone projects that were run as internship programmes with dedicated time to the projects and no other course workload for the students. Interdisciplinary teams were involved and the participating students received good working experience and excellent starting jobs while delivering results to the businesses. There was increased workload for the faculty but the success of the projects and publicity received by the department compensated this. This study found that the University of Otago has internship programmes where businesses engage students to work full-time with them for a specified period. There seems to be a possibility here to apply the internship concept to capstone projects.

In addition to improving on interaction with businesses, the activities also formed the basis for research and the delivery of publications, such as those referred to in this study. It highlights the possibility of producing publications in tandem with initiatives to improve university–business outcomes.

The undergraduate assignments found in this study, although limited in scope, still have the opportunity to research specific issues that can help businesses, as shown in the case of the project that improved effectiveness of the use of web applications. Students applied their skills in a real world situation, and provided a service at the same time.

The findings of this study show that university curriculum-based consulting activities are conducted through capstone projects, undergraduate assignments, and postgraduate research projects, which can be restrictive due to course requirements.

5.3   Clusters as Complex Adaptive Systems

This study shows that university–business activities involve the University of Otago, businesses, the Dunedin City Council, and other intermediaries of the ICT cluster in Dunedin. Rullani (2002) presents the complexity of clusters explaining that clusters are spontaneous forms that naturally self-organise, have no central authority, and are governed by rules that evolve over time and are adapted by cluster actors. Firms and other organisations, on the other hand, serve specific purposes, are guided by strategic directions, and have structured processes. Another feature of clusters is that cluster actors choose to live within a cluster that

will meet both their economic and social needs. While clusters have the potential for competitive advantage, they can only succeed if the complexity of clusters is embraced. It must therefore be recognised that standard organisational management practices may not constitute the most effective approach. Metcalfe (2010) also highlights that businesses, and universities are part of a complex adaptive system, and university–business interactions should be considered within this context.

The study findings indicate the complexity of the ICT cluster in Dunedin. When looking for academics with specific areas of expertise, businesses do not know whom to contact. Even when they are able to contact someone, academics find they do not have enough time to handle such requests, or do not have the same orientation towards the requirements of the business as discussed in Section 2.3.3. The reverse situation occurs when academics source for businesses to engage in student capstone projects, and assignments. There is no central database of business contacts maintained by the university. The focus group meeting highlighted the role of the city council as a broker in matching the businesses to the university course requirements. The many possible businesses to deal with, the complex structure within the university, and the involvement of the city council highlights the complexity of matching businesses to university activities for different requirements. Literature highlights the need to think out-of-the-box in dealing with the complexity of clusters, and discusses the use of gatekeepers, boundary spanners, and brokers as means that help in handling complexity. Giuliani (2011) explains the gatekeeper role that universities can play in bringing new extra-cluster knowledge into the cluster for its growth. Youtie and Shapira (2008) describe the boundary spanning roles that occur among academics, businesses, and public organisations communication knowledge within as well as across organisations. While knowledge exchange is crucial, matching the right businesses with the university activities requires the role of brokers. Brokers facilitate transactions between two or more parties when there is a lack of trust between these parties (Gould & Fernandez, 1989) as these parties do not know each other or are acquaintances.

5.3.1   Matching Businesses to University Activities

Implementing curriculum-based activities with businesses raises complexity as it involves academics, businesses, and the city council, as surfaced in the focus group meeting. One of the main challenges identified in this study is matching businesses with the relevant requirements of the student projects. If students cannot source businesses, the academics assist. Academics have their own personal list of contacts, which they share with others on a

person-to-person basis. This study also found that there is no central database of contacts to draw from. Having such a database can potentially make it more efficient for academics to find businesses that can be involved in their student projects. Literature highlights the complexity of clusters with businesses and other organisations having their own objectives, and there is no central player that has power or control over the cluster (Rullani, 2002). Compared to curriculum-based non-KTO activities, KTO activities under OIL and R&E are better organised in relating to businesses, as explained later in this section.

The findings of this study show that lack of communication between businesses and the university also makes it difficult to identify businesses that match the university curriculum-based activities and that the course requirements can be restrictive for businesses. While potentially a higher number of business collaborations are possible by employing curriculum-based student activities, managing the contacts and relationships is expected to be difficult. Literature identifies brokers as crucial in facilitating transactions when there is little or no relationship between two parties (Gould & Fernandez, 1989). Bruhn and Camp (2004) highlight the formation of an industry advisory committee of local industry leaders assisting the faculty in preparing the curriculum and matching student projects with the businesses. Based on the study findings, the ICT cluster in Dunedin can potentially gain by engaging local industry leaders as brokers, with multiple benefits of reducing academic workload, receiving feedback from industry on curriculum development, and developing industry contacts for future projects.

Literature highlights that one of the success factors of the Entrepreneurial University is the institutional structure, facilities, and resources that support the model (Ramos-Vielba & Fernández-Esquinas, 2012). The findings of this study show that KTO activities of the University of Otago are well structured for commercialisation, with a mission statement that commits to knowledge application and enhancement of society, as well as OIL and R&E resources to facilitate the commercialisation activities. This is in line with the call for universities to adopt the Entrepreneurial University model (Etzkowitz et al., 2000; OECD, 2003) delivering a third mission of economic and social development in addition to its two other missions of teaching and research (Etzkowitz, 1998, 2003; Gulbrandsen & Slipersaeter, 2007).

5.3.2   Matching University Activities to Business Needs

Findings from the study indicate that different channels may be better suited in conducting consulting activities for different groups of businesses. An understanding of how best to match different types of businesses and their requirements against the different university channels can provide general directions when matching businesses to university channels. The channels are R&E under KTO, and under non-KTO are the curriculum-based programmes, and student-run consulting organisations. The following discussion is an attempt at defining appropriate channels for different groups of businesses based on absorptive capacity, and challenges faced by academics, who are important players in both KTO and curriculum-based projects. As academics' participation in student-run consulting organisations is voluntary, any challenges they face is by choice.

As discussed in Section 5.2, businesses investing in R&D have a higher absorptive capacity making it possible for them to draw from KTOs, but small and medium-sized businesses have limited absorptive capacity. While large and R&D focused businesses can work through the KTO, the small and medium-sized businesses require different channels. This study has highlighted the use of curriculum-based programmes such as capstone projects, assignments, and postgraduate theses studies, and extracurricular initiatives such as student consulting organisations as possible ways of providing consulting and technical support services to small and medium-sized businesses.

The challenges faced by the academics in dealing with KTO activities, as discussed in Section 4.2.2, are consistent with literature. In the context of this study, the barriers faced by KTO are assumed to be the same as TTO. Both findings and literature indicate that these challenges are due to the commercial nature of KTO activities.

Based on this, it is the researcher's opinion that curriculum-based activities should not face challenges as those of the KTO as they are based on the teaching mission. As the involvement of academics in extracurricular activities is voluntary, they should not face these challenges. The rest of the section elaborates on the findings and literature on challenges faced by academics when involved in KTO activities.

Based on interviews with academics, it seems that some academics are not driven by commercial outcome, which is what businesses are interested in. Academics also have their preference for topics, and want to develop their ideas while businesses just want enough to deliver their business objectives. These findings are supported by (a) D'Este and Perkmann

(2011) who argue that most academics engage in collaborations with businesses to further their research agenda rather than the application of knowledge, and (b) Tartari et al. (2012) who describe these conflicting objectives as 'Mertonian' or orientation barriers referring to the long-term, research-oriented outlook of academics versus the short-term, profit-oriented outlook of businesses.

The study findings indicate that the KTO rates for consulting are not competitive. Tartari et al. (2012) describe this as 'Williamson' or transactional barriers referring to the costs of commercial engagements through the university's rules and regulations.

Another area of academics' contention with KTO activities that the study identified relates to the level of detail of publications and the timing of their release. Tartari et al. (2012) explain that academics' collaboration is motivated mostly to support their own research objectives, and they work within a peer recognition system through publications from original research.

Literature states that time distribution between teaching and research also impacts academics' ability to allocate time for knowledge transfer (Ramos-Vielba & Fernández-Esquinas, 2012). This supports the findings of this study that academics' teaching and research take up a significant amount of their time, leaving them little time to evaluate business requests. The first priority of academics is teaching, which decides the extent to which they can become involved in KTO activities.

The findings of this study show that IP rights negotiation is not regarded as a big challenge in the case of ICT, and it is seen as something that needs to be done. However, if it takes too long, it can potentially delay the progress of the business especially if it needs investment for it to be viable. Open Source has also become a consideration in recent times, which may be in conflict with the focus on commercialisation.

Considering that clusters are complex adaptive systems, different approaches may potentially help in widening the range of university activities to cover a broader set of businesses, as listed below:

- KTO to continue its activities as currently structured,

- Student-run consulting organisations focus on businesses that do not match KTO requirements and at a lesser cost, (note that there are also other organisations that can fit into this group), and

- Curriculum-based programmes for which businesses are not charged, but there is time investment.

5.4 Revised Framework

After analysing the data from the study and combining concepts and theories for knowledge, clusters, universities, and learning techniques, the researcher's view is that the activities should be viewed at the university actors' level, while still taking into consideration the institutional levels of KTO and non-KTO, as opposed to direct university and university-related as shown in the original framework in Figure 2-7. The university actors are the academics and students. The revised framework is as shown in Figure 5-1 below:
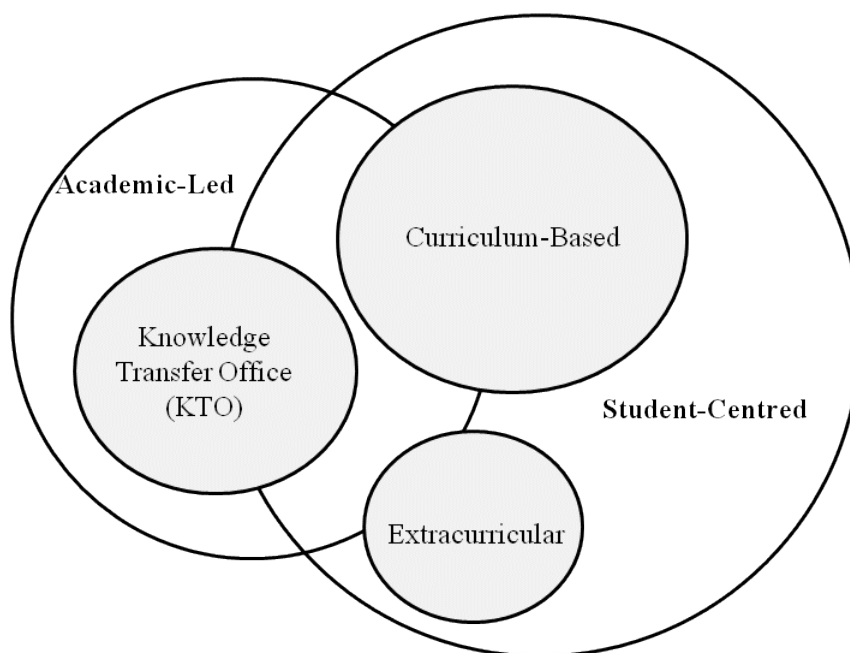
Figure 5-1: Revised Framework of University Activities

The KTO includes academic commercialisation and academic engagement. Non-KTO activities cover curriculum-based activities and extracurricular activities. Curriculum-based activities include capstone projects, postgraduate thesis studies, and assignments. Extracurricular activities include student-run consulting e.g. Ignite Consultants and Orange Consulting, and entrepreneurial programmes e.g. Audacious, and StartUp Weekend, which are supported or sponsored by the University of Otago.

In the revised framework, academic-led and student-centred activities overlap with each other to different extents. The student-centred circle is larger than the academic-led circle

representing the larger student population than academics. The curriculum-based circle is larger than the extracurricular circle as curriculum-based activities are applicable to all students within a specific programme while extracurricular activities are voluntary.

Academic-led activities indicate that academics take on the primary role, while students play a supportive role. An example of this is KTO activities where academics are supported by postgraduates who provide the extended capacity required in the projects both in terms of resources and also their knowledge and skills (Ponomariov, 2009). This is illustrated by the KTO circle overlapping both the academic-led and student-centred circles.

Student-centred activities indicate that students are the visible persons interacting with businesses during the activities, although academics remain in charge (as in the case of curriculum-based activities, but more from behind the scene). This is indicated by the greater overlap of the curriculum-based circle with the academic-led circle as compared to extracurricular activities, in which academics participate on a voluntary basis.

Table 5-1 provides a detailed view of university–business activities, outcomes, and how the different university models fit, and summarises the details of the KTO and non-KTO components described in previous chapters. Spinoffs, consulting, publications, and graduate skill enhancement are the common outcomes between KTO and non-KTO. While academic KTO activities are undertaken with publications in mind, this is not always the case for non-KTO activities, and hence the anticipation of more publications from KTO. However, non-KTO activities expose more students to real world work experience and are therefore expected to contribute more towards graduate skill enhancement. The traditional university performed its teaching and research mission, but entrepreneurial activities occurred serendipitously, hence, the Serendipitous University model. With knowledge being recognised as a crucial resource, and reduced funding for universities, the Entrepreneurial University model emerged. However, literature has highlighted that a focus on outcomes such as spinoffs and licenses has been at the expense of other forms of knowledge transfer such as consulting, joint research, and contract research (Kitson et al., 2009; Perkmann et al., 2013; Ramos-Vielba & Fernández-Esquinas, 2012). The Entrepreneurial University model does not seem to have lived up to the expectations for it, as indicated in Table 5-1.

Table 5-1: Roles of Universities within the Revised Framework

	Knowledge Transfer Office (KTO)			Non-KTO		Others
Activities	Academic commercialisation	Academic engagement		Curriculum-based	Extra-curricular	'Other'
		Formal	Informal			
Outcomes	Spinoffs Patents Licenses	Consulting Contract research Joint research	Ad hoc advice Networking	Spinoffs Consulting	Spinoffs Consulting	'Other'
	More --------------------------------- Publications --------------------------------- Less					
	Less ------------------------- Graduate skill enhancement -------------------------- More					
University Models	Entrepreneurial University		Serendipitous University			
	Connected University					
	Extended Connected University					

The Connected University model emphasises the need to connect to a wider set of businesses, with a focus on academics applying established knowledge in addition to conducting cutting-edge research through the Entrepreneurial University model. This study offers the Extended Connected University model that includes the student-centred activities to achieve the three missions of universities. Figure 5-2 depicts the revised roles of universities, capturing the various models discussed in this thesis and indicating the position of the Extended Connected University model in the context of these. 'Other' in Table 5-1 refers to activities that are not included under KTO and non-KTO, as this study focuses only on university-cluster interactions. Therefore, the Serendipitous University model will continue to co-exist representing other activities.
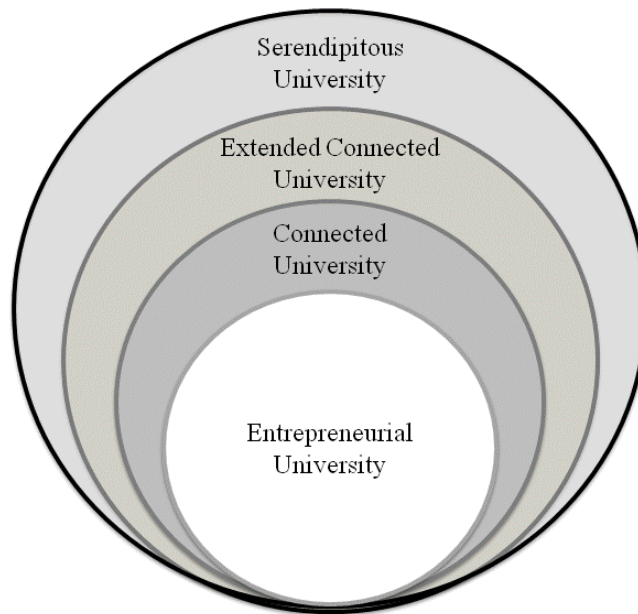
Figure 5-2: Revised Evolving Roles of Universities

The researcher is of the opinion that engaging businesses through student-centred activities will extend the university's contact base and social capital that in turn will help drive KTO activities. The researcher also believes that engaging with businesses can provide opportunities for academics to collect research data on university–cluster activities, student learning, and student voluntary services, and provide the basis for producing publications.

5.5   Chapter Summary

This chapter synthesises the findings and literature against cluster features:

- Geographical proximity enables sharing of common infrastructure, resources, and knowledge, and development of social capital among cluster actors due to frequent face-to-face interaction.

- As clusters grow, heterogeneity of accessible knowledge reduces, and clusters can decline if new knowledge does not flow into the clusters. Universities are suitable as gatekeepers to bring in this new knowledge as they have access to worldwide knowledge resources.

- Many small and medium-sized businesses have limited absorptive capacity to utilise explicit knowledge that flows in through gatekeepers and therefore cannot engage in university KTO activities.

- University students act as boundary spanners by working with businesses, when they are able to use their explicit knowledge by applying it for business requirements.

- Academics involved in supporting student interactions with businesses do not face the challenges faced by those involved in KTO activities, as their involvement is within their teaching capacity.

- By engaging students in university–business activities, there is opportunity to cover the businesses that may not suit KTO-related activities. These student activities support business requirements, while the students acquire experience in a work environment. In working with businesses, there is also knowledge flow back to universities that has potential as research data that can generate publications and conference content.

In this way, knowledge exchange happens between universities and the cluster while preparing students for future employment, and active participation in the cluster and community.

6 Conclusion, Contribution, and Recommendations

The purpose of this exploratory study was to investigate ways to generate better outcomes for both businesses within clusters and participating universities through university activities, based on the research question:

How can university–cluster activities result in better outcomes?

Outcomes refer to spinoffs, patents, licenses, consulting, research, publications, and preparing students for their future careers. The findings of this study show that patents and licenses apply only to KTO activities, and therefore are not applicable for the second half of the study, which focused on non-KTO activities.

The first section of this chapter summarises previous chapters, the second section discusses the contribution of this research study, the third section presents recommendations (for practice, policy, and research), and the last section covers limitations of this study.

6.1 Summary

This section summarises and draws conclusions based on the value of the literature engaged, methods used, and findings and discussion presented in previous chapters.

Literature Review

The initial literature review on knowledge, clusters, and roles of universities developed a framework to form the research question. Literature discussing university activities with regard to IP-related outcomes is well established. This is shown by literature that focused on university consulting and research activities, which highlights the comparatively greater attention to IP-related outcomes, and the need for attention to a wider set of university initiatives. This was echoed by a call to go beyond the Entrepreneurial University model to the Connected University model. Other literature focused on the role of students in spinoffs, reporting a higher number of spinoffs generated by students than by academics. In accordance to grounded theory methodology, data analysis was performed in parallel with data collection, and the role of students in consulting emerged as a concept for further investigation.

Further literature review on this emerging concept moved the search to higher education literature to review academic coursework that related to interacting with businesses. More literature was uncovered on undergraduate and postgraduate programmes generating spinoffs,

and also on working with businesses in a consulting mode. Besides these programmes, extracurricular activities also contributed. Combining the various lines of thought helped to synthesise literature with the findings, leading to the recommendations and contribution described in this chapter.

Method

This exploratory study combined case study method and grounded theory techniques. This combination provided the rigour of structured management of validity and reliability from the case study method, and a better take on data analysis from grounded theory techniques. While the two methods use different terminologies, they target similar objectives and complement each other well. Other studies have fruitfully employed this combination of methods (Lehmann, 2010; Pandit, 1996).

Twenty-five in-depth interviews were conducted with academics and administrators from the University of Otago, businesses and intermediaries from the Information and Communication Technology (ICT) cluster in Dunedin, and participants external to the Dunedin ICT cluster. Initial interviews were based on a purposeful sample, with additions through snowballing. The comparative analysis done in parallel with data collection showed that the initial literature reviewed did not cover student involvement in university–business activities through curriculum-based programmes and extracurricular activities. This led to the emerging concept of student-centred activities in university–business collaboration. More literature was reviewed and additional interviews were conducted to gain further information on this emerging concept. Interview data was transcribed generating fifty-two open codes, which were then grouped into four categories and thirteen subcategories. The categories are outcomes, activities, cluster actors, and challenges, which form the basis of the new framework representing the Extended Connected University model.

Findings and Discussion

This study investigated how universities within clusters can take advantage of cluster features to produce better outcomes for businesses, the university, and students. Geographical proximity of cluster actors allows face-to-face interaction (which is crucial for tacit knowledge exchange), helps build social capital, and develops cognitive proximity. It is to the advantage of local businesses to participate in university activities.

The findings led to two groupings of university activities, Knowledge Transfer Office (KTO), referring to the established university structure for academic commercialisation and academic

engagements, and non-KTO, which includes student-centred curriculum-based and extracurricular activities. The outcomes of these university activities were identified as spinoffs, patents, licenses, consulting, research (both joint and contract), publications, and skilled graduates. KTO activities cover spinoffs, patents, licenses, research, and consulting, with a definite intention of generating publications. Non-KTO activities cover spinoffs, and consulting, and have the opportunity for research for generating publications.

The study findings showed that the KTO activities are consistent with literature. KTO activities are led by academics, with postgraduate students supporting them in some activities. The academics range from those who are naturally inclined towards commercialisation to those whose interest is in basic research. Some challenges faced by academics are the known Mertonian orientation barriers and Williamson cost barriers.

The non-KTO curriculum-based activities have students interfacing with businesses. Curriculum-based activities are organised by academics that prepare and implement the coursework. Academics' role in extracurricular activities is voluntary. Literature indicated that a higher number of spinoffs are generated through non-KTO activities than KTO. Higher education literature highlights the use of curriculum-based activities in interacting with local businesses, but does not link it back to clusters.

Student-centred activities that are curriculum-based appear to have the potential to improve cluster outcomes for the following reasons:

- Curriculum-based programmes are already within the system and do not require development of a new programme.

- Academics working alone face fewer challenges than when they participate in commercially driven collaborations.

- Over time, curriculum-based activities will have an impact on businesses in the cluster, although businesses will need to work within some constraints in order to participate in such collaborations.

- Participating students gain experience in the real world, which better prepares them for future employment.

- Information gathering from such interactions has the potential to provide research inputs, which in turn may help improve the processes and/or form the basis for publications.

- Social capital amongst cluster members will increase, which should have a positive impact and form the foundation for other cluster activities.

By engaging in student projects with businesses, universities can expand from the Connected University model, and take a step forward to the Extended Connected University model. Curriculum-based activities have the advantage of a continuous flow of students available to collaborate with businesses. Small businesses stand to gain as the students work on a consulting basis within the business, responding to the issue of limited absorptive capacity. Being within the same cluster allows face-to-face interaction that is more effective for the exchange of tacit knowledge. While the students handle the boundary spanning, brokers need to be established to match students with projects.

A major challenge for curriculum-based activities is the difficulty in matching curriculum topics with relevant businesses, because clusters are complex self-organising units with no central management. Currently, such curriculum-based activities are facilitated by the academics responsible for the programme. There is no overall structure and academics manage their own programmes. Businesses that participate need to accept the timeframe and topic constraints based on the course definition. Additionally, there is no central database of contacts for academics to draw from when attempting to arrange collaborations with other cluster members, implying that more effort is required and suboptimal matches are likely.

6.2 Contribution

The main contribution of this study is in identifying university student activities as a means to improve outcomes of businesses within clusters, as well as to benefit the students and universities. While extant literature has considered the role played by university students and ex-students in generating spinoffs, the same has not been the case for curriculum-based activities for consulting. The effectiveness of curriculum-based activities for better student learning experience as well as to benefit businesses, community, and the university within the same locality are discussed in a different thread of literature. These two threads of literature cover different perspectives, which this study brings together to extend existing theory on university–business interactions in clusters. This has led to the development of the Extended

Connected University model, which focuses on student participation in addition to the role played by academics.

6.3 Recommendations

Recommendations for practice, policy, and further research are presented in this section.

6.3.1 Practice Recommendations

Practice recommendations apply to cluster administrators, businesses, local government, and practicing academics. Considering that curriculum-based student activities have potential for a wider impact, and that programmes are already part of the university curriculum, it is recommended that the university, businesses, and the local government work together to find the right matches for capstone projects, assignments, and thesis study requirements that are applicable to local businesses. Projects can be further improved by incorporating consulting techniques. Related to this is the need for the faculty to measure outcomes of such initiatives to track progress as well as to highlight their contributions, so that they can impress upon the university authorities the impact of these other university–business collaborations. Over time, this is anticipated to develop social capital that will pave the way for better communication among businesses, university, and the local government.

Businesses have difficulty in identifying the right university contact or intermediary to contact for assistance with entrepreneurial or business development initiatives. Having a single point of contact that can help businesses identify the most appropriate organisations to address their needs will save time for businesses. Such a contact point also provides an opportunity for data collection regarding the types of requirements of local businesses. A central database of contacts and information on the collaborations will provide valuable data for longitudinal studies on this study topic.

6.3.2 Policy Recommendations

Extending focus to non-KTO activities provides a greater scope for university–business collaborations. University authorities should expand their focus to include non-KTO activities and establish relevant measures that can be used to establish such activities. These measures will provide the university administration with relevant information based on which they can support such initiatives and recognise their contributions to the local economy and community. These activities will also provide the university an opportunity to draw tacit knowledge from businesses, which can subsequently be used to improve the subject matter of topics in assignments and also provide input for areas where research can be done.

Considering that non-KTO activities also generate spinoffs and consulting activities, universities should take into account the metrics for these collaborations in addition to KTO activities. It follows that a concerted effort is needed to identify and track relevant measures.

6.3.3 Recommendations for Further Research

There are four possible areas for further research.

Firstly, further research is needed in curriculum-based activities for university–business interactions. Research must identify metrics that can be used to highlight contributions of these activities. Techniques used in matching businesses to university activities should also be included in the research, considering the complexity of facilitating multiple cluster actors.

Secondly, further research is required in the use of different university channels for consulting, namely the KTO, curriculum-based student activities, student consulting organisations, and other university groups that are not identified in this study.

Thirdly, further research can be conducted on extracurricular activities that were not covered sufficiently in this study.

Fourthly, similar research in other disciplines will illuminate their differences, and potentially generate cross-disciplinary ideas as well as collaborations.

6.4 Limitations of This Study

There are limitations to the study that must be understood when considering the practice and policy implications. In particular, this study was done in a primarily 'university city', Dunedin in New Zealand, where the University of Otago is the only university. It, therefore, does not take into consideration larger cities with multiple universities. While the framework of the study may be relevant, the level of interactions may be more complex in larger cities. A study in a larger city should provide comparisons between small and large cities.

Another limitation is that the study involved a research university that covers a wide range of areas, unlike specialised universities that are developed to work in tandem with the cities where they are constructed. Research into such a university will confirm if curricula of such universities are intertwined to the industry needs, or whether there are other activities that can be better exploited. This study is not intended to be generalisable but to form a reference based upon which other studies can be done, as different universities have different objectives.

A third limitation is that the study sample of twenty-five is small and may not sufficiently represent proponents and opponents. Further to this, this study only identifies the research gap of student-centred activities but does not delve into further details on various other activities, how they are currently administered, and how businesses are identified for matching. The study was done only for the ICT cluster, and may not reflect other disciplines.

7   References

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8 Appendices

8.1 Ethics Approval Documents

8.1.1 Ethics Approval Application

Application Form for ethical consideration of research and teaching proposals involving human participants

HUMAN ETHICS APPLICATION: CATEGORY A

1. **University of Otago staff member responsible for project:**

   Everett, André   Professor

2. **Department:**

   Management

3. **Contact details of staff member responsible:**

   Andre.Everett@otago.ac.nz; ph. 479 7371

4. **Title of project:**

   Roles of Universities in Clusters – The University of Otago and the Dunedin ICT Cluster

5. **Indicate type of project and names of other investigators and students:**

Staff Research	X	**Names**	Dr. Conor O'Kane, Management Dept.
Student Research	X	**Names**	Regina Maniam

Level of Study (e.g. PhD, Masters, Hons)	Master of Business

6. **Is this a repeated class teaching activity?**

   NO

7. **Fast-Track procedure**: Do you request fast-track consideration?

   NO

8. **When will recruitment and data collection commence?**

   April 2013

When will data collection be completed?

August 2013

9. **Funding of project.**

Is the project to be funded by an external grant?

NO

If commercial use will be made of the data, will potential participants be made aware of this before they agree to participate? If not, please explain:

There is no commercial use.

10. **Brief description <u>in lay terms</u> of the purpose of the project** (approx. 75 words):

This research is for a Master's thesis. It examines "clusters", defined as inter-related businesses, suppliers, other support organisations including government, and educational institutions that are geographically located close together (Porter, 1990). This research is intended to

– contribute to more effective interactions between clusters and universities, benefiting both participants and the community of Dunedin;

– provide guidance towards university policy on interactions with industry, including faculty motivations; and

– contribute to the academic literature on university-cluster interactions.

11. **Aim of project, including the research questions the project is intended to answer:**

Economic factors such as demand, resource availability, and the synergy between the various cluster members contribute to cluster success. The earlier concept of industrial districts, with its geographical viewpoint, has recently morphed into the perspective of knowledge clusters (Pinch, Henry, Jenkins, & Tallman, 2003). Knowledge may be divided into two basic types, explicit and tacit, with the former being more easily codified and easier to share (Nonaka & Takeuchi, 1995). The process of converting between these types of knowledge, e.g. by tacit knowledge being codified into explicit knowledge, facilitates the practical application of new knowledge, creating a "knowledge spiral."

2

It is within this context that universities (with their explicit knowledge) and businesses and other support organisations (with their tacit knowledge), by working together, are able to produce a knowledge spiral benefiting both universities and other cluster members. This is well embedded in the "triple helix" concept where universities take on an entrepreneurial role in addition to their historical teaching and research roles (Etzkowitz, 2003). University policies have embraced this triple role, and programs and processes have been put into place to enable it. Many research studies have focused on selected types of interactions, typically those resulting in patents, journal articles, joint and contract research, and consulting (D'Este & Patel, 2007), as well as the motivations for such interactions (D'Este & Perkmann, 2011).

Strategy involves four components: policies and processes at an organisation level, and planning and practice at a management level (Whittington, 1996). Existing literature shows a focus on policies and processes, with little on strategy as practice (Perkmann et al., 2013). The aim of this project is to focus on strategy as practice (as opposed to policy and processes) to help identify how cluster members handle challenges faced in university-cluster interactions and why some interactions have better outcomes than others. In order to examine real interactions, a specific university-cluster pair was chosen for a case study – the University of Otago and the Dunedin information and communication technology (ICT) cluster.

The research questions (which form the basis for the open-ended interview questions) are:

How do the university and cluster members interact?
- What are the types of interactions?
- What are the contents of the interactions?
- What are the outcomes of the interactions?
- How can the success of such interactions be judged?
- What factors lead to more successful or less successful outcomes?
- What can be done differently to generate more successful outcomes?
- How will different approaches be perceived by both sides (and relevant peripheral participants)?

Potential practical outcomes include recommendations on how to improve these interactions for the benefit of all participants (university, businesses, city / society at large). Potential academic outcomes include extension of the literature in both clusters and knowledge management areas, as well as university-community interactions.

12. **Researcher or instructor experience and qualifications in this research area:**

Student researcher: Has completed a Graduate Diploma in Strategic Management, Otago Polytechnic, 2011, and first year of Master's studies in management at the University of Otago, focusing on clusters and strategic management.

Faculty supervisor: Professor of management, with multiple supervision experiences in related fields, including two new PhD thesis research projects in cluster-related areas (with the candidates also serving as potential resources for this student).

Faculty co-supervisor: Lecturer in management, focusing on strategic management, researching technology transfer offices of universities and the strategic role of principal investigators in their delivery of publicly funded research.

13. **Participants**

13(a) **Population from which participants are drawn:**

University staff engaged in cluster activities

Dunedin City Council staff involved in cluster activities

Business representatives from the ICT cluster

13(b) **Specify inclusion and exclusion criteria:**

All members of the three populations (above) are eligible for inclusion in the sample. If deemed necessary, members of other clusters (beyond ICT) may also be interviewed.

13(c) **Estimated numbers of participants:**

12–15 participants; number may increase if additional eligible participants request to participate during the course of the interviews (e.g., via referrals from participants).

13(d) **Age range of participants:**

Adults only.

13(e) **Method of recruitment:**

Identify participants through the Dunedin City Council and the University of Otago.

4

Identify additional participants during the research process, including via referrals from existing participants.

Contact participants via email or letter, utilising referrals and/or introductions from the Dunedin City Council and the University of Otago.

13(f) Please specify any payment or reward to be offered:

No payment of any reward or incentive. A summary of the research outcomes will be offered to the participants, but this should not be construed as a payment or reward.

14. Methods and Procedures:

Grounded theory, which is a qualitative method that uses structured procedures in coding and categorising to inductively derive theory (Strauss & Corbin, 1990), is used in this research study on interactions between universities and clusters. Interviews will be the primary method for data collection, and secondary data will be collected through observation of cluster activities and review of past records including minutes of meeting, reports, newspaper articles, and other publications. Participants will include the Dunedin City Council representative for the ICT cluster, academics from the University of Otago involved in cluster activities, ICT businesses, and other organisations offering support to clusters in Dunedin.

Interviews will be conducted and audio-recorded after participants sign the Information Sheet for Participants. The interviewees will be informed of the academic use of the data collected and the confidential treatment. The interviews will subsequently be transcribed and codified for analysis.

Open-ended questions will be used during the interviews to enable interviewees to provide in-depth information (please refer to section 11 above for a list of the general questions). An initial model based on the literature reviewed will guide the interview questioning. After the initial couple of interviews, coding and categorising activities will be done and the model will be reviewed and revised as necessary before further interviews. Further literature review may be conducted to expand academic findings on new thoughts discovered during the initial interviews. This iterative process will occur as new discoveries are made during the interviews. Further interviews for clarification and gaining additional information will be conducted as necessary during the analysis stage.

5

Findings from the analysis will be used to provide a better understanding of how interactions between universities and clusters can be strategically conducted leading to outcomes of a greater impact.

15. **Compliance with The Privacy Act 1993 and the Health Information Privacy Code 1994 imposes strict requirements concerning the collection, use and disclosure of personal information. These questions allow the Committee to assess compliance.**

    15(a) **Are you collecting and storing personal information directly from the individual concerned that could identify the individual?**

        YES

    15(b) **Are you collecting information about individuals from another source? Please explain:**

        Further information about participants, beyond what they volunteer, will be collected during the research process from public sources (e.g., newspaper articles) and from any limited-access sources that are made available (e.g., minutes of cluster meetings, company reports, etc.). The information about these individuals is about their professional activities, not their personal attributes or actions.

    15(c) **Collecting Personal Information:**

- Will you be collecting personal information?

  YES: Name and contact details will be collected. Participants' involvement in cluster activities and potentially their background that resulted in such activities will be recorded.

- Will you be informing participants of the purpose for which you are collecting the information and the uses you propose to make of it?

  YES: In the participant information sheet, participants will be informed of the nature of information to be collected and how they will be used. They will also be informed that the research contributes to a Master's thesis.

- Will you be informing participants who will receive the information?

6

YES: As part of the Master's thesis, and according to the university's policy, the dissertation will be provided to the University of Otago Library for research purposes. The study can potentially also be submitted for publishing in academic publications.

- Will you inform participants of the consequences, if any, of not supplying the information?

  YES: Participants will be informed that they will be at no disadvantage by not participating in the interviews (not supplying information), and that they can decline to be interviewed.

- Will you inform the participants of their rights of access to and correction of personal information?

  YES: Participants will be informed that they have the right to access their interview transcripts and correct any personal information.

Where the answer is YES, please make sure the information is available in the Information Sheet for Participants.

If you are NOT informing them of the points above, please explain why:

Not applicable.

15(d) Please outline your data storage and security procedures.

The data collected will be securely stored in such a way that only the researcher and supervisors have access to it. Hardcopies and audio recordings will be stored in a locked cabinet at the researcher's home office. Access to files in the computer is protected through administrator password protection and all external storage media (memory sticks) are stored in a locked cabinet while not in use.

At the end of the project, any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

15(e) Who will have access to personal information, under what conditions, and subject to what safeguards?

Only the researcher and her supervisors will have access to the data collected. All data will be maintained by the researcher and discussed with the supervisors during meetings only as required for the purposes of the research.

Will participants have access to the information they have provided?

Participants will be offered the opportunity to access their interview transcripts and correct any information they deem inaccurate.

15(f) **Do you intend to publish any personal information they have provided?**

NO. However, some personal information – such as name and job title – will be either included (published) or easily discernible from the roles of some of the interviewees (e.g., the key individuals within the University and the Dunedin City Council). This information should not be considered private as it is publicly available on the websites of these organisations.

If YES, please specify in what form you intend to do this?

Not applicable.

15(g) **Do you propose to collect demographic information to describe your sample? For example: gender, age, ethnicity, education level, etc.**

NO. However, some of this information may be easily discernible for identified individuals (refer to 15(f) above) from their organisation's public websites, e.g. from photographs on those websites or listings of educational attainments among their qualifications.

15 (h) **Have you, or do you propose to undertake Māori consultation? Please choose one of the options below, and delete the options that do not apply:**

(Please see http://www.otago.ac.nz/research/maoriconsultation/index.html).

YES   We have already undertaken consultation. A copy of the completed Research Consultation with Māori Form is attached.

16. **Does the research or teaching project involve any form of deception?**

NO

17. **Please disclose and discuss any potential problems**: (For example: medical/legal problems, issues with disclosure, conflict of interest, etc)

None known or anticipated.

18. **Applicant's Signature:** ....

 [Principal Applicant: as specified in Question 1]

 Date: ....

19. **Departmental approval:** _I have read this application and believe it to be scientifically and ethically sound. I approve the research design. The Research proposed in this application is compatible with the University of Otago policies and I give my consent for the application to be forwarded to the University of Otago Human Ethics Committee with my recommendation that it be approved._

Signature of Head of Department: ....

Name of Signatory (please print): ……………………………………………………

 Date: ....

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Te Whare Wānanga o Otāgo

NEW ZEALAND

Roles of Universities in Clusters –
The University of Otago and the Dunedin ICT Cluster

INFORMATION SHEET FOR PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The aim of this project is to gain a better understanding of the types and contents of interactions between the university and clusters in Dunedin. This is to identify how the university can play a better role in serving the clusters in Dunedin from a perspective of knowledge creation and knowledge transfer. This project is intended to help identify how cluster members handle challenges faced in university-cluster interactions and why some interactions have better outcomes than others. This study focuses on interactions between the University of Otago and the Dunedin ICT cluster.

This project is being undertaken as part of thesis research for a Master of Business (Management) at the University of Otago.

What Type of Participants are being sought?

Participants are selected based on their involvement in ICT cluster activities in Dunedin. This includes representatives from businesses, other support organisations, the Dunedin City Council, and the University of Otago.

Potential participants have been identified with the help of the staff of the Dunedin City Council and the University of Otago, who have been involved in cluster activities in Dunedin. The selection of participants will depend on the extent of participants' involvement in cluster activities. It is anticipated that 12 to 15 participants will be interviewed.

There will be no payments made to participants. However, they will be offered a report summarising the results of the research once it has been completed.

What will Participants be Asked to Do?

Should you agree to take part in this project, you will be asked to participate in one or more interviews. After the initial interview, subsequent interviews may be requested for clarifications or for gathering further information. The initial interview is anticipated to be one hour, involving only the researcher and the interviewee.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

What Data or Information will be Collected and What Use will be Made of it?

The main purpose of this research project is to collect information purely for preparation of the researcher's thesis in the Master of Business program.

The interviews will be audio taped, to allow the researcher to listen to the interview and transcribe it. No personal information will be collected, other than the interviewee's name and position / role / job title information. All information is collected purely for the purpose of preparation for the researcher's thesis in the Master of Business program. The thesis supervisors will have access to the information.

The data collected will be securely stored in such a way that only the researcher and the thesis supervisors will be able to gain access to it. Data obtained as a result of the research will be retained for at least 5 years in secure storage. Any personal information held on the participants (including contact details and audio recordings after they have been transcribed) may be destroyed at the completion of the research even though the data derived from the research will, in most cases, be kept for much longer or possibly indefinitely.

Due to the nature of the research, some personal information – such as name and job title – will be either included (published) or easily discernible from the roles of some of the interviewees (e.g., the key individuals within the University and the Dunedin City Council). This information should not be not considered private as it is publicly available on the websites of these organisations.

There may be participants who prefer to get the attention of the public as part of their strategic goals, and would prefer to have their names and organisations published. This could include quotations from their interviews. However, there may be participants who would prefer not to have their names released. Publication of such information will be cleared with each of the participants on an individual basis (via a signed consent form) prior to any disclosure of their details (e.g., name or organisation name). Where publication of the name (or organisation name) is not permitted, a sufficiently anonymised pseudonym will be employed to disguise the identity of the individuals/companies concerned.

On the Consent Form you will be given options regarding your anonymity. Please be aware that should you wish, we will make every attempt to preserve your anonymity. However, with your consent, there are some cases where it would be preferable to attribute contributions made to individual participants. It is absolutely up to you which of these options you prefer.

This project involves an open-questioning technique. The general line of questioning concerns interactions between the University of Otago and the Dunedin ICT cluster. The precise nature of the questions which will be asked has not been determined in advance, but will depend on the way in which the interview develops. Consequently, although the

University of Otago Human Ethics Committee is aware of the general areas to be explored in the interview, the Committee has not been able to review the precise questions to be used.

You will be informed about the general topic of the interview and possible available questions that may be asked during the interview in advance. In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable, you have the right to decline to answer any particular question(s) and you may withdraw from the project at any stage without any disadvantage to yourself of any kind.

The results of the project will be available in the University of Otago Library (Dunedin, New Zealand), and may be published in part (in academic journals, practitioner magazines, and/or academic conferences, as well as public media releases).

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Regina Maniam	and/or	Professor André Everett
Department of Management		Department of Management
University Telephone Number: 479 8125		University Telephone Number: 479 7371
Email: manre062@student.otago.ac.nz		Email: Andre.Everett@otago.ac.nz

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

Roles of Universities in Clusters –
The University of Otago and the Dunedin ICT Cluster

CONSENT FORM FOR PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the project is entirely voluntary;

2. I am free to withdraw from the project at any time without any disadvantage;

3. My participation in this project involves principally granting the researcher interviews of usually one hour. These interviews will be recorded and subsequently transcribed;

4. The data (recordings) will be destroyed at the conclusion of the project, but any raw data on which the results of the project depend will be retained in secure storage for at least five years, after which it may be destroyed;

5. This project involves an open-questioning technique. The general line of questioning includes information on interactions between the Dunedin ICT cluster and the University of Otago. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops and that in the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable I may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind.

6. I understand that this form gives me the option to allow publication of my name, or to require that all references to me and what I have said be anonymised as far as possible, using a pseudonym to disguise my identity and that of other individuals/organisations where I indicate that is appropriate in my interview(s).

7. A summary of the research outcomes will be offered to me if requested, but this should not be construed as a payment or reward.

8. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my anonymity should I choose to remain anonymous.

9. I, as the participant: a) agree to being named in the research, ☐   OR;

     b) would rather remain anonymous ☐

I agree to take part in this project.

....
          (Signature of participant)   (Date)

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

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14

8.1.2 Initial Decision Letter

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Te Whare Wānanga o Otāgo
NEW ZEALAND

13/093

Academic Services
Manager, Academic Committees, Mr Gary Witte

25 March 2013

Professor A Everett
Department of Management
Division of Commerce
School of Business

Dear Professor Everett,

I am writing to let you know that, at its recent meeting, the Ethics Committee considered your proposal entitled "**Roles of Universities in Clusters - The University of Otago and the Dunedin ICT Cluster**".

As a result of that consideration, the current status of your proposal is:- **Approved**

For your future reference, the Ethics Committee's reference code for this project is:- **13/093**.

The comments and views expressed by the Ethics Committee concerning your proposal are as follows:-

While approving the application, the Committee would be grateful if you would respond to the following:

Please provide the Committee with a copy of the interview questions to be asked of participants, or a general outline if the questions themselves are not available.

Please provide the Committee with copies of the updated documents, if changes have been necessary.

Approval is for up to three years from the date of this letter. If this project has not been completed within three years from the date of this letter, re-approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

Yours sincerely,

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

c.c. Assoc. Prof. I C McAndrew   Department of Management

8.1.3   Amendment Letter

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Te Whare Wānanga o Otāgo
NEW ZEALAND

13/093

Academic Services
Manager, Academic Committees, Mr Gary Witte

4 April 2013

Professor A Everett
Department of Management
Division of Commerce
School of Business

Dear Professor Everett,

I am again writing to you concerning your proposal entitled "**Roles of Universities in Clusters - The University of Otago and the Dunedin ICT Cluster**", Ethics Committee reference number **13/093**.

Thank you for your email of 3 April 2013, which provided a copy of the interview questions to be used. We confirm that this has been attached to the record of your application.

Your proposal continues to be fully approved by the Human Ethics Committee. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing. I hope all goes well for you with your upcoming research.

Yours sincerely,

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

c.c. Assoc. Prof. I C McAndrew   Department of Management

8.1.4 Supplement to Ethics Approval

Supplement to Ethics Application Approval No. 13/093 (Response to request by Ethics Committee for the interview questions)

Question Summary

	ICT Businesses	University of Otago	DCC and Intermediaries
Actual opening question			
Opening question	What type of interactions have you had with the University of Otago, and how have you benefited (or otherwise) from them?	What type of interactions have you had with ICT businesses in Dunedin, and how have the University and the businesses benefited (or otherwise) from them?	What type of interactions have happened between ICT businesses in Dunedin and the University of Otago, and how have they benefited (or otherwise) from them?
Interview questions checklist			
First question	1. What are the types of interactions between the University of Otago and your business?	1. What are the types of interactions between the University of Otago and ICT businesses in Dunedin?	1. What are the types of interactions between the University of Otago and ICT businesses in Dunedin?
Common questions	2. What are the contents of the interactions? 3. What are the outcomes resulting from the interactions? (Both more and less desirable outcomes) 4. How do you judge whether an outcome is more or less desirable? 5. What are the challenges and barriers faced during the interactions? 6. What different methods/techniques/practices were used in the interactions? 7. Which of these methods/techniques/practices contributed to more, or less, desirable outcomes? 8. What can be done differently to generate more desirable outcomes?		
Last question	9. How would the various approaches be perceived by both the University of Otago and your business?	9. How would the various approaches be perceived by both the University of Otago and the ICT businesses?	9. What role does the Dunedin City Council (or the intermediary) play in facilitating interactions between the University of Otago and the ICT businesses?

8.1.5   Maori Consultation

NGĀI TAHU RESEARCH CONSULTATION COMMITTEE
Te Komiti Rakahau ki Kai Tahu

Tuesday, 19 March 2013.

Ms Regina Maniam,
University of Otago,
DUNEDIN.

Tēnā Koe Ms Regina Maniam,

Roles of Universities in Clusters – The University of Otago and the Dunedin ICT Cluster

The Ngāi Tahu Research Consultation Committee (The Committee) met on Tuesday, 19 March 2013 to discuss your research proposition.

By way of introduction, this response from The Committee is provided as part of the Memorandum of Understanding between Te Rūnanga o Ngāi Tahu and the University. In the statement of principles of the memorandum it states "Ngāi Tahu acknowledges that the consultation process outline in this policy provides no power of veto by Ngāi Tahu to research undertaken at the University of Otago". As such, this response is not "approval" or "mandate" for the research, rather it is a mandated response from a Ngāi Tahu appointed committee. This process is part of a number of requirements for researchers to undertake and does not cover other issues relating to ethics, including methodology they are separate requirements with other committees, for example the Human Ethics Committee, etc.

Within the context of the Policy for Research Consultation with Māori, the Committee base consultation on that defined by Justice McGechan:

"Consultation does not mean negotiation or agreement. It means: setting out a proposal not fully decided upon; adequately informing a party about relevant information upon which the proposal is based; listening to what the others have to say with an open mind (in that there is room to be persuaded against the proposal); undertaking that task in a genuine and not cosmetic manner. Reaching a decision that may or may not alter the original proposal."

The Committee considers the research to be of interest and importance.

As this study involves human participants, the Committee strongly encourage that ethnicity data be collected as part of the research project. That is the questions on self-identified ethnicity and descent, these questions are contained in the 2006 census.

The Committee encourages contact with KUMA, Te Kupeka Umaka Māori ki Araiteuru, Māori Business Network Otago/Southland.

We wish you every success in your research and The Committee also requests a copy of the research findings.

This letter of suggestion, recommendation and advice is current for an 18 month period from Tuesday, 19 March 2013 to 8 September 2014.

The Ngāi Tahu Research Consultation Committee has membership from:

Te Rūnanga o Ōtākou Incorporated
Kāti Huirapa Rūnaka ki Puketeraki
Te Rūnanga o Moeraki

Nāhaku noa, nā

Mark Brunton
Kaiwhakahaere Rangahau Māori
Research Manager Māori
Research Division
Te Whare Wānanga o Otāgo
Ph: +64 3 479 8738
Email: mark.brunton@otago.ac.nz
Web: www.otago.ac.nz

8.2   Interview-related Documents

8.2.1   Email Invitation to Participate in Interview

Email invitation to participants

Subject: University of Otago: Invitation for interview: Roles of Universities in Clusters – The University of Otago and the Dunedin ICT Cluster

Dear _____

The topic of my master's thesis research at the University of Otago is:
Roles of Universities in Clusters with a focus on
the University of Otago and the Dunedin ICT Cluster.

The aim of this project is to gain a better understanding of the types and contents of interactions between the University of Otago and the ICT cluster in Dunedin, including techniques, methods, and other aspects that contribute to both more and less desirable outcomes.

The underlying purpose is to help identify how the university can interact better with the ICT cluster in Dunedin from the perspective of knowledge creation and transfer. My intention is to directly benefit the Dunedin ICT cluster, and provide feedback to the University for use in their plans for interactions with the ICT cluster.

Should you agree to take part in this project, you will be asked to participate in a one-hour interview, sharing your experiences involving university-cluster interactions. After the initial interview, subsequent interviews may be requested for clarifications or for gathering further information.

This project has obtained University ethics approval. A complete information sheet is attached as a PDF document.

If you would like to participate, please provide your contact details and I can contact you to arrange a suitable time for the interview. You may want to propose a date and time (preferably during business hours) that might be suitable for you, and the venue for the interview.

If you are unable to participate, but would like to nominate someone else who may have relevant content, please provide their details so that I can contact them directly.
 Thank you.

Sincerely,

Regina Maniam
Researcher
Master of Business (Management) student
Department of Management
University of Otago, Dunedin
manre062@student.otago.ac.nz
Telephone Number: 03 479 8129
If you have any questions about this project, either now or in the future, please feel free to contact either myself or my supervisor:

Prof. André Everett
Department of Management
andre.everett@otago.ac.nz
Telephone Number: 03 479 7371

8.2.2 Information Sheet for Participants

Reference Number: 13/093
25 March 2013

Roles of Universities in Clusters –
The University of Otago and the Dunedin ICT Cluster

INFORMATION SHEET FOR PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The aim of this project is to gain a better understanding of the types and contents of interactions between the university and clusters in Dunedin. This is to identify how the university can play a better role in serving the clusters in Dunedin from a perspective of knowledge creation and knowledge transfer. This project is intended to help identify how cluster members handle challenges faced in university-cluster interactions and why some interactions have better outcomes than others. This study focuses on interactions between the University of Otago and the Dunedin ICT cluster.

This project is being undertaken as part of thesis research for a Master of Business (Management) at the University of Otago.

What Type of Participants are Being Sought?

Participants are selected based on their involvement in ICT cluster activities in Dunedin. This includes representatives from businesses, other support organisations, the Dunedin City Council, and the University of Otago.

Potential participants have been identified with the help of the staff of the Dunedin City Council and the University of Otago, who have been involved in cluster activities in Dunedin. The selection of participants will depend on the extent of participants' involvement in cluster activities. It is anticipated that 12 to 15 participants will be interviewed.

There will be no payments made to participants. However, they will be offered a report summarising the results of the research once it has been completed.

What will Participants be Asked to Do?

Should you agree to take part in this project, you will be asked to participate in one or more interviews. After the initial interview, subsequent interviews may be requested for clarifications or for gathering further information. The initial interview is anticipated to be one hour, involving only the researcher and the interviewee.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

What Data or Information will be Collected and What Use will be Made of it?

The main purpose of this research project is to collect information purely for preparation of the researcher's thesis in the Master of Business program.

The interviews will be audio taped, to allow the researcher to listen to the interview and transcribe it. No personal information will be collected, other than the interviewee's name and position / role / job title

information. All information is collected purely for the purpose of preparation for the researcher's thesis in the Master of Business program. The thesis supervisors will have access to the information.

The data collected will be securely stored in such a way that only the researcher and the thesis supervisors will be able to gain access to it. Data obtained as a result of the research will be retained for at least 5 years in secure storage. Any personal information held on the participants (including contact details and audio recordings after they have been transcribed) may be destroyed at the completion of the research even though the data derived from the research will, in most cases, be kept for much longer or possibly indefinitely.

Due to the nature of the research, some personal information – such as name and job title – will be either included (published) or easily discernible from the roles of some of the interviewees (e.g., the key individuals within the University and the Dunedin City Council). This information should not be considered private as it is publicly available on the websites of these organisations.

There may be participants who prefer to get the attention of the public as part of their strategic goals, and would prefer to have their names and organisations published. This could include quotations from their interviews. However, there may be participants who would prefer not to have their names released. Publication of such information will be cleared with each of the participants on an individual basis (via a signed consent form) prior to any disclosure of their details (e.g., name or organisation name). Where publication of the name (or organisation name) is not permitted, a sufficiently anonymised pseudonym will be employed to disguise the identity of the individuals/companies concerned.

On the Consent Form you will be given options regarding your anonymity. Please be aware that should you wish, we will make every attempt to preserve your anonymity. However, with your consent, there are some cases where it would be preferable to attribute contributions made to individual participants. It is absolutely up to you which of these options you prefer.

This project involves an open-questioning technique. The general line of questioning concerns interactions between the University of Otago and the Dunedin ICT cluster. The precise nature of the questions which will be asked has not been determined in advance, but will depend on the way in which the interview develops. Consequently, although the University of Otago Human Ethics Committee is aware of the general areas to be explored in the interview, the Committee has not been able to review the precise questions to be used.

You will be informed about the general topic of the interview and possible available questions that may be asked during the interview in advance. In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable, you have the right to decline to answer any particular question(s) and you may withdraw from the project at any stage without any disadvantage to yourself of any kind.

The results of the project will be available in the University of Otago Library (Dunedin, New Zealand), and may be published in part (in academic journals, practitioner magazines, and/or academic conferences, as well as public media releases).

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Regina Maniam	and/or	Professor André Everett
Department of Management		Department of Management
University Telephone Number: 479 8125		University Telephone Number: 479 7371
Email: manre062@student.otago.ac.nz		Email: Andre.Everett@otago.ac.nz

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

8.2.3 Consent Form for Participants

UNIVERSITY *of* **OTAGO**

Te Whare Wānanga o Otāgo
NEW ZEALAND

Reference Number: 13/093
25 March 2013

Roles of Universities in Clusters –
The University of Otago and the Dunedin ICT Cluster

CONSENT FORM FOR PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the project is entirely voluntary;

2. I am free to withdraw from the project at any time without any disadvantage;

3. My participation in this project involves principally granting the researcher interviews of usually one hour. These interviews will be recorded and subsequently transcribed;

4. The data (recordings) will be destroyed at the conclusion of the project, but any raw data on which the results of the project depend will be retained in secure storage for at least five years, after which it may be destroyed;

5. This project involves an open-questioning technique. The general line of questioning includes information on interactions between the Dunedin ICT cluster and the University of Otago. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops and that in the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable I may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind.

6. I understand that this form gives me the option to allow publication of my name, or to require that all references to me and what I have said be anonymised as far as possible, using a pseudonym to disguise my identity and that of other individuals/organisations where I indicate that is appropriate in my interview(s).

7. A summary of the research outcomes will be offered to me if requested, but this should not be construed as a payment or reward.

8. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my anonymity should I choose to remain anonymous.

9. I, as the participant: a) agree to being named in the research, ☐ OR;

   b) would rather remain anonymous ☐

I agree to take part in this project.

....
(Signature of participant) (Date)

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

8.3   Case Study Protocol

8.3.1   Research Questions

How can university–cluster activities result in better outcomes?

8.3.2   Documents for Use During Interview

Information sheet (Appendix 8.2.2)

Consent form (Appendix 8.2.3)

8.3.3   Interview Preparation Checklist

- ☐ Review company website and any other documentation
- ☐ Review applicability of detail questions
- ☐ Add new questions based on background information of interviewee
- ☐ Check date and time, and directions to venue
- ☐ Printouts of any relevant documents for interview (if applicable)
- ☐ Extra consent forms
- ☐ Extra information forms
- ☐ Digital voice recorder
- ☐ Pad and pens

8.3.4   Post-interview Checklist

- ☐ Transfer voice recording to computer notebook
- ☐ Use naming convention for files: [Participant name][yyyymmdd].mp3
- ☐ Make two backup copies on USB drive
- ☐ Make reflection notes
- ☐ File paper notes made during interview
- ☐ Email participant to thank them

8.3.5 Interview Preparation Form

Name:	Date:
Organisation:	Time:
	Venue

Additional questions:

Notes:

8.4   Case Study Database

Directory Structure for Case Study Base and Contents

Master's Thesis

    Ethics Approval

        Ethics application

        Ethics approval

    Interviews

        Tracking

        Interviewees

            Audio recording of interview

            Transcription & Notes

    Focus Group

        Audio recording of interview

        Transcription of discussion

Literature: All journal articles are stored within the EndNote Application.

8.5 List of Categories, Subcategories, and Open Codes

Categories	Sub-categories	Open Codes
Outcomes	KTO	Spinoffs
		Patents
		Licenses
		Consulting
		Joint research
		Contract research
		Journal articles
		Conference presentations
		Graduates for employment
	Non-KTO	Spinoffs
		Consulting
		Research
		Journal articles
		Conference presentations
		Graduates for employment
		Projects
Activities	Academic-led activities	Spinoffs
		Patents
		Licenses
		Consulting
		Joint research
		Contract research
	Curriculum-based activities	Capstone projects
		Assignments
		Postgraduates thesis
	Extracurricular programmes	Audacious
		StartUp Weekend
		Internships
		Student projects
		Student organisations
Cluster actors	Businesses	Large businesses
		Small and medium-sized

Categories	Sub-categories	Open Codes
		businesses
	University	Academics
		Administrators
		Students
	Intermediaries	City council
		Consulting organisations
		Entrepreneurship programmes
		Interest groups
Challenges	Different outlooks	Different perspectives
		Communication difficulties
		Different expectations
	Academics' aspirations	Exposure to business world
		Lifestyle preference
		Performance measurement
		Busy schedule
		Incentives
	Commercialisation issues	IP rights issues
		Uncompetitive price structure
		Open source preference
	University–business interaction issues	Perception of university
		Contacting right people in university
		Not comfortable interacting with university
		Relevance
		Not much interaction
		Lack research facilities
		University is research oriented
	Others	Interactions with ex-students