THE KEY INFLUENCES IN SPIN-OFF DEVELOPMENT

JOSEPHINE TAN

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ABSTRACT

The aim of this research is to understand the key influencing factors in spin-off development. Whilst there is a growing stream of spin-off literature, greater attention is needed to understand what inhibits and enables spin-off development. This research begins to address this gap by exploring the key influencing factors of spin-off development at the institutional, firm and individual level.

This research conducts 25 in-depth, semi-structured interviews with stakeholders in the spin-off eco-system. Interviews were conducted with scientists/academic entrepreneurs, university technology transfer office (TTO) managers, commercialisation managers and government actors. These interviews were complemented with two full-day direct observations of KiwiNet Investment Committee Meetings. The benefit of these various data sources allowed for rich insight into the key influences of spin-off development, at a range of levels. Data was analysed using pattern matching and a coding process.

The findings show that academics are encouraged to partake in commercialisation activities by university management, government and commercialisation actors, and there are established support mechanisms to create spin-off ventures. Importantly, the findings imply there are limitations with these mechanisms as university culture, misaligned expectations and opinions, and entrepreneurial inexperience cause barriers for spin-off development. Thus these findings indicate that the development of spin-offs is complicated and involves a multitude of stakeholders. This suggests that while the involvement of these stakeholders are necessary in supplementing capability and resource deficiencies, their effectiveness may depend on the ability to align various interests and communicate differences. Overall, this research contributes to existing literature by exploring the key influences in spin-off development. Several theoretical and managerial implications are highlighted.

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CHAPTER 1 – INTRODUCTION

1.1 - Background

Academic spin-offs are recognised as an effective form of knowledge transfer not only because they exploit innovations and new knowledge, stimulate local and regional markets, but also make a significant contribution to university productivity (Algieri, Aquino & Succurro, 2013; Van Weele, van Rijnsoever & Nauta, 2017). An academic spin-off has been defined as a new venture that was created by current students or faculty members to exploit research outcomes (Soetanto & Jack, 2016). Various motives drive the development of spin-offs. Universities support spin-offs as it demonstrates their capability to be entrepreneurial and forward-thinking in translating scientific discoveries (Clarysse, Wright & Van de Velde, 2011). Society and business users encourage spin-offs as they believe they can benefit from knowledge transfer and it will aid some of society's problems (Casati & Genet, 2014; Neves & Franco, 2016). Policy makers support spin-offs as they aim to increase synergies between university-industry-government and they find that spin-offs present commercial opportunities that strengthen the co-evolution of scientific opportunities (D'Este et al. 2013; Mustar et al. 2006; Van Horne & Dutot, 2016). Finally, the drivers behind academics commercialising their results through spin-offs can be intrinsically and extrinsically based (Lam, 2011). In scenarios where academics are extrinsically motivated, this can be driven by the desire to solve problems or create job opportunities with industry (Grimaldi et al. 2011). In situations where academics are intrinsically motivated, it can be to achieve recognition for a scientific discovery in their community or an alternative form of revenue generation (Ambos et al. 2008; Clarysse, Tartari & Salter, 2011).

Along with the variety of parties interested in spin-offs, there is also the complexity that ensues as these actors become stakeholders to spin-off ventures (Rasmussen, 2011). Spin-offs operate in complex and turbulent environments given the multitude of stakeholders involved, as well as

start-ups being distinct from university activity (Bjornali, Knockaert & Erikson, 2016). The combination of turbulent environments and various stakeholders with the demanding and complex tasks that are experienced in spin-off creation make these new ventures heterogeneous in nature (Bjornali, Knockaert & Erikson, 2016; Clarysse, Wright & Van de Velde, 2011; Rasmussen, Mosey & Wright). A growing stream of literature explores the critical junctures that spin-offs will face, how university technology transfer offices influence spin-off development and the impact of entrepreneurial competencies in spin-off creation (Algieri, Aquino & Succurro, 2013; Clarysse, Wright & Van de Velde, 2011; Lockett & Wright, 2005; Rasmussen, Mosey & Wright, 2011.

Whilst these studies show that spin-offs are important for the entrepreneurial university, current understanding about what inhibits and enables spin-off development is incomplete. Identified in the literature is the opportunity to explore the main challenges that spin-offs are likely to encounter as academics attempt to commercialise their research results. The complexity that is associated with spin-off development regard the lack of experience that academics have in commercialisation and the cultural inhibitors that discourage academic entrepreneurship.

In light of these challenges, scholarly attention has focused on research from the triple helix, entrepreneurial university, spin-off and academic entrepreneurship literature. The relationship and linkages between these levels are significant in contributing to the economy and developing commercialisation opportunities (Van Horne & Dutot, 2016). Existing literature from the institutional perspective on academic entrepreneurship has demonstrated that the evolution of this area has been influenced by the nature of the external eco-system (Kodama, 2008; Gunasekara, 2006). The change in the external eco-system has led to the development of the entrepreneurial university and thus changes in university management (Rasmussen, Mosey & Wright, 2011). However, more focus is needed on the knowledge transfer activity of spin-off

development that incorporates a variety of views regarding the various inhibitors and drivers in the spin-off process.

From the institutional theory perspective, the theory will help explain how spin-offs develop and how the nature of the external eco-system influences the commercialisation process (Bruton, Ahlstrom & Li, 2010). Previous research has explored the changes that facilitate academic entrepreneurship such as senior university management incorporating business processes into their activities (Gunasekara, 2006). In addition, the institutional theory allows the culture, tradition and history from an organisation to be considered, which is critical in spin-off development given the importance of context (Tolbert, David & Sine, 2011). This leads to consideration of spin-offs at the firm and individual level as researchers like Bercovitz & Feldman (2007) identify that the individual traits of academic entrepreneurs are also likely to be linked to the institutional context they belong to. This highlights the challenges that occur within the entrepreneurial university as cultural norms shifts and tensions arise between academics who value traditional measures of excellence, opposed to academics that support commercialisation activities (Wurmeseher, 2017).

To this end, research has regarded the types of commercialisation activities that are available to academic entrepreneurs, including patenting, licensing, spin-off development and technology park creation (Festel, 2015; Philpott et al. 2011). The entrepreneurial extent and involvement of these activities vary between institutions and individuals, which highlight the heterogeneous nature of commercialisation and processes that are adopted to undertake these activities (Abreu & Grinevich, 2013; Dorner, Fryges & Schopen; Soetanto & Jack, 2016). From the knowledge transfer activities, we find there is the opportunity to further explore academic spin-offs and this research begins to address this gap by exploring the key challenges that occur in spin-off development at the institutional, firm and individual level. The following section outlines the research questions for this study.

1.2 - Research Questions

The purpose of this research is to explore the key influences in spin-off development. To this end, it poses the following research question:

What are the key influences in spin-off development?

For analytical purposes, this research adopts a multi-level analysis that explores inhibitors and drivers of the spin-off process at three levels; institutional, firm and individual.

a. **What are the inhibitors and drivers at an institutional level?**
b. **What are the inhibitors and drivers at the firm level?**
c. **What are the inhibitors and drivers at an individual level?**

These questions are addressed through the data collected from 25 interview respondents that include academic entrepreneurs, university TTO managers, commercialisation managers and government actors. This data was supplemented with direct observations of two full-day KiwiNet Investment Committee Meetings. Building on this data set, this research provides a detailed description of what inhibits and enables spin-off development at the institutional, firm and individual level. In doing so, it is anticipated that this research will shed light on how academic spin-offs are developed and the barriers that are overcome to achieve this endeavour.

1.3 - Structure of the Thesis

This thesis is organised into six chapters. This chapter - Chapter One - gives an introduction into the research and provides the contextual background to this study.

Chapter Two assesses the literature underpinning this research and is broken into four sections. The first two sections discuss literature around the triple helix and the entrepreneurial university, respectively. The third section discusses the forms of knowledge transfer that is conducted within the entrepreneurial university. The final section explores academic entrepreneurship and in doing so, outlines the challenges that arise at the institutional, firm and individual level.

Chapter Three explores the research design and methodology. Explained in this section is the rationale for qualitative research and in-depth, semi-structured interviews. Next, the data collection processes are explained, as well as concerns around validity, reliability and ethical considerations. This chapter concludes with a description of the data analysis process.

Chapter Four presents the findings of this research and begins by exploring the inhibitors and drivers at an institutional level. Following this, the firm and then academic level findings are discussed.

Chapter Five is the discussion of the findings and links these to the literature reviewed. It begins by exploring the key influencing factors in spin-off development. Following this, theoretical implications are explored.

Chapter Six concludes the thesis. It highlights the key findings of the research and how these findings are significant in relation to the research questions. This is concluded with the theoretical contributions of the research, managerial implications, limitations and future opportunities for research.

CHAPTER 2 - LITERATURE REVIEW

This research explores the key influences in spin-off development that arise at the institutional, firm and academic level. In doing so, it draws on the academic entrepreneurship and spin-off literature. This chapter reviews the literature in these fields to understand the approach that is taken to this research. Section 2.1 examines the triple helix literature. Specifically, it builds the background and context for which academic entrepreneurship has developed. Section 2.2 discusses the entrepreneurial university and academic entrepreneurs, as part of the triple helix context. This section addresses the tensions within the entrepreneurial university and introduces the forms of knowledge transfer that are conducted in academic entrepreneurship. This leads into section 2.3 which discusses the various forms of knowledge transfer, concluding that little is known about the specific activity of spin-offs. Finally, section 2.4 integrates academic entrepreneurship and spin-offs to explore the tensions that arise in spin-offs at the institutional, firm and academic level.

2.1 - Triple Helix

This section reviews the triple helix literature which is important for understanding the context by which the entrepreneurial university, and thus academic entrepreneurship has developed. Universities partaking in commercialisation and entrepreneurial activities are a result of the increasing interactions between university-industry-government relations (Etzkowitz et al. 2000; Philpott et al. 2011). This interaction can be considered as a triple helix of institutional forces emerging within innovation systems (Etzkowitz et al. 2000; Philpott et al. 2011). The triple helix eco-system is intended to be the core element of regional development (Leydesdorff, 2000; Miller et al. 2016). In pursuit of regional development, universities have adopted a 'third mission' which is to foster links with knowledge users and producers with the aim of facilitating technology and knowledge transfer (Philpott et al. 2011). The relationship and linkages between the three spheres aim to capture synergies that allow enhanced performance of all

three groups (Philpott et al. 2011; Van Horne & Dutot, 2016).

The triple helix has blurred the traditionally distinct lines between academia and business. The traditional mission of the university has been described as knowledge transfer through teaching and education, as well as ensuring the advancement of knowledge through basic research (Philpott et al. 2011; Rasmussen & Borch, 2011). However, the development of the triple helix has seen a shift from this traditionally perceived mission as universities have started encouraging the incorporation of an entrepreneurial ideal. This is where academic entrepreneurs partake in commercialisation activities that benefit industry, policy makers and society (Philpott et al. 2011). These activities are reliant on academic participation as they are well positioned to contribute and influence the innovation ecosystem with their knowledge and scientific capabilities (Etzkowitz, 2011).

The establishment of the triple helix has prompted various scholarly investigations which explore different perspectives of the phenomenon. The triple helix literature has been examined from both evolutionary and institutional perspectives (Li et al. 2016; Meyer, Sinilainen & Utecht, 2003). Research has explored the exchange mechanisms between the three functions of the triple helix and this includes knowledge production, wealth creation and normative control (Li et al. 2016). In contrast, research has also explored networking and exchange between different institutions and organisations and contributes to understanding how entrepreneurialism is captured in universities (Li et al. 2016).

From these two distinct strands of research, it is likely the pressures from society and policy makers formed the evolutionary perspective of research. This in turn developed the institutional perspective to understand how universities reacted and evolved to these pressures. For example, Gunasekara (2006) and Kodama (2008) explore institutional research that evolved due to the nature of the external eco-system. Gunasekara (2006) found that senior university management adjusted core behaviours in order to accommodate for regional needs.

Moreover, Kodama (2008) highlights that one of the methods universities utilise to adapt to these changes are through technology transfer systems. Kodama (2008) explains this involves intermediaries and regional firms possessing absorptive capacity that is critical in a regional system for innovation activity. These studies highlight findings in the institutional perspective in terms of how institutions react and shape movements from the triple helix. The changing nature of this phenomenon demonstrates the complexity of academic entrepreneurship and the various perspectives that are important in the commercialisation context.

The interactions within the triple helix can also be understood from the institutional theory perspective. The institutional theory suggests that managers look to industry norms, firm traditions and management activities. The purpose of firm managers looking at these processes is to better secure their positions and achieve legitimacy (Soetanto, 2016). Within academic entrepreneurship, the institutional perspective looks at how elements such as regulatory structures, governmental agencies, societal and cultural practices influence the rule sets that universities will conform to. The institutional perspective suggests organisations evolve over time and adopt industry tradition where institutions develop expectations that are deemed appropriate actions for firms (Bruton, Ahlstrom & Li, 2010). Institutional theorists have suggested organisations aim to be similar to their peers to achieve legitimacy with the key driver affecting firm resources, survival and performance (Zhao et al. 2017).

Recent research from Zhao et al. (2017) highlights the need for the institutional theory to be integrated into strategic action that management can take. The authors suggest that institutional theory can be combined with resource-based views of the firm which can highlight firm portfolio of resources, as well as institutional capital. The integration of institutional theories with spin-off research provides a unique position to analyse entrepreneurial activities of universities as they adopt commercialisation activities. This may limit some of the tensions that arise as universities attempt to satisfy various stakeholders as university management

incorporate entrepreneurial activity.

The origination of the institutional theory from sociologists has seen research on the development of new ventures (Tolbert, David & Sine, 2011). The institutional theory is a useful lens to understand the impact that culture, tradition and history have on an organisation, and its entrepreneurial success. These factors are likely to influence spin-off development as the institutional theory regards regulatory and cultural influences that guide new entrepreneurial organisations. Tolbert, David and Sine (2011) found in their research of entrepreneurship and institutional theory that there is a relationship between the two elements. They argue that institutions influence entrepreneurs' opportunity identification, as well as the manner in which opportunities are seized. Equally, entrepreneurs are essential actors to the development and institutionalisation of new processes and systems that enact change at the organisational level.

Moreover to this point of academic entrepreneurs, Bercovitz and Feldman (2007) research academic entrepreneurs and find that individual characteristics are important, but they are dictated by the institution they operate within. If academic entrepreneurs find a misalignment between their training norms, they will conform to the localized social norms in their work eco-system, opposed to their prior experience. In addition, Simeone, Secundo and Schiuma (2016) find that institutions affect the development of entrepreneurial activities and value creation. They identified design elements (interpreted as prototyping, sense making and visualisation), to be effective methods of connecting and aligning the needs and interests of numerous stakeholders. Finally, Van Geenhuizen & Soetanto (2009) found clear signs of relations between the strength of ties and network multi-plexity between spin-offs and university impact. They identified that well-connected networks of university and non-university contacts assist in spin-off development and achieving funding for their innovations. To this end, the institutional perspective is a valuable lens to explore academic entrepreneurship given the applicability and relevance to the phenomenon.

2.2 - Entrepreneurial University & Academic Entrepreneurs

Markman, Siegel & Wright (2008) argue greater pressures have been placed on universities to undertake pro-active measures that ensure entrepreneurial stances are adopted and portrayed. These pressures are a reflection of the increasing interactions within the triple helix. Universities are responding to these calls by adopting an entrepreneurial ideal that is enacted through academic structures. These ideals are reconfigured with entrepreneurial activities and incorporate economic development alongside their traditional research and teaching missions (Etzkowitz et al. 2000). The entrepreneurial university is not restricted to the invention of technologies or universities that are purely research oriented, but the entrepreneurial paradigm can be enacted through teaching and various innovations in undergraduate education (Etzkowitz et al. 2000). The entrepreneurial university not only produces new knowledge, but they also diffuse knowledge into industry and society (Kalar & Antoncic, 2015). This is evident as the core competency of the university has extended to some business functions with a shift from the original generation and dissemination of human capital and knowledge (Etzkowitz, 2011; Kim, Kim & Yang, 2012). Now, entrepreneurial universities contribute by shaping and diffusing IP through various methods of internal and external innovations.

Within the entrepreneurial university, academic entrepreneurs are faculty members like scientists who behave in an entrepreneurial manner as they identify opportunities and ensure resources are secured to enable their activities (Dorner, Fryges & Schopen, 2017). The academic entrepreneur is the actor who bridges the gap between the research and business world (Walter, Auer & Ritter, 2006). The academic entrepreneur participates in entrepreneurial activities through a range of knowledge transfer activities that facilitate knowledge dissemination to occur. The types of knowledge transfer activities are discussed in section 2.3 below.

2.3 - Types of Activity: Knowledge Transfer

The role of the university in entrepreneurial activities has become more legitimate with increasing acceptance that universities are appropriately positioned to license, patent and develop academic spin-offs (Wurmeseher, 2017). Knowledge transfer activities like spin-offs allow academic research to be transported into the commercial market. The act of knowledge transfer can be defined as a process that moves codified, tacit and legally protected knowledge from one party to another (Van Horne & Dutot, 2016). Often the types of knowledge that is transferred from academia into industry regard new knowledge and innovations (Hayter, 2016). This is critical for stimulating new product and service deployment, economic dynamism and growth (Hayter, 2016). It is with these outcomes that university knowledge transfer is seen to provide novel ideas and technological improvements for society (D'Este et al. 2013).

Based on this rationale, academics are encouraged to partake in a variety of knowledge transfer activities that range on an entrepreneurial spectrum from formal (hard initiatives) to informal (soft initiatives) mechanisms (D'Este & Perkmann, 2011; Philpott et al. 2011). For example, hard initiatives like patenting, licensing, spin-off development and technology park creation are often seen as more entrepreneurial in nature (Festel, 2015; Philpott et al. 2011). Firstly, patenting and licensing is the activity of securing IP rights on inventions and know-how (Klofsten & Jones-Evans et a. 1999). The benefit of licensing strategies is speed, scope and impact for innovation (Markman, Siegel & Wright, 2008). However, despite universities increasing the number of licenses they hold for their inventions, there are limitations as universities then become responsible to a wider range of stakeholders, thus complicating licensing goals given the multifaceted nature of the parties involved (Markman, Siegel & Wright, 2008).

Secondly, contract research is attractive given the possibility for academics to build close external relationships (Etzkowitz, 2011). The perceived benefit is that external relationships could lead to consulting opportunities as well as the potential to translate knowledge to a

useable form (Etzkowitz, 2011). Research from Perkmann & Walsh (2008) suggest there are three forms of academic consulting work; opportunity-driven consulting which requires specialist expertise and typically is income-motivated, commercialisation-driven consulting which requires tacit expertise and the motive is technology development, and finally research-driven consulting, which requires strategic judgement and the motive is research opportunities. They find that contract work that is driven by commercialisation and research outcomes, opposed to opportunity-driven outcomes, are more likely to foster research productivity. However, as contract research regards knowledge that is commercially applicable to organisations, there is minimal public support and funding of these activities (D'Este & Perkmann, 2011).

Among academics, collaboration and industry engagement is more common than patenting and other forms of academic entrepreneurship (Perkmann & Walsh, 2009). Markman, Siegel & Wright (2008) note universities will commonly partake in alliances and collaborations where joint ventures with industry partners provide unique access to resources. These partnerships are often leveraged for commercialisation purposes that otherwise may not be available to universities (Markman, Siegel & Wright, 2008). However, Perkmann & Walsh (2008) argue that opportunity-driven consulting is often arranged by new technology-based organisations aiming to fulfil expertise or equipment deficiencies. The consequence of this is that opportunity-driven consulting is less likely to develop research benefits. This is because such consulting activities addresses problems and provides improvements, opposed to developing new project ideas. Given the nature of these research activities, this is potentially detrimental to academics publishing outputs given publication of such results is unlikely.

In addition to these activities, the development of commercialisation systems such as technology parks are also recognised as being effective methods of resource sharing given they are property-based organisations (Markman, Siegel & Wright, 2008). Technology parks are a

formal site for businesses to be located within to enable university interaction (Klofsten & Jones-Evans, 2000; Philpott et al. 2011). Technology parks are recognised to be effective in transferring knowledge between universities and firms, with an emphasis on the creation and transfer of technological knowledge (Diez-Vial & Montoro-Sanchez, 2016). The implementation of capital development projects like this, are highly useful in resource development and establishing new university-industry relations (Etzkowitz, 2011).

Often in parallel to these hard commercialisation activities, university supported infrastructure like business incubators and university TTOs are established to support knowledge transfer activities. These services are developed to facilitate and stimulate entrepreneurship, innovation and economic growth (van Weele, van Rijnsoever & Nauta, 2017). University TTOs help turn ideas into business opportunities, as they take inventions and develop IP and project manage inventions to investor readiness or a potential commercialisation pathway. University TTOs are recognised to be beneficial in addressing conflict as they act as boundary spanners and act as a bridge between the firm's/industry and the academics (Markman, Siegel & Wright, 2008). University TTOs also connect units by overcoming various boundaries by translating potentially complex knowledge (Chau, Gilman & Serbanica, 2016). These boundary spanners assist and motivate the academics in socialisation towards markets that are industry-oriented (Hayter, 2016). O'Kane (2016) suggests university TTOs assist academics in securing resources that enable implementation of their research projects. The study indicates that university TTOs have a greater emphasis on collaboration with scientists, opposed to facilitating collaboration between scientists and industry. Furthermore, O'Kane (2016) finds that as academics look to public funding and industry relations for their research projects, university TTOs are probing deeper into universities to act as an intermediary between a university and funding agents. The study suggests that given the skill deficiencies of academics, they value university TTO contributions.

Closely related, business incubators facilitate university industry-government intentions as they provide: 1) economic development in terms of job creation and diversifying the regional economy, 2) technology commercialisation, 3) real estate development and 4) entrepreneurship (Markman, Siegel & Wright, 2008). Incubators provide a wide range of services and resources to their start-up firms that include physical infrastructure, business-related services, technical expertise and a well-developed support network (van Weele, van Rijnsoever & Nauta, 2017). Incubators also aim to train and mentor academic entrepreneurs in order to improve entrepreneurial skills and professional capabilities (Soetanto & Jack, 2016). University-related incubators provide services like faculty consultants, student employees and library services (Grimaldi et al. 2011).

These initiatives which are typically understood as hard entrepreneurial activities are compared to soft university activities. These soft activities have typically been better aligned with the traditional academic culture and are further away from the entrepreneurial paradigm (Philpott et al. 2011). This may include teaching that equips graduates to be highly skilled and prepared to enter the workforce (Philpott et al. 2011). Soft activities may also include academics publishing results in books and articles, as well as faculty staff accessing grants to achieve basic research (Klofsten & Jones-Evans, 2000; Philpott et al. 2011).

The variety of these knowledge transfer activities allow knowledge and information to be disseminated through a number of mechanisms. Implicit in many of the accounts of the entrepreneurial university is the assumption that academics are able to partake in activities of their desire. Academics' decision to partake in commercialisation activities are based on a range of factors that are related to their personal motivations, departmental and institutional level support/infrastructure, and availability for research funding (Etzkowitz et al. 2011; Philpott et al. 2011).

Inherent in knowledge transfer activities are challenges that arise. A challenge for academics is

the assumption they are equipped with the necessary capabilities to undertake a wide variety of commercialisation activities. However, studies show academics have deficiencies in commercialisation capabilities (Festel, 2015; Rasmussen, Mosey & Wright, 2011; Soetanto & Jack, 2016). Another challenge is the range of factors that inhibit academics from partaking in activities like patenting and spin-offs due to publication responsibilities which is a clash with academic norms. For these reasons and others, academic entrepreneurship is still an ambiguous phenomenon which is poorly understood and under-researched in various areas.

A foundational understanding of the various types of knowledge transfer activities has been formulated, but much less is known about the knowledge transfer activity of academic spin-offs. In particular, we have a poor understanding of what tensions and challenges are inherent throughout the spin-off process. The capabilities that are required by academic entrepreneurs in spin-offs are ambiguous, given the unique challenges that are present in the entrepreneurial university environment. The literature is nascent in discussing the various perspectives of spin-offs and it is to this end that more research is required to understand academic entrepreneurship in particular, the drivers, and the various inhibitors of spin-off development.

To further our understanding of academic entrepreneurship, our research is also grounded in the resource-based view (RBV) because we are looking at the entrepreneurial activities of universities. Thus it is important to explore the RBV of capabilities in academics. In conjunction with the institutional theory, RBV is useful in understanding the resources that are central to the success of a new firm. RBV theories recognise firms that have valuable, rare, inimitable and non-substitutable resources as being strongly positioned (Barney, 1991). The RBV is useful in exploring the conditions to which a firm's resources will enable a competitive advantage (Barney, 1991). Perhaps this is why academic entrepreneurship studies have adopted RBV perspectives to understand the influencing factors that resources play in academic entrepreneurship. Powers and McDougall (2005) adopt an RBV perspective on their academic

entrepreneurship research, finding that human capital and organisational resources are amongst the predictors of technology transfer in universities. Their study highlights that RBV is appropriately applied to academic entrepreneurship given the revolutionary change of institutions as universities compete for funding, faculty and top-quality students. Similarly, O'Shea et al. (2005) find factors such as orientation of science and commercial capability to be predictors of university spin-off activity. The authors find that the type of university resource available, and thus the potential resource combinations that can be developed, are influential factors in determining spin-off activity. The authors confirm that the resources of a university play roles in the development of academic entrepreneurial behaviour. These findings are extended from Wiklund and Shepherd (2003) research suggesting that knowledge-based resources in technology transfer activities are positively related to venture performance and entrepreneurial orientation is beneficial in development. To this end, the RBV perspective is an effective lens to understand the challenges that spin-offs encounter in their development, and how these are likely to influence their ability to develop a successful firm. Finally, Galati et al. (2017) find that spin-offs will typically experience a slow growth if they have resource shortages. This introduces the background of academic spin-offs as well as the tensions they face in their development as academic entrepreneurs attempt to achieve recognition and resources for their commercialisation endeavours.

The application of the RBV lens allows the organisational capabilities to be explored as firm's assets and their capabilities lead to the organisation's performance (Rasmussen & Borch, 2010). This is significant as the development of a spin-off may be influenced by the university context from which they emerge, and thus the unique capabilities and resources that are available within the environment (Rasmussen & Borch, 2010). Particularly as knowledge that is required for spin-off development is ingrained in human capital, it is crucial to involve university scientists within the development process as they contribute to the inimitable factors of competitive advantage (Colombo, D'Adda & Piva, 2010).

In addition, as the university often acts as an incubator to assist in spin-off development, the capabilities that universities provide are often most important during the early stages of the entrepreneurial process (Rasmussen & Borch, 2010). Given RBV explores unique resource bundling, the theory is useful to understand how resource endowments will influence the way in which technology transfer can occur, and how a firm can increase their likelihood of establishing a sustainable firm. The impact of university resources and how inimitable they are effects spin-off development as university management and direct support is related to spin-off creation (Rasmussen & Borch, 2010). This highlights the importance of the RBV theory in relation to spin-off development as universities individually have unique capability combinations that are path dependent and thus effect how spin-offs will develop (Rasmussen & Borch, 2010).

Research from Iturriagta & Cruz (2008) highlight that RBV theory can be used to understand why a firm would develop a spin-off. Their findings suggest 1) to create complementarities, 2) to appropriate residual rents and 3) to narrow their core business. The exploration from this resource based perspective encourages insight as to why spin-offs may be encouraged, and how the resources available influence these developments. Firms have been found to more likely exploit technologies if they originate from core competencies in which they are able to achieve synergies, highlighting the value the RBV theory extends (Kasch & DOwling, 2008). Pazos et al. (2012) also highlight how spin-off generation is positively associated with industry-funded research, research oriented universities and incubation services. These are resource combinations that may be unique to individual universities.

2.4 - Academic Spin-Offs

Academic spin-offs are one mechanism to transfer knowledge and technology to the marketplace. An academic spin-off is a firm that is the result of research institutions commercially exploiting knowledge that is produced from academic activities (Dorner, Fryges & Schopen, 2017). Spin-offs are typically founded around a core technological innovation with initial development from the university (Knockaert et al. 2010). The inventor and founder of the spin-off is typically "an academic whose primary occupation, prior to playing a role in a venture start-up, and possibly concurrent with that process, was that of a lecturer or researcher affiliated with a higher education institute" (Franklin, Wright & Lockett, 2001, pg. 128). Spin-offs are unique to their counterpart high-technology start-ups as academics engage in the advancement of science itself, opposed to just using science to progress innovation (Miozzo & DiVito, 2016). When successful knowledge transfer is combined with university and industry cooperation, these interactions facilitate innovation (Lew, Khan and Cozzio, 2016). This continual exchange of knowledge spill-over leads to knowledge accumulation in society and these interfaces stimulate the innovation lifecycle (Lew, Khan and Cozzio, 2016).

The growth of studies in academic knowledge transfer have recognised spin-offs to be beneficial for economic prosperity, job creation and stimulating industry competition (Marion, Dunlap & Friar, 2012; Soetanto & Jack, 2016). Based on these rationales, spin-offs are typically developed from discoveries or research with IP potential that could benefit society (Vohora, Wright & Lockett, 2004).

Vohora, Wright & Lockett (2004) study on the critical phases that an academic spin-off is likely to undergo, in conjunction with Rasmussen, Mosey & Wright (2011) study on entrepreneurial competencies within spin-offs allude to the types of capabilities that are necessary at various phases of spin-off development. Through this research, we hope to extend the literature by identifying the limitations that challenge academics, and identify the key drivers of spin-off development. Vohora, Wright & Lockett (2004) identified five stages a spin-off will undergo; 1)

research phase, 2) opportunity framing phase, 3) pre-organisation, 4) re-orientation and 5) sustainable returns. The framework suggests that within these stages, spin-offs must overcome critical junctures; 1) opportunity recognition, 2) entrepreneurial commitment, 3) threshold of credibility and 4) threshold of sustainability.

Vohora, Wright & Lockett (2004) explain the importance of the first phase; research. This typically regards scientific research that has taken place over a number of years within an academic department. Before academics are involved in commercial opportunities, their main focus is on perfecting academic research and the publication of their research towards their relevant scientific community. The authors found that all the academic inventors involved were at the forefront of their chosen research fields and possessed valuable tacit knowledge and technological assets. They found this to align with existing research that suggested spin-offs are founded by the more successful scientists in comparison to scientists that are not typically experts in the area. They found the latter group encountered issues with obtaining strong IP rights for their spin-off if the technical capabilities were not strong. In order to transition the research into the next development stage, the academics had to identify a match between a market opportunity and a solution that could fulfil that need. Then, opportunity recognition was achieved.

The second phase of the spin-off regards opportunity framing and this entails crafting and development of a venture. Prodan & Drnovsek (2010) explain opportunity framing where "opportunities to create future goods and services are discovered, evaluated and exploited". This stage is when a significant opportunity in technology or science has been recognised and it is essential warranted evidence is presented that justifies commercialisation (Vohora, Wright & Lockett, 2009). It is only when this process has been validated that the commercial opportunity can be framed (Vohora, Wright & Lockett, 2009). This finding supports Rasmussen, Mosey & Wright (2011) who suggests opportunity refinement is critical to a business opportunity being

developed. The authors noted that stages like opportunity framing require capabilities that enable creativity and the ability to adapt the idea beyond the resources that are currently available. The capability of opportunity refinement hinges on technological knowledge and expertise, as well as industry and market specific knowledge. During this stage of opportunity framing, the challenges the academics must overcome typically arise as they lack prior knowledge in commercialisation and entrepreneurial activities. Consequently, they have an inability to understand how the results can be applied and exploited in a market sector, and they lack the ability to continue entrepreneurial behaviour (Vohora, Wright & Locket, 2009).

When opportunity recognition and framing is successful, the spin-off moves to the third phase. This sees the management team developing and enacting strategic plans during the pre-organisation phase. This may result in decision making regarding existing resources and capabilities that need to be developed, as well as what knowledge is required now and in the future, and where these resources will be obtained. Vohora, Wright & Lockett (2004) identified this phase to be a critical juncture point of entrepreneurial commitment as this is when there is likely to be unforeseeable impact on the entire success of the spin-off. This requires the academic to evolve their vision they have mentally created, towards a business formation that is operational and credible in a marketplace. A spin-off may encounter critical junctures in entrepreneurial commitment if the academic is reluctant to leave their academic post or if the academic is unable to fulfil their role due to their lack of business experience. The importance of entrepreneurial commitment is similar to Rasmussen, Mosey & Wright (2011) identification that credible ventures require an entrepreneurial team with the competencies that enable credibility. Colombo, Mustar & Wright (2010) and Clarysse, Wright & Van de Velde (2011) identify that in most instances, the founding team of a new venture cannot be considered as a static concept and the team's internal make-up will change as new members are added and others leave. This is often to balance various levels of entrepreneurial commitment and team strengths and weaknesses. The development of the entrepreneurial team is likely to involve two

new and overlapping components; management and the board of directors (Colombo, Mustar & Wright, 2010). The management team plays an important role when the firm's environmental conditions change where they need to undertake more rigorous reconfiguration of resources and capabilities (Kindstrom, Kowalkowski & Sandberg, 2013). This may see the management team undertaking more contemporary practices and entrepreneurial acts such as developing new markets and at least periodic asset orchestration that facilitates redesigning routines (Teece, 2012). This is supported by Rasmussen, Mosey & Wright (2011) finding that recognises the importance of academics ability to also access and combine resources that will allow the venture to be sustained throughout the development phases. This requisite capability demonstrates the interrelated relation of the management team with the academics capabilities. It is clear skills and experiences are leveraged to progress the venture and gain resources as required. In addition to management teams, university TTOs are typically useful in facilitating growth of capabilities and entrepreneurial commitment in this development phase (Festel, 2015). In addition, deliberate team composition that exploits new and diverse capabilities, as well as resources is critical.

The fourth process of Vohora, Wright & Lockett (2004) spin-off development model is the re-orientation phase. This phase is achieved as the spin-off has reached credibility and they now look to secure customers and develop revenue. This poses challenges as the entrepreneurial team must now continuously identify, acquire and reconfigure their resources so they are able to achieve their desired goals. The spin-off team will learn how to develop newly acquired information and knowledge so it can be transformed into valuable capabilities that provide returns to the firm. This juncture tests the academics ability to access and acquire stocks of resources, in particular financial resources that are used for the businesses function and to secure customer bases.

Finally, the spin-off is able to secure sustainable returns as they access and reconfigure

resources and capabilities. This last phase sees the venture developing their capabilities. The spin-off must satisfy the threshold of sustainability in which the spin-off must produce continuous profitable returns, as well as recognise additional market opportunities in their patents and product development (Vohora, Wright & Lockett, 2004). In terms of success that is experienced in the spin-off, the study indicates it is likely to come in iterative and various stages. When reconfiguration of necessary resources, capabilities and network ties has been accomplished, this is what assists in juncture points being overcome (Hayter, 2016). It is essential the academic is able to develop necessary capabilities that enable them to come to speed with the market so their invention can survive. This aligns with Rasmussen, Mosey & Wright (2011) championing competency as this relates to the personal leadership role that is essential for the venture to sustain the start-up process. The championing competency is not static as the necessity for the competency evolves and develops. This occurs when the venture reconfigures from prioritising university relations to requiring capabilities that enable external credibility with industry partners and potential investors. Rasmussen, Mosey & Wright (2011) found that some spin-offs shared the championing competency as co-founder roles highlighted the ability to share the uncertainty that is experienced in spin-offs. They also found the championing role could be shared between the academic founder and the external CEO who governed the company. In other cases, the championing competency was led by external industry partners who contributed in moving the venture forward. There were also scenarios where different individuals were key for the venture throughout different stages of development.

Table 1: Five stages of spin-off development

Five stages of spin-off development(Vohora, Lockett & Wright, 2004)	**Key activities**	**Critical junctures**
Research phase	Academics develop scientific contributions where they have identified the potential for an opportunity. It is critical the scientist(s) have strong technical capabilities	
Opportunity framing phase	The research result is framed into a commercialisation opportunity that has the potential to be exploited. A validated opportunity must be identified in order for the spin-off to progress.	Opportunity recognition
Pre-organisation phase	Strategic decisions are made in terms of the resources and capabilities that are required for the venture to progress. The critical success factor is the business formation that ensures the venture has necessary resources to function	Entrepreneurial commitment
Re-orientation phase	Alternative plans or new decisions may have to be made to ensure the viability and continuity of the venture. It is important the entrepreneurial team is searching for new opportunities and minimising threats	Threshold of credibility
Sustainable returns	The venture must continue to develop necessary capabilities so the venture can achieve sustainable returns. The critical success factor is the ability to sustain profits and achieve new goals.	Threshold of sustainability

2.5 - Spin-Off Challenges

The challenges that arise in spin-off development manifest at three major levels; the institutional, firm and academic level. Each level presents distinct challenges to spin-offs, but the way in which they influence new venture development is interrelated. This may be attributed to the complexities that arise as academic entrepreneurs are often firmly rooted in their academic positions, thus making institutional level tensions interrelated with individual level tensions. The three levels are explored in the following sub-sections.

2.5.1 - Institutional Tensions

The entrepreneurial university has not emerged without criticism. Institutional level tensions regard drivers and inhibitors in terms of university policies, incentives for academics, university TTOs and institutional rigidities. Throughout the spin-off development process, it is commonly recognised that spin-offs will experience challenges in terms of stakeholder expectations, as well as triple helix complications. These complexities are inherent in the entrepreneurial process given spin-off development is iterative and heterogeneous. To this end, the nature of interaction and relationships between spin-off actors and triple helix stakeholders will continuously differ, based on the university and form of knowledge transfer.

The first institutional tension regards university specific capabilities. Rasmussen & Borch (2010) argue that universities require specific capabilities that enable the spin-off process to be facilitated so conflict is avoided with other university stakeholders. The authors identify these specific university capabilities to regard the ability to create new paths of action, the ability to balance academic and commercial interests, as well as establish new resources. They find that university capabilities play a sequential role where these capabilities assist spin-offs at different times of the development process. It is suggested that if universities possess strong external ties with industry, they may then more likely develop specific entrepreneurial capabilities. This argument is supported by Kalar & Antoncic (2015) who find that universities are more likely to adopt an entrepreneurial ideal if they have strong ties with industry and government. When

universities are able to develop these connections, universities may be better positioned to foster academics in entrepreneurial activities.

In addition, the likelihood and success of university spin-offs may be attributed to the development of clear strategies and policies, as critical components in university infrastructure (Algieri, Aquino & Succurro, 2013; Markman, Siegel & Wright, 2008). University level infrastructure, policies and support networks are important drivers in spin-off facilitation, as well as being key drivers in academic entrepreneurship. When institutional level initiatives are implemented through university supported vehicles like university TTOs, management is better equipped to enact on strategies and policies. This facilitates better stimulation and encouragement on the dissemination of academic research.

Many spin-offs will be guided by their university TTO and research shows university TTO effectiveness is enacted if they ensure new pathways of creation are encouraged (Rasmussen & Borch, 2010). This may be translated if university TTOs balance the two missions of academic science and creating wealth streams. The pursuit of these dual missions requires university TTOs to integrate new resources and capabilities that ensure academics' intended outcomes are achieved. Whilst these studies stimulate the discussion of university infrastructure on spin-off outcomes, they fail to capture how spin-offs adapt to the detailed institutional pressures.

The development of these external ties is significant as spin-offs are made up of a wide range of stakeholders, all of whom are involved at different phases of development. The direct action of governments will affect entrepreneurial efforts that institutions aim to pursue as regulations and policies dictate market function (Bruton, Ahlstrom & Li, 2010). Based on this dynamic, building connections with key government actors are beneficial in new venture development (Bruton, Ahlstrom & Li, 2010). Conversely, government stakeholders argue they are encouraging universities to develop better industry interaction as they recognise commercial opportunities strengthen the co-evolution of scientific opportunities (D'Este et al. 2013).

Despite government claims they are attempting to bridge commercialisation and industry, academic entrepreneurs in spin-offs still experience tensions that arise from external barriers. Shifts in the broader institutional framework regard changes in governmental policies and academics facing research funding pressures (Jain, George & Maltarich, 2009). These changes result in academics having to adjust and satisfy new policies or expectations. These shifts can come from government, society and university, but despite the complexity these stakeholders add to spin-off creation, they are critical links in spin-off development. Industry partners, investors and governmental support agencies provide access to resources that are necessary for spin-off growth (Rasmussen & Borch, 2010). For instance, industry funding and established relationships with venture capitalists are positively linked with spin-off performance (Rasmussen & Borch, 2010). This indicates external drivers are likely to be a cause for tension if spin-offs are unable to achieve funding or secure relationships with their necessary agents. As explored by Vohora, Wright & Lockett (2004), a part of spin-off development is the management team's ability to enact strategic plans, which could entail seizing business relationships. This requires decision making in terms of existing resources and capabilities. These two elements of resources and capabilities may need to be developed or obtained which then dictate the achievement of strategic relationships or industry links.

Academics are likely to be disadvantaged if universities lack entrepreneurial capabilities. The large nature of institutions typically results in slow and challenged change processes due to institutional rigidities and cultural complexities (Galati et al. 2017). Given these rigidities, incremental adjustments of university character is required for change to take action. If academic entrepreneurs find their local environment to be lacking in these specific entrepreneurial capabilities, academics are required to combat these deficiencies. The spin-off will be developed in an environment where the academic entrepreneur must adapt to potential non-routinized systems and services to ensure venture success.

Substantial barriers also exist between industry and university whereby university attitudes, behaviours and institutionalised administration activities cause interaction barriers. For example, Bruneel, D'Este & Salter (2010) find these challenges can be mitigated, and university-industry interaction can be fostered through building trust. This entails university-industry actors to understand the variances between different incentive systems, to initiate face-to-face contacts and sustain repeated interactions. Successful university-industry interaction is likely to involve a wide range of channels that utilise personal and professional relationships. Petruzzelli (2011) research supports the finding that collaboration requires the establishment of trust between academic and industrial partners.

The development of relational routines and complementary understanding is an effective way to enhance collaborative relations. This is noted as successful interaction has been recognised when firms and universities operate in complementary fields. This facilitates absorptive capacity which stimulates immersion of scientific research and industry activity. To this end, Petruzzelli (2011) highlights the importance of complementary technology capabilities and the development of strong relationships between partners as important elements in fostering collaboration. This position reflects the need for academics to be receptive in their spin-off activities where they are fostering capabilities that allow these outcomes to be achieved. This may require academics to evaluate these two elements of complementarity and relationship building when they search for partners throughout their spin-off development.

The disruptive nature of the entrepreneurial university has led to disagreements between advocates of the norms of open science, versus sponsors who support commercial activity (Wurmseher, 2017). From the former group, concern is raised that academics may neglect their main academic roles to accommodate for commercialisation-related activities. This presents a challenge for academics as they are often required to ambidextrously balance their academic career with their commercialisation time. This is particularly concerning for academics in spin-

offs given the entrepreneurial nature of the commercialisation process which can entail lengthy development.

Moreover, organisational rigidities are argued to prevent change and successful commercialisation outcomes from occurring (Jain, George & Maltarich, 2009; Kalar & Antoncic, 2015). This is noted as the core of the arguments against entrepreneurial universities is based on universities being perceived as mismatched for entrepreneurship (Philpott et al. 2011). This argument hosts the perspective that university culture is incompatible with the requirements of entrepreneurial activity, and subsequently the role and identity of academics (Philpott et al. 2011). In these instances, shifting mind-sets and reconfiguring organisational culture and norms to include entrepreneurial orientation is required. University management attempts to shift mind-sets and cultural norms through the implementation of internal systems and regimes that support commercialisation of research (Etzkowitz et al. 2000). However, these decisions are often reacted to with apprehension that an entrepreneurial ideal will make universities indistinguishable from other firms which threatens the traditional integrity and conduct of open science (Jain, George & Maltarich, 2009; Walsh & Huang, 2014).

Further concern is expressed that spin-off participation will lead to time delays in publication as well as increases in secrecy when it comes to sharing research results (D'Este et al. 2013[2]). These two elements are closely linked as commercialisation of knowledge may require secrecy in terms of patents in order to protect IP. This leads to time delays in the publication of scientific results and the dissemination of new knowledge (D'Este et al. 2013; Jain, George & Maltarich, 2009). Secrecy of scientific results typically occurs with collaborations or projects that may be associated with restrictions on the disclosure of research findings. This reinforces the opinion that commercialisation is threatening the norms of open science (D'Este et al. 2013[2]). The perceived threat is that academic entrepreneurial activities will undermine the free flow of basic knowledge (Etzkowitz et al. 2000) and will negatively affect the production and

advancement of scientific knowledge (D'Este et al. 2013). This also has ramifications for the academic entrepreneur as it is against their norm to not publicise their scientific findings to their academic community and through publishing. Particularly in the early stages of protection, IP requirements restrict academics in disclosing their research in public domains and forums where IP may be threatened.

As it is the standard in the scientific community to share and present scientific research results, this has caused cultural issues for academics. The norms and processes within the scientific community may deter academics in initiating and developing spin-offs if they feel they are likely to be excluded or disparaged from their peers. Disagreements over such elements lead to universities experiencing cultural issues, particularly as they attempt to foster an entrepreneurial ideal (Philpott et al. 2011). If academics decide they do still want to participate in commercialisation activities, the complexity of entrepreneurial tensions is noticed in later stages when academics disseminate this knowledge into the market. This is due to the unknown factors of how consumers and markets react to academic research based technologies.

Concerns that universities will be indistinguishable from industry firms are highlighted when studies demonstrate the importance of entrepreneurial universities to fully adopt, integrate and support an entrepreneurial spirit in order for commercialisation to be effective (Audretsch, Lehmann & Palearsi, 2014). Evidence like this supports apprehension that academic entrepreneurship could derail the crux of a smooth functioning science system (Walsh & Huang, 2014).

In contrast to these perspectives, Jain, George & Maltarich (2009) have suggested that universities have long possessed a mixed culture. They find universities have combined basic and applied orientations, implying the concept is a virtuous cycle that exists between involvement in commercialisation activity and academic productivity. Perkmann et al. (2013) support this argument explaining that academic engagement is not a new phenomenon, and it is

most common at universities that encourage a practical and technical approach.

Scholarly disagreement has also ensued in relation to funding policy changes. As science-technology disciplines are typically allocated majority of funding proportions, this has enhanced the variances between divisions, particularly with humanity disciplines (Philpott et al. 2011). This has seen departmental funding competition increased as institutional perspectives emphasise IP commercialisation as a mechanism to generate revenues (Lam, 2010). This may originate with the increase in contributions made from emerging scientific fields, or research developed from cutting edge technology. Slaughter & Rhoades (1996) refer to academic capitalism which entails market-like behaviours within institutions as faculty members compete for funding. Whilst academics may be encouraged to partake in commercialisation activities, the incentives are often lacking as the promotional model for academics is based on publishing criteria.

These studies suggest academics face a wide variety of challenges that originates from the institutional level and departmental level in universities. Academics experience tension with numerous commercialisation perspectives as the entrepreneurial university attempts to satisfy multiple stakeholders. These tensions flow into the development and progression of a spin-off as the context of academic entrepreneurship is so heavily influenced by the contextual setting. These inhibitors are likely to test academics in their decision to commercialise their research, and also act as a barrier to their chosen commercialisation pathway.

2.5.2 - Firm Level Tensions

Academics not only experience challenges at the institutional level of support and infrastructure from university management, but they experience firm level obstacles. In pursuit of spin-off development, the growth of the firm is often limited by the inexperience of academics, as well as the access of resources. This occurs as knowledge is transitioned into the marketplace. Research has recognised that spin-offs in connected and supported networks will better absorb knowledge; allowing resources to be utilised with less resistance (Soetanto & Jack, 2016). However, spin-offs are likely to face liabilities to newness and smallness that are experienced due to limited financial resources and lack of managerial experiences (Lundqvist & Middleton, 2013; Neves & Franco, 2016; Philpott et al. 2011; Soetanto & Jack, 2016).

At the firm level, the difference in perception and expectation of stakeholders involved in spin-offs causes disruption to the spin-off process. This often occurs as mental barriers inhibit some academics from partaking in entrepreneurial activities (Philpott et al. 2011). These mental barriers may arise when academics are not committed to the spin-off venture, and commercialisation actors perceive academic entrepreneurs to prioritise academic activity over venture development (Brennan, Anthony & McGowan, 2005). This can arise when academics have a lack of understanding in entrepreneurial concepts, a lack of entrepreneurial culture and an academic promotional model that may not reward academic entrepreneurs (Philpott et al. 2011). This leaves the spin-off being disadvantaged when the entrepreneurial team is not committed and synergies cannot be leveraged. In these situations, the academic may have developed a potential business solution, but the entrepreneurial commitment to drive the solution is lacking. This presents challenges at the firm level as managers must work alongside academics and have commitment to the venture. Simultaneously, agency theory relates to whether the interest of the organisation is in shareholders' interests, opposed to personal interest (Hermano & Martin-Cruz, 2016). This will also inhibit spin-off development if perspectives are not aligned.

Spin-offs are also challenged as venture members attempt to obtain and access resources, they face uncertainty in technological development, market acceptance and entrepreneurial capabilities; all of which present challenges to the firm (Soetanto & Jack, 2016). These tensions arise as academics identify a scientific result with market potential, however, the necessary capabilities in progressing the venture are lacking. Whilst academics are skilled in progressing scientific understanding with their tacit knowledge, they often lack the commercial experience and knowledge for entrepreneurial business endeavours (Hayter, 2015). When scientists attempt to commercialise entrepreneurial ideas, they face uncertainties regarding the best method to develop a business concept. They also lack relevant resources and capabilities that can help with effective decision making (Rasmussen, Mosey & Wright, 2011). These shortages may be common as academics have not had the necessity to build up resources and networks of this domain, or because the academic is limited in capabilities that enable access to these resources.

The traditional academic is bound by teaching, research and publishing responsibilities. These tasks create career strains and require trade-off decisions to be made when academics participate in venture development (Etzkowitz et al. 2000). Academics face time restrictions not only in their traditional role, but within the spin-off venture. This is a unique challenge for academics given their novice experience in commercialisation and the various activities that are critical during venture development (Hayter, 2016). The academic is required to ambidextrously pursue both activities, or prioritise one activity over the other (Chang et al. 2016). This is a tension point for academics as they are then in a dilemma where they are forced to choose between missions of advancing science or creating wealth (Lubik & Garnsey, 2016). This dilemma causes disruption to academics as their approach is ingrained within their scientific community and often clashes with commercialisation actors approach. Scientists are trained to share and advance science and the pursuit of spin-off activities can sometimes restrain this mission.

Chang et al. (2016) further explains the concept of ambidexterity by arguing that when faculty members are required to publish their research and are simultaneously encouraged to commercialise, the two activities are fundamentally different. Each activity set requires distinct capabilities and this highlights the challenges academics experience as they are required to develop capacity for both activities (Chang et al. 2016; Markman, Siegel & Wright, 2008). D'Este et al. (2013) explain the difficulties academics find in balancing these activities as they see the production of excellent research important, but finding the capacity to justify the relevance of research in economic and social terms is not always easy. The tensions between exploration and exploitation are important as they are seen as the underlying themes in research on organisational learning, strategy, innovation and entrepreneurship (Clarysee, Wright & Van de Velde, 2011).

2.5.3 - Academic Tensions

The academic level of analysis considers what tensions may exist for scientists within the commercialisation context. As introduced at the institutional level analysis, one of the changes academics are likely to experience is identity shifts due to the change in adjustment in work context.

Increased triple helix interactions have caused disruption to academic self-identity as they proceed through the academic entrepreneurship process. The phenomenon of the entrepreneurial university results in academics reconfiguring their self-identity to accommodate new work experiences. These increasing interactions between science and business result in academic roles adjusting to these entrepreneurial activities (Lam, 2010). Jain, George & Maltarich (2009) identify that when a role becomes closely linked to an individual's sense of self, the individual is likely to behave in relation to their role identity. This reinforces that the institutional level portrayal of commercialisation influences academics role identity and what they see their behaviour should entail.

Despite the drivers for this challenge being external and institutional, change of action occurs at the individual level if academics intend to diversify their academic activities. Understanding a scientist's role identity is critical in understanding how commercialisation activity is achieved as this contributes in the explanation of mechanisms and processes utilised (Jain, George & Maltarich, 2009). Lam (2010) finds from her study that academics develop a range of modes to partake in knowledge transfer activities. The study demonstrates that scientists do not react uniformly to the dynamic drivers of the institutional environment, and the blurred distinction between science and marketplace highlight the ambiguity of scientists in this context.

This presents a challenge to academics as it is possible in circumstances where scientists are reluctant to adapt, that a considerable number of opportunities will be lost to this reason (Wurmeseher, 2017). This requires academics to have an openness to learn, adapt their mind-set and have elements of flexibility in their work roles. If the academic is reluctant to change, the cognitive preferences of these academic individuals are an important signal in understanding the decisions academics make during the commercialisation process. It is these micro-mechanisms of cognitive processes that help explain the technology transfer process of academics as cognitive preferences guide the mental frameworks of decision making (Jain, George & Maltarich, 2009). There are two perspectives from which this can be adopted: supply side and the demand side. The supply side looks at the characteristics and attitudes of individuals that may explain the suggested predisposition that some academics are better able to recognise entrepreneurial opportunity (Jain, George & Maltarich, 2009). On the other hand, the demand side perspective looks at the contextual conditions that may invoke scientists to undertake technology transfer activities. This can include funding pressures, the culture of the university/department, and national legislature e.g. Bayh-Dole Act (Jain, George & Maltarich, 2009). By understanding where scientists position their priorities and research commercialisation intentions, this may help in explaining how they proceed with commercialisation activities (Jain, George & Maltarich, 2009).

A significant component in achieving spin-off success is understanding academic priorities. The priorities of academics are likely to indicate the extent of entrepreneurial commitment, particularly as spin-offs require re-organisation of time commitments as commercial expectations are so distinct from traditional academic activities (Rasmussen, Mosey & Wright, 2014). If these challenges are not addressed, it is likely the academics will experience tension between their commercialisation business partners. These challenges are likely to develop as the commercialisation actors attempt to progress the venture, but the academics' priorities lie in academic activities.

From these academic level challenges, it is clear a range of factors influence an academic's ability to partake in commercialisation activities and spin-off development. In summary, the increased interaction within the triple helix has positioned the entrepreneurial university to be recognised as an appropriate vehicle to participate in commercial activity. Implicit from these developments is that the role of academics is evolving. While 'blue-skies' research was originally a focus for scientists, academic entrepreneurs are now expected to fulfil science and technology opportunities (D'Este & Perkmann, 2011). These shifts in the external and institutional environment have resulted in unknown challenges that academics in spin-offs will experience. The evolving nature of the triple helix and academic entrepreneurship suggest academics are required to constantly adapt and integrate new resources.

The spin-off literature begins to explore the variety of challenges that are present in spin-off development. However, it is unclear what the main challenges encountered in development processes are, and what level the challenges originate. The spin-off literature is nascent in explaining how challenges affect spin-off development and what capabilities and resources are necessary to overcome these challenges. To this end, we look to explore: *what are the key influences in spin-off development.* To help answer this research question, we explore *what are the inhibitors and drivers at an institutional level? What are the inhibitors and drivers at the firm*

level? What are the inhibitors and drivers at an individual level? Through these levels of analysis, we contribute to the spin-off literature by developing an understanding of key influences in spin-off development.

The answers to these questions are addressed in this research, and contribute to key policy debates related to the evolvement of the university ecosystem. Given that a number of influential stakeholders have criticised the commercialisation activities of universities and academic faculty, this study provides a unique window to address these different viewpoints. This research contributes to the emerging body of literature on tensions and capability deficiencies experienced by academics in spin-offs.

Table 2: Review of challenges

Level of analysis	**Challenges**
Institutional level	● Stakeholder challenges: complexities arise as spin-offs incorporate numerous parties to complement capabilities. ● University entrepreneurial capabilities: facilitating entrepreneurship; creating new paths of action and providing necessary resources ● Established connections with industry and government to aid spin-off development ● Organisational rigidities: University policy, lack of entrepreneurial awareness and capabilities ● Cultural challenges as tensions arise between the advocates of traditional university missions versus supporters of the entrepreneurial university. Shifting mind-sets ● Traditional university norms that academics uphold ● Industry firms are apprehensive that universities will become competitors ● Funding changes with increases in academic capitalism
Firm level	● Liabilities to newness and smallness ● Differences in opinion between spin-off stakeholders regarding business decisions ● Entrepreneurial team conflicts ● Uncertainty regarding access to resources and market acceptance ● Business and entrepreneurial inexperience ● Time restrictions in management decisions ● Ability to ambidextrously achieve work outcomes - balance between exploration and exploitation
Individual level	● Self-identity uncertainty as academics transition/adopt additional roles ● Reluctance to adapt and accept new processes and activities ● Changing mind-sets and having an openness to learn and being flexible in work arrangements ● Supply side and demand side cognitive processes ● Balancing academic priorities with commercialisation commitments ● Conforming to university requirements and expectations regarding performance criteria's

CHAPTER 3 – METHODOLOGY

The purpose of this research is to investigate the key challenges that arise as academic entrepreneurs develop spin-offs. The research is exploratory based. Although much is known about the types of knowledge transfer in academic entrepreneurship, few studies have investigated the drivers and inhibitors that are key influences in spin-off development.

This chapter discusses the methodology used for this research. Section 3.1 discusses why an in-depth semi-structured interview approach was adopted. Following this, section 3.2 discusses the data collection methods used – participant interviews and direct observations, while the following sections address issues around reliability and validity (section 3.3) and ethical considerations (section 3.4). This chapter ends with a discussion of the analysis process used in this research (section 3.5).

3.1 - Research Design

Due to the exploratory nature of this research, a qualitative approach is undertaken to investigate the research questions (Maxwell, 2008). The use of qualitative research methods is primarily facilitated by the type of research question that is being asked (Bachiochi & Weiner, 2002). The use of qualitative research has been recognised as a means of identifying generalizable themes that are important questions in the research of strategic management (Bettis et al. 2015).

Our research question is:

What are the key influences in academic spin-off development?

To answer this, we focus on the following three sub-objectives:

a. What are the inhibitors and drivers at an institutional level?

b. What are the inhibitors and drivers at the firm level?

c. What are the inhibitors and drivers at an individual level?

Our research question requires the interview participant (academic entrepreneurs, university TTO managers, commercialisation managers and government actors) to provide unrestricted accounts of their experiences which enables the researcher to yield rich contextual information that may not be achievable through quantitative processes (Bluhm et al. 2011). The criteria that can determine qualitative approaches includes if the context is central to the research question, if the participant's interpretation is essential, if depth and richness of data is significant, and if the research is exploratory (Bluhm et al. 2011). After consideration of the above issues, a qualitative approach is deemed most appropriate.

As the inhibitors and drivers inherent in the spin-off process are heterogeneous and specific to the individual context, a qualitative approach is considered to be well aligned with this research. Qualitative research is also appropriate for studies in which the ability to represent the views and perspectives of the participants is critical, where meaning is given to real-life events (Yin, 2011). This facilitates the purpose of our study as different stakeholders are interviewed to contribute to our understanding.

Qualitative research in strategic management has included topics on collaboration between firms, top management, new ventures, decision making, organisational learning and strategic renewal (Bettis et al. 2015). These concepts are all discussed to some extent in this research, thus highlighting the justification of qualitative research. Furthermore, qualitative research has

encouraged debate on concepts like exploratory versus exploitative activities which is also considered in our research (Bettis et al. 2015). Studies of spin-offs from a capabilities and resources based perspective highlight the need for better understanding of the heterogeneity of academic spin-offs and it is necessary to examine how firms develop iteratively over time (Mustar et al. 2006). Opportunities are identified where spin-offs can be analysed through various perspectives that allow synthesis so typologies can be created (Mustar et al. 2006; Guerrero & Urbano, 2012). Finally, the utilisation of open-ended queries in qualitative methods is useful in investigating underexplored phenomenon, whereby new discoveries and insights can be made (Bettis et al. 2015).

3.2 - Data Collection

3.2.1 - In-depth Interview Study Design

Semi-structured interviews allows for more open-ended data gathering techniques which allows investigation into interview participants perspectives on their work and relevant events that have challenged them (Bachiochi & Weiner, 2002). This approach involves the research to use some pre-formulated questions, but new questions that emerge during the conversation, and improvisation are encouraged (Myers, 2013).

Semi-structured interviews are a common method that is used in management as it allows the interviewer to add important insights that may arise during the interview (Myers, 2013). Godfrey and Hill (1995, p. 530) identify that "the description of the firm found in RBV is complex, deep and historical". To this end, the richness of data collected and contextual background in discussing resources is important as interviews can provide rich sources of qualitative information which is useful when in-depth discussion provides clarity on topics (Bachiochi & Weiner, 2002).

Email invitations were sent out to 50 participants. All 50 potential participants had been involved in the initiation or development of a spin-off to some extent. These participants were

identified through online spin-off searches and snowballing techniques where participants were selected based on their involvement in a spin-off. The process by which applicants were selected included evaluating their involvement in spin-off development through their title, as well as if the research was created from within a university. The below table highlights the interview participant we were seeking for the research, and the necessary title or role they must have within the spin-off.

Table 3: Interview participant criteria

Interview participant	**Title requirement**
Academic entrepreneurs	Founder, inventor, researcher
Spin-off actor	CEO, manager
University TTO	commercialisation manager,
Government actor	Commercialisation analyst
Commercialisation manager	Investor

Academic entrepreneurs who had developed, or are developing a spin-off were sought for the research. The personal accounts of academics who had/are developing spin-offs were critical to the first hand understanding of spin-off drivers and inhibitors. Academic entrepreneurs who had developed a spin-off were able to provide accounts from hindsight, by which they had typically been a part of spin-off for more years. Academic entrepreneurs who were developing spin-offs were able to share their current challenges and provide insight into specific stages of spin-off development.

To complement their accounts, commercialisation experts like university TTO managers, business/technology incubator managers, government actors and investors were also sought. The purpose of interviewing a variety of individuals was because the drivers and inhibitors that a spin-off endures originate and develop from this variety of individuals. The interview participants together form part of the eco-system of spin-offs and are the key stakeholders throughout the entire process. Each perspective of the participants is critical as it contributes to developing a well-rounded understanding of academic entrepreneur's role in

commercialisation.

An information sheet (Appendix 2) was attached to the email to help inform the recipient's decision. In total, 25 spin-off actors were interviewed with the other 25 respondents being unavailable during the data collection period, or unresponsive to the emails and follow up emails. Interviewing participants from a variety of backgrounds provided different perspectives on the challenges that a spin-off endures throughout development (see table 1 below). This ensured the data collected provided richer insights than relying on a single group of informants. The purpose of interviewing a range of participants is that their perspectives add meaning and context to other participant's perspectives. The below table represents the interview respondents: their role in spin-off development and their status within the venture.

Table 4: Interview participant information

Interview respondent number	**Spin-off role**	**Contextual background**
Interviewee 1	University TTO manager 1	
Interviewee 2	University TTO manager 2	
Interviewee 3	Academic entrepreneur 1	Founded and is a part of 1 spin-off. Venture stage: in market
Interviewee 4	Academic entrepreneur 2	Academic team and helped develop 2 spin-offs. Venture stage: in market
Interviewee 5	CEO of spin-off 1	Managing spin-off. Venture stage: about to launch into the market
Interviewee 6	Academic entrepreneur 3	Founded and exited 1 spin-off. Venture stage: in market
Interviewee 7	Academic entrepreneur 4	Co-founded and exited 5 spin-offs. Venture stage: in market, seeking funding and research phase
Interviewee 8	Commercialisation manager	

	(Investor-based)1	
Interviewee 9	Academic entrepreneur 5	Founded and is a part of 1 spin-off. Venture stage: in market
Interviewee 10	Commercialisation manager 2	
Interviewee 11	University TTO manager 3	
Interviewee 12	Academic entrepreneur 6	Founded and is a part of 1 spin-off. Venture stage: market validation
Interviewee 13	Government commercialisation analyst 1	
Interviewee 14	Academic entrepreneur 7	Co-founded and is a part of 1 spin-off. Venture stage: in market
Interviewee 15	Academic entrepreneur 8	Co-founded 2 spin-offs and is a part of 1 spin-off. Venture stage: terminated and in market
Interviewee 16	Academic entrepreneur 9	Founded and is a part of 1 spin-off. Venture stage: in market
Interviewee 17	Academic entrepreneur 10	Co-founded and is a part of 1 spin-off. Venture stage: clinical testing
Interviewee 18	Academic entrepreneur 11	Founded and is a part of 1 spin-off. Venture stage: in market
Interviewee 19	Academic entrepreneur 12	Co-founded and not a part of spin-off. Venture stage: market validation
Interviewee 20	Academic entrepreneur 13	Co-developed and is a part of 1 spin-off. Venture stage: in market
Interviewee 21	University TTO manager 4	
Interviewee 22	University TTO Manager 5	
Interviewee 23	Academic entrepreneur 14	Co-developed and exited 1

		spin-off, a part of 1 spin-off. Venture stage: market validation
Interviewee 24	Academic entrepreneur 15	Co-developed and is a part of 1 spin-off. Venture stage: in market
Interviewee 25	Commercialisation manager 3	

Table 4.1 Interview participant summary

Spin-off role	Total Count
University TTO manager	5
Academic entrepreneur	15
CEO of spin-off	1
Commercialisation manager (Investor-based)	3
Government Commercialisation Analyst	1
Total	**25**

Each interview began by going through the information sheet to ensure the participant understood the purpose of the research and manner in which the data would be collected. A participant information and consent form (Appendix 2 & 3) was also read and signed. Whilst the precise order in which questions and answers were coordinated, the general questioning pattern began with questions around the nature of work the participant was involved in. This developed to topics that included the participant's involvement in spin-offs, and then more detailed questions around the challenges they faced. A full interview schedule is provided in Appendix 4, illustrating the interview questions associated with each of the different phases of the interview. The interview schedule was referred to throughout the interview process to ensure that all relevant information was discussed. Interviews lasted approximately 60 minutes.

With permission from the participants, all interviews were voice recorded to ensure that all relevant information was collected (face-to-face and over the phone). This allowed full attention to the participant so engaging conversation and probing was enabled. Several precautions were undertaken to prevent voice recording failure (E.g. spare batteries and a backup recorder). The recordings were subsequently transcribed and secured in safe locations. The data will be stored in such a way that only the researcher and supervisors will have access to the data.

3.2.2 - Observations

Interview data was complemented with two full-days of direct observations of a government-related funding process that can be a typical part of spin-off development for scientists. Observations were noted from The Kiwi Innovation Network (KiwiNet) Investment Committee (IC) meetings (Appendix 5). KiwiNet works to transform scientific discoveries into commercially applicable products and services, and KiwiNet acts as a channel for collaboration between researchers (KiwiNet, 2017). During this time, observations were made about the investment process; interaction between committee members and academic presenters, analysis and evaluation of proposals and judgement of project potential. The KiwiNet Investment Committee meetings covered academic proposals, updates and previews. In these presentations, academics were seeking funding, advice and guidance.

These observations provided first hand exposure to the investment and review process that spin-offs are likely to undergo as they seek assistance to develop their projects further. Importantly, these observations facilitated a deeper understanding of the commercialisation eco-system with various spin-off stakeholders attending the meeting. This aligned with many of the roles we sought for interview participation, such as researchers, government actors, incubator managers, investment managers and university TTO managers.

The KiwiNet committee itself comprised of a range of individuals. These diverse skills represent backgrounds in science/research, University TTO representatives, Crown Research members,

venture capitalists and government actors. The combination of the committee members' resources, skills and networks are leveraged for the scientists and their projects.

Additionally, observers are given permission to attend the meeting where the potential for shared resources and additional complementary capabilities and networks can be offered. The numerous stakeholders facilitate the KiwiNet mission of 'achieving more together' as they leverage the strengths of their combined networks and resources.

The purpose of attending the KiwiNet meetings was to observe the investment process of government allocated funding and to complement findings from data collected in interviews by noting the investment process. Data was collected as IC members discussed elements regarding market application and academics pitching their ideas; topics which were discussed during interviews. Notes were taken in relation to the issues IC members and academics raised. The KiwiNet meeting was also beneficial to assess how the various actors in the eco-system integrate their knowledge and resources to develop potential spin-offs. These observations complemented the interview data as findings could be challenged or confirmed.

3.3 - Validity and Reliability

Validity and reliability play a role in the interpretation and rigor of empirical research (Silverman, 2013). Validity is the extent to which findings are interpreted in a correct way and the extent to which researchers' results are truthful (Golafshani, 2003). Validity of research concerns whether or not the claims that researchers make are supported by the data and the extent to which an account is accurately represented (Silverman, 2013; Silverman & Marvasti, 2008). A strategy of allowing interview participants who have been part of academic entrepreneurship to speak freely in respect to their own knowledge structures was facilitated so good validity can be created (Stenbacka, 2001). To this end, validity is achieved when research methods are used through non-forcing interviews and research participants are strategically chosen (Stenbacka, 2001).

Reliability is the degree to which findings is independent of the observer and is the degree of consistency with which instances are observed (Kirk & Miller, 1986; Silverman & Marvasti, 2008). To ensure reliability in qualitative research, the examination of trustworthiness is a significant factor (Golafshani, 2003). Reliability was ensured throughout all interviews as an interview schedule was adhered to that addressed key elements of the data collection. This allowed standardised procedures and systematic organisation of data during analysis. Finally, secondary material from university websites and news articles were read to provide objective data.

3.4 - Ethical Considerations

A number of processes were taken to ensure the research was conducted in an ethical approach. Prior to data collection, an *Ethical Approval Form: Category B* was obtained from the Department of Management and the University of Otago Ethics Committee (Appendix 7). This level of ethical approval was sufficient as no personal information was essential to the collection of the data. In addition to the ethics form, an Information Sheet (Appendix 2) was provided to participants at the time of recruitment. This ensured the participant understood the purpose of the study, what information was going to be collected and how data would be analysed. The Information Sheet also detailed how the data would be preserved, and how confidentiality is maintained. The researcher also went through the Information Sheet with participants at the beginning of each interview to ensure the participants understood this information. Finally, a signed information consent form (Appendix 3) was collected from each participant to ensure participants recognised their rights.

3.5 - Data Analysis

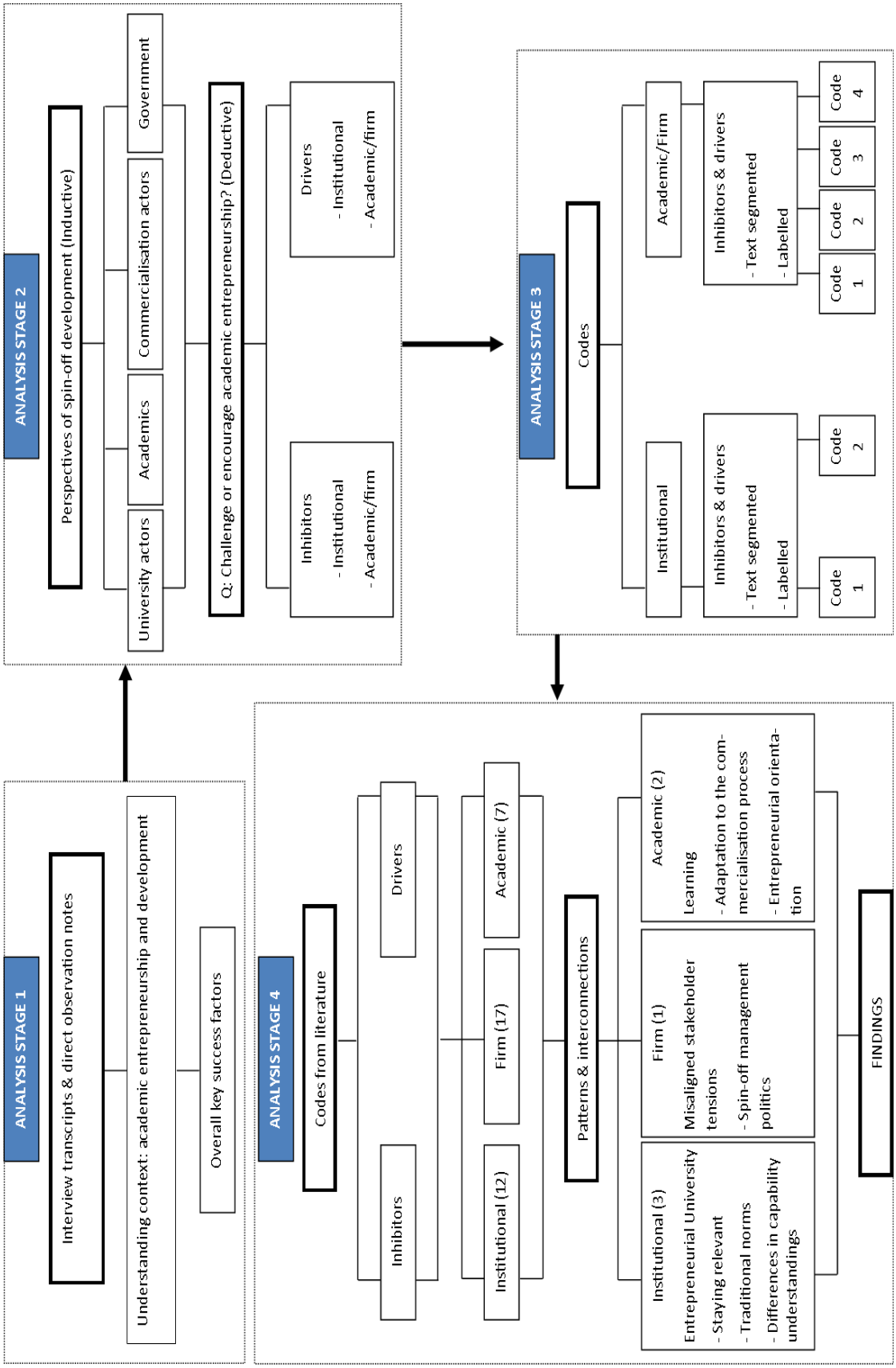
Data from the interviews conducted was analysed in *NVivo* software through a multi-coding process. Throughout this process, thematic analysis was adopted for coding and this applied deductive and inductive approaches. This allowed themes to be developed and also found in the data. Themes are "a pattern in the information that at minimum describes and organises the

possible observations and at maximum interprets aspects of the phenomenon" (Boyatzis, 1998, p. 161).

Encoding the information allows the data to be organised in a method that facilitates theme development (Fereday & Muir-Cochrane, 2006). This allowed important moments to be coded which helped capture the qualitative richness of the topics (Fereday & Muir-Cochrane, 2006). These themes and codes were only possible when the data was read and re-read. These approaches were adopted throughout this research process to ensure the richness of the data was captured and accurate themes were developed.

The below diagram depicts the overall analysis process and each stage is explored in-depth in the following sections.

Diagram 1 – Data analysis process



In the first stage of analysis, the interview data was analysed to understand the context of spin-off development and how spin-offs are heterogeneous. This helped to understand the academic entrepreneurship background and alluded to the overall key success factors in spin-off development.

In the second stage of analysis, the data was arranged into perspectives. See the table below that refers to the spin-off actors in this research:

Table 5: Stakeholder reference guide

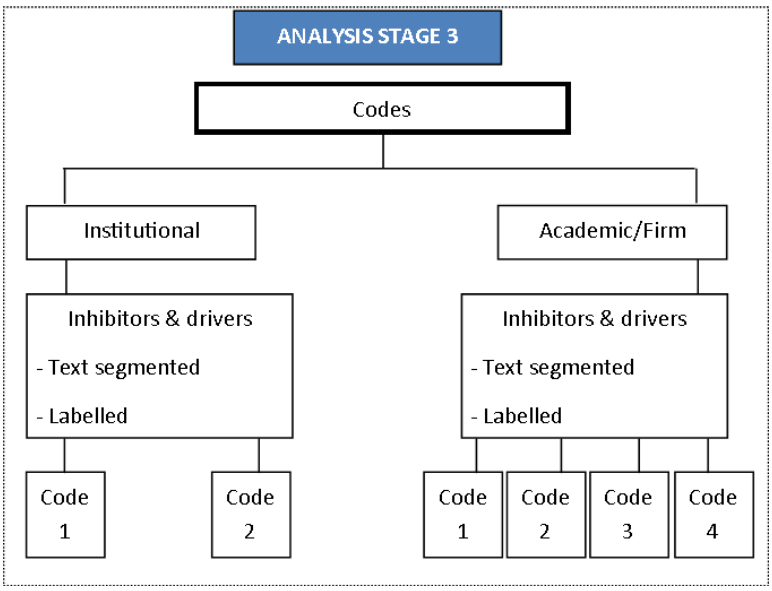
Academic entrepreneurs refer to:	academics and scientists
Commercialisation managers refer to	technology incubator managers and venture capital managers
University TTO managers refer to	university technology transfer office managers
C*ommercialisation actors* refer to	commercialisation managers and university TTO managers
spin-off actors refer to	members of the venture

The categorisation of interview perspectives was fundamental to the exploration of the research question. The views and perspectives of the participants are critical in understanding the context of inhibitors and drivers in spin-off development, and to cross check perspectives against each other. By considering the respondents background, this highlighted their role in spin-off development, but also acknowledges their role in the academic entrepreneurship eco-system. These categories were fundamental throughout the remaining coding stages as patterns were developed based on the respondent's individual perspectives. This allowed related features and differences within groups to be examined which helps develop insight (Yin, 2011). This process was useful for pattern identification later in analysis stage 4.

These foundations facilitated coding, by which analysis moves to a higher conceptual level so

unique aspects can be better identified (Yin, 2011). The coding of these perspectives was primarily inductive as it allowed contextual experiences to be accounted for. This formed the inhibitors and drivers to the spin-off development process by examining whether a challenge was represented, or if spin-off development was encouraged. This approach began the coding of institutional, firm and academic level.

Diagram 2 – Data analysis stage 3



As seen above, the academic and firm level was initially in a single category. However, throughout the data analysis it was recognised the two levels required distinct individual attention. This is further explained in the fourth stage of data analysis.

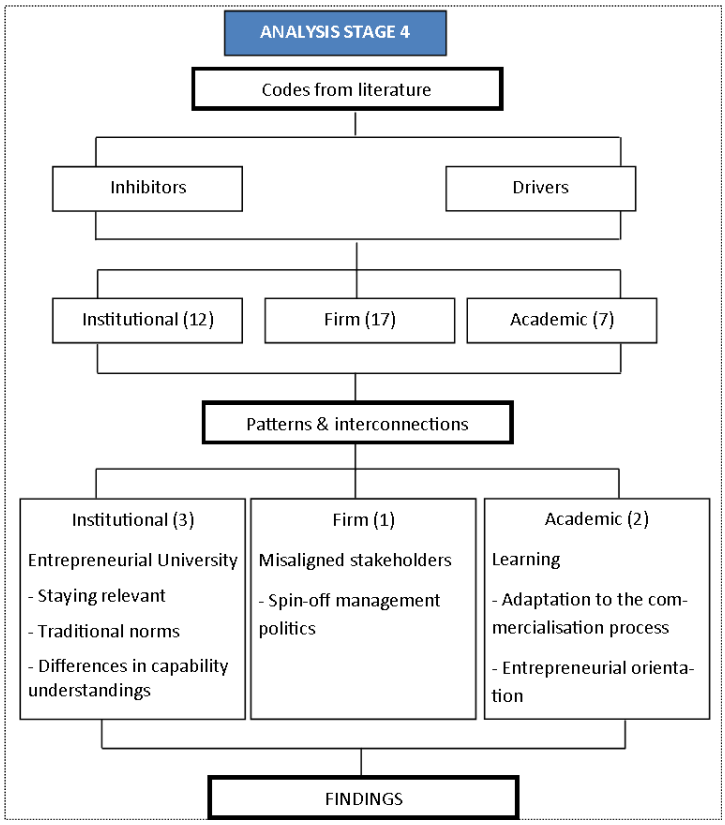
The next stage of analysis saw the corresponding sections of text segmented and labelled within *NVivo,* as seen above in diagram 2. As text segmentation was used when coding the data, the general context of the information was considered to ensure the integrity and validity of the data was not comprised (Silverman & Marvasti, 2008). From the initial analysis, 6 codes emerged - institutional level (2) and academic-firm level (4) which followed a deductive approach.

Below, diagram 3 illustrates the third stage of analysis with the codes that were used within *NVivo* highlighted by italics and underlining. In this example, two codes associated with the firm level were identified in the selected quote. Subsequently, these portions of the text were grouped into the firm level inhibitor that is experienced in spin-offs.

Diagram 3 – Example of third stage of analysis

Firm level inhibitor	**Quote**
Code: Spin-off management tensions *Label: misaligned stakeholder tensions*	*There was a decision to take the product to market at a point in time, and I thought that was premature. And I said so at the time, but that nonetheless, it is what happened. I didn't think it was ready. And I think subsequent events have vindicated my point of view.* ***And I understand the imperative to do that as we had to demonstrate some ability to get the customers so we could get the funding, but it is one of those compromise situations where it is difficult.*** *(Interviewee 20)*
Academic level inhibitor	**Quote**
Code: Learning *Label: Adaptation to the commercialisation process*	*Originally we thought we have been making this particular product and this would be perfect for medical applications but it wasn't actually until we started talking to manufacturers that they said there are bigger issues out there and medical applications might look great on a research paper,* ***but things like [specific industry context], is a huge global issue. And they really helped direct the application.*** *(Interviewee 12)*

Diagram 4 – Example of fourth stage of analysis



In the fourth stage of analysis, the data was categorised into codes sourced from the academic spin-off literature. These deductive codes were based on inhibitors and drivers that were identified from the three levels of analysis.

During this stage of analysis, academic/firm level was split into individual codes. The premise behind distinguishing these two categories is the pattern identification, which highlighted the differences between these two levels. It became clear that firm level findings regarded management tensions and motivations within the spin-off. On the other hand, the individual level regarded learning and personality characteristics.

In total, 42 codes were identified (see appendix 8). At the institutional level, 12 codes were identified, with 17 at the firm level and 7 codes at the individual level. Close examination and grouping of the inhibitors and drivers allowed for the main themes to be developed which represented the key influencing factors at the three levels. Finally, the codes were narrowed to 6

final codes – institutional level (3), firm level (1) and academic level (2). These wider themes represent the key findings of this research, and are presented in-depth in the following chapter. Within the coding, analysis shows that many interview participants held similar perspectives. In instances where more than 5 interview participants held the same perspective, this is referred to as a *number of informants* in Chapter Four, and if there were more than 10 similar perspectives, this is referred to as a *large number of informants* throughout the Findings Chapter. This terminology refers to the number of participants who represented a particular finding/theme.

From the emergence of the main themes, the interview data was revisited to analyse and justify the themes, which then developed subsections within the main themes.

Table two below demonstrates how the codes captured in stage two were linked to the development of the main themes in stage four.

Table 6 – Example of fourth stage of analysis

Academic level: Learning – Adaptation to the commercialisation process	**Relevant quote**
Sub-section: minimum viable concept	*The idea of iteration as well, and the whole minimal viable product style of things, as a scientist you particularly don't really want to talk about things until it is perfect. And the ideas of just getting the bare minimum down and out the door is something you struggle with until somebody explains it to you, and say if you want this to succeed, you have to get something out there and you can't just do R&D for ten years.*

3.6 - Chapter Summary

This chapter highlighted the methods adopted in the study. It discusses the decisions relating to the research decision and the justification of adopting a qualitative approach and in-depth, semi-structured interviews. Then, the research context and interview participants were discussed, and explanations why the participants are appropriate for exploration of the challenges that spin-offs face in their development. To gather sufficient information for this research, two direct observations of full day KiwiNet meetings complemented the interviews. This chapter also discussed issues of validity and reliability, and how they were addressed to maintain the rigor of this research. Finally, the data analysis process was described. This involved four stages of continuous development and led to the identification of the main key success influences in spin-offs development at the institutional, firm and academic level. The following chapter presents these findings in detail.

CHAPTER 4 – FINDINGS

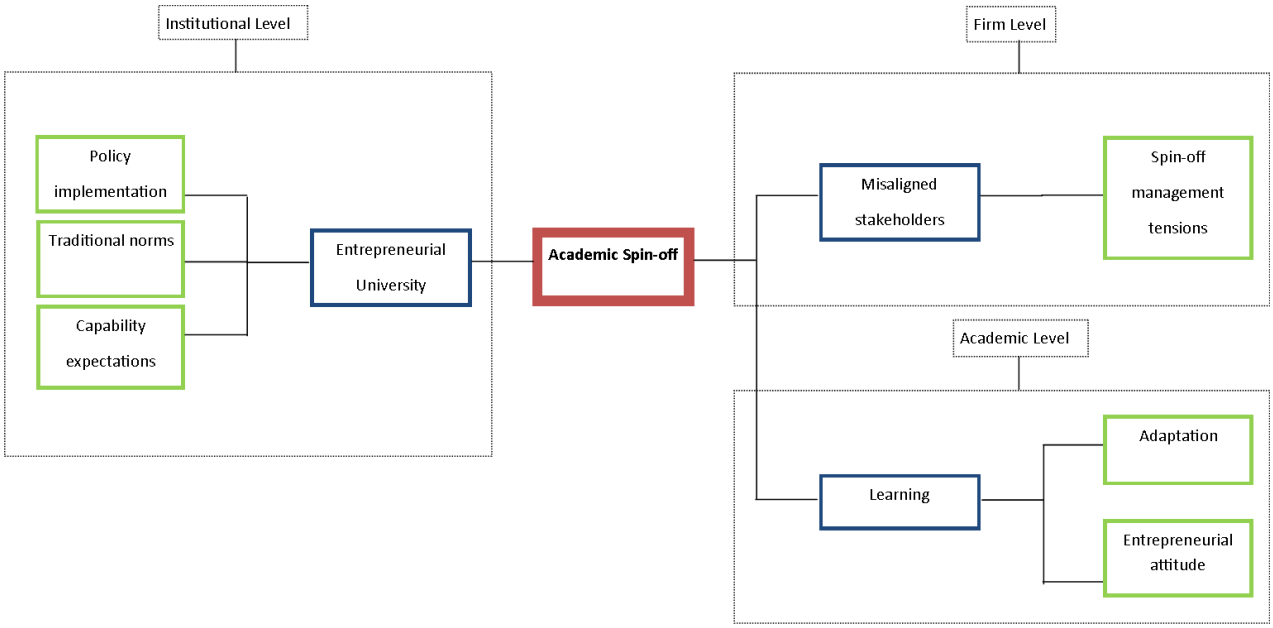
The aim of this research was to explore the factors that influence spin-off development using analysis of the interview data and direct observations, this chapter provides insight into the main inhibitors and drivers in academic spin-offs. The purpose of this study was to explore:

What are the key influences in academic spin-off development?

a. What are the inhibitors and drivers at an institutional level?
b. What are the inhibitors and drivers at the firm level?
c. What are the inhibitors and drivers at an individual level?

In this section, I present my findings in relation to the research questions. From the analysis, three main themes were identified as well as subsections within each theme. The first theme is the institutional level factors that are present within the *entrepreneurial university.* We then explore the subsections within the entrepreneurial university, regarding *policy implementation, traditional norms* and *capability expectations*. The second theme is *misaligned stakeholders* and the subsection discusses *spin-off management tensions*. The final theme regards *learning* and the subsections explore scientist's *adaptation* and how scientists develop an *entrepreneurial attitude.* The findings are structured where inhibitors and drivers are explored within each theme. At the end of each key influence, a summary table highlights the key findings. The following diagram represents the overall structure of the findings section:

Diagram 5 – Findings structure



4.1 - Institutional level: Entrepreneurial University

From the institutional level, the first theme from the analysis regards the entrepreneurial university. Within the entrepreneurial university, one driver; *policy implementation* and two inhibitors; *traditional norms* and *capability expectations* emerge as key determinants in spin-off development. The below table summarises the key findings from the institutional level.

Table 7: Summary of the inhibitors and drivers at an institutional level

Finding	Details
Policy implementation	• Government is pressuring universities to be conducting entrepreneurial activities so universities can contribute in creating a technologically advanced nation • Scientists are required to alter their activities and research agendas if they are to be considered a superstar researcher • VCs and PVS are encouraging entrepreneurial outcomes which has helped legitimise commercialisation as a form of knowledge transfer
Traditional norms	• University environments are conflicted between the mission of teaching, educating and research, versus entrepreneurial activities, knowledge translation and commercialisation. This presents tensions in publishing versus patenting • Approximately 10% of academics find commercialisation to be incompatible and unsuitable for university purposes • Academics are not incentivised to be participating in entrepreneurial activities and are restricted in their time to pursue spin-off activity

	● Current mechanisms of performance review inhibit the adoption of commercialisation, limiting the legitimacy of the entrepreneurial university ● Misunderstandings arise as department managers do not understand commercialisation and judge scientists for their time management ● Role models help potential academic entrepreneurs to transition to the commercialisation environment and adopt new activities
Capability expectations	● Academics, university TTO managers and commercialisation managers hold different opinions and expectations about commercialisation capabilities ● Commercialisation managers find academics can be limited in entrepreneurial capabilities ● Academics find commercialisation managers can be overbearing and dominating ● Commercialisation managers find university TTO managers lack market insight ● There is a mismatch in opinion about commercialisation opportunities coming out of universities

4.1.1 - Policy Implementation

The first driver that contributes to spin-off development is *policy implementation.* Universities are adopting entrepreneurial ideals, as they are required by government to do so. The Ministry of Business, Innovation and Employment (MBIE) are central in shaping the New Zealand economy. They assist the delivery of policies, services and regulation to businesses and individuals in New Zealand (MBIE, 2017). MBIE is encouraging scientists to adopt research that focuses on transforming New Zealand into a more diverse, technologically advanced and smart nation (MBIE, 2017). These initiatives are based on the premise that universities should be using their research outputs to make an impact to society.

The findings indicate universities feel much more of an obligation to fulfil entrepreneurial outcomes as they are well positioned to convert knowledge into economic opportunities and that university capabilities in research and knowledge dissemination should be used for commercial purposes to help facilitate this mission. One way this is achievable is through spin-off creation, which can produce income sources that can fund research, facilitate new relationships, and use spin-offs to enhance the universities reputation. Additional income sources are also attractive to universities so they can work towards being self-sustaining. The

signals that are coming from government, as well as the recognition that universities are well positioned, highlight the importance of spin-offs and the entrepreneurial university. This is highlighted in the following scientists' view:

> *So rather than research just being funded by the tax payers earnings, by actually having new entities – it becomes much more self-sustaining. And I think universities are now recognising that they have much more of an obligation to be not just generating knowledge, but converting that knowledge into economic growth. And we see that - a lot of the signals from MBIE are around that - so it isn't a novel concept. But I think that start-ups are one critical pathway by which this happens. And I think it has a lot to be said for it. (Interviewee 18)*

Our findings indicate the MBIE led initiatives have influenced the types of funding that scientists are able to receive, and thus the types of research they can be conducting. These changes within the entrepreneurial university are experienced as researchers applying for particular funding grants realise that blue skies research will not be funded. Our findings highlight that scientists must adapt their research to areas that have the potential of making a difference to society. These changes signal to scientists that research should be translational and government grants support these types of research activities. This results in scientists strategically assessing their research agenda as two commercialisation managers explain:

> *The funding which is now MBIE, they have driven things this particular way and said if you want funding for pretty much anything except for blue skies research; big science connection. And if you don't show the relevance to NZ or how you can make an impact on NZ, you're not going to get your funding. (Interviewee 10)*

> *A lot of research grants have aspects about them that are how you will make a real world impact with this research grant, and a lot of the research grants are keen to put a commercialisation angle around that. (Interviewee 8)*

These perspectives suggests that the changes in grants are significant to scientists, as they are

required to generate funding for their research projects. Whilst academics have alternative options for resource funding, it is expected that scientists applying for these particular research grants will have considered the commercial application. Our findings also signal that university policy implementation has influenced the criteria that deem a strong academic career. Scientists who are pursuing a career in academia are expected to be conducting research that is relevant, in order to be recognised as a superstar researcher. This is evident as the commercialisation manager discusses:

> *The signals coming from the government and universities are becoming a lot stronger. There is also an expectation that super star researchers who want a strong career in research; this is a part of what they have to do. And also it is about generating more income to do research. To generate funding, you have to apply for grants or you can work with industry that will pay for research, or you can work with a start-up or create a spin-out and that generates a research relationship. (Interviewee 8)*

Our findings indicate that if universities facilitate spin-off creation, they are demonstrating their ability to be entrepreneurial and they possess the capabilities required for such activity. Demonstration of these capabilities is important when universities aim to attract prospective staff and students. As stated by this academic entrepreneur:

> *It is important to tell prospective staff and students that the university celebrates entrepreneurship… So if I was a student from Malaysia or India and planning to come to university and I knew from the universities entrepreneurial eco system that they will help me set up a business idea, of course that university will be the one. (Interviewee 6)*

Universities are also interested in being recognised as entrepreneurial as it provides the opportunity to boost their reputation. Our findings signal that spin-offs are able to increase university reputation as it demonstrates to university stakeholders they are offering jobs to graduates and stimulating economies. Spin-offs also demonstrate that universities are looking

to solve problems in society. These aspects are important in the university landscape to also demonstrate to university staff the entrepreneurial activities that are happening on campus. The commercialisation manager perspectives below highlight these positions:

> *It looks great for universities to have spin-offs out there; employing people and making cutting edge technology. I don't think there is any university that wouldn't want to be associated with young, up-start companies that are trying to change the world. (Interviewee 10)*

Moreover, the implementation of policies is important so universities can be recognised as supporting government initiatives. Universities are driven to do this as they attempt to be self-sustaining which is attractive to government. This may stimulate additional university support and funding if these government stakeholders are satisfied. As commented by this academic entrepreneur:

> *And also if you're an entrepreneurial type university, you're more likely to get some of the public grants that are there. That puts a share of grants/money back into research if you're using those types of grants and hopefully the projects that are successful have made some money that can go back into research at the university. (Interviewee 6)*

Based on these reasons, our findings suggest university management like VC and PVC are encouraging commercialisation. Top level support is critical in demonstrating to government and academics that entrepreneurial initiatives are being taken seriously. This is important to government, as university management are the implementers of these policies. A university TTO manager highlights the need for entrepreneurial activities to have top support:

> *I think the university has come a long way particularly with the VC as I think the VC has legitimised commercialisation and I think the VC has made it something that shouldn't be hidden away. (Interviewee 22)*

Similarly, a commercialisation manager agrees that university management support is fundamental to continued improvement:

> *So governments are asking for it, senior university management like the VC and PVC are keen to be seeing research commercialisation. (Interviewee 8)*

A university TTO respondent builds on these views, adding that additional changes are required within university culture. More changes are needed because entrepreneurial activities like spin-offs are not traditional forms of knowledge dissemination. Universities must emphasise that commercialisation activities are opportunities for academics. Greater emphasis needs to be made to ensure that proactive measures are taken to facilitate the evolving university culture so alternative mechanisms to knowledge transfer are recognised:

> *I think it starts from the top. If the university management and deans encouraged staff to think of this commercialisation pathway as a potential option...because it is just not traditionally thought of in that way. And it is a hard thing to solve, because it requires changing mind-sets a little bit. (Interviewee 11)*

From the university TTO perspective, the elements regarding cultural differences and adoption reluctance are highlighted. These are inhibitors within the entrepreneurial university and are presented in the next subsection; *traditional norms.*

4.1.2 - Traditional norms

As discussed in *section 4.1.1,* the importance of university management support in the execution of entrepreneurial activities is critical. Without constant and responsive support from university management, spin-off activity will continue to be challenged as academics attempt to conduct research in a split university culture. Highlighted throughout the following discussion, is how the *traditional norms* of universities inhibit spin-off development as academics and university staff varies in their perspectives about the entrepreneurial university. The variety of perspectives results in cultural rigidities and change inhibitors.

The traditional norms of the university inhibited spin-off activity as it expects researchers to teach and educate undergraduate students. Similarly, traditional university norms value

academic output through activities like publishing. Our findings highlight that when these traditional norms are perceived as the most important and most valuable form of knowledge translation, these beliefs highlight commercialisation as an abnormal university activity. The expectation that academics are at university to teach and publish shows the tensions that exist between the traditional norms of the university and the values of an entrepreneurial university. Whilst the entrepreneurial university values academic entrepreneurship and industry engagement, academics who strongly value traditional university norms oppose these perspectives. From our interviews, an academic entrepreneur explains a previous experience with unsupportive university management regarding translational research during 1985. The unsupportive nature is attributable to the traditional norms of the university where the academic was reprimanded for not focusing on teaching as their university purpose:

> *A letter from the Vice Chancellor - you can do what you like with your inventions, you can publish text books and play on the stock market if you want, but you are here to teach and we are paying you to teach and research and what you do is your own business. And that was normal in 1985. (Interviewee 15)*

The findings suggest that whilst university management perspectives on commercialisation may not be as extreme as this reaction in 1985, tensions still exist, as portions of academics still possess this same attitude. A large number of informants explain that scientists are disinterested and speculate about the legitimacy and viability of translational research outputs. These traditional perspectives inhibit acceptance of the entrepreneurial university when academics are sceptical of academic entrepreneurship. Three respondents estimate only 10% of academics are interested in commercialisation (interviewee 2, 22 and 8) (appendix 4).

Evident in our findings is the traditional university norms, culture and beliefs make the implementation of the entrepreneurial university a slow-changing process. The cultural rigidities of the university require personal opinions and academic understanding to be shifted

so traditional norms can be equalised to entrepreneurial values. A number of commercialisation managers have commonly experienced low levels of interest as they attempt to seek academics who do value the entrepreneurial ideals. Commercialisation managers find some academics support commercialisation, some academics are supportive but are not personally interested, and there are academics that have a strong distaste for commercialisation:

> *If I put a number on the percentage of inventors who wanted to get involved, I would say something like 10%. I think it's like a bell curve; there are 10% who really want to do it, there are probably 10% who would be really opposed to commercialisation and think it is the devil, and there is a whole bunch in the middle that think it is good to be done, but I am glad someone else is doing it. (Interviewee 8)*

Our findings suggest that the traditional values of universities are contributing to these low figures of interested academics. Despite government encouragement of entrepreneurial activity, academics have been attuned to the value of traditional mechanisms of knowledge transfer. This may explain the rationale behind certain academics who are unsupportive of these activities as they may prefer to uphold the traditional values that have been instilled in their academic career. It may be challenging for academics who prefer traditional university missions to understand alternative methods of knowledge sharing and alternative activities when processes have been institutionalised.

However, in order to improve the number of academics who are supportive and interested in spin-off activity, greater integration between traditional norms and the entrepreneurial university is required. The traditional norms suppress academic engagement as the adoption of new values and interest is limited. As explained by this commercialisation manager:

> *Maybe only 5 or 10% of academics see that commercialisation is something they are interested in doing. You really cut the pool down in terms of individuals who might have a view that this is something they could do. (Interviewee 22)*

Our findings highlight the reluctance of academics to adopt entrepreneurial activities can in part be explained by the promotional models and performance measures in universities. Academics are not incentivised to be conducting commercialisation activities and the current incentive systems signal to academics that promotion and recognition is based on publication output. Whilst government have incentivised commercialisation through funding grants, equivalent incentives are not present within universities.

The evidence suggest that the university promotional and review systems do not formally encompass elements around commercialisation. The measurement and evaluation of academic performance is through the PBRF system, which is based on publication output. The challenge is that these promotional criteria align with the traditional norms of the university, thus reinforcing the importance of these mechanisms, opposed to the features of an entrepreneurial university. A number of academics and commercialisation managers have expressed how the lack of incentives within universities limits and does not facilitate, nor encourage academics to change their perspectives around translational research. A number of commercialisation managers then go onto explain how this also inhibits university TTOs abilities in finding potential disclosures within universities because the importance of commercialisation is not justified as academics value academic status:

> *The drivers within the university are very much academic. So we work with a very small proportion across campus because not everyone wants to go down commercial pathways. To a lot of academics, it is just of no commercial interest, whatsoever. So I guess there is just that general mind-set thing and I don't necessarily blame them either, because they are not incentivised to do commercial work. (Interviewee 11)*

Similarly, this commercialisation manager agrees:

> *I think as a nationwide thing, academics need to be much more incentivised in terms of revenue, contract revenue and metrics like the number of spin-offs encouraged through things like PBRF.*

And that would be the obvious thing to do and that's not really happening. Which is a disadvantage to some people, and that is a major thing…You really need that drive and encouragement from the top. (Interviewee 5)

The lack of university incentives restrains top management's efforts in legitimising academic entrepreneurship and thus fulfilling government missions. This results in a number of academics having to approach their research with the purpose of developing their academic career and sustaining their position within the university. Our findings provide reason to suggest that academics that are driven by incentives take an approach that satisfies their review criteria. For these academics, this approach is moulded by the university incentive system and the importance of translational research seems to be left to personal interest. Academics are prioritising the requirements for them to be a successful researcher, as dictated by university management. The below academic entrepreneur explains:

I suppose a lot of people just focus on their outputs in terms of grants and applications, and bits and pieces because I suppose it is more focusing on a career than the outcome. (Interviewee 12)

Moreover, the below commercialisation manager has experienced similar inhibitors:

I think some of the funding doesn't necessarily help commercialisation and some of the PBRF mechanisms are a bit of a challenge around that. (Interviewee 8)

The findings indicate that the challenge that the traditional measures of excellence also bring to spin-off development is that whilst university management encourages academic entrepreneurship, the time required for these activities have not been considered in review processes. A large number of informants find they must balance the pressures of publishing responsibilities, grant applications and student supervision. These commitments in addition to their entrepreneurial activities stretch their capabilities, resources and time.

An academic entrepreneur highlights that any additional time is unlikely to be dedicated to

areas that do not provide personal promotion or academic benefit. This signifies the imbalance between traditional and entrepreneurial knowledge dissemination. However, if commercialisation activities were explicitly accounted for, it is likely academics may be persuaded that they should consider a portion of their time to these activities:

> *They can change incentives around resources, grants that you can apply for – internal university grants – if there was some reference for commercially oriented or if they got strategic bonus points, things like promotions and that kind of stuff. If it was explicitly accounted for, then people would probably designate some of their precious time towards it. (Interviewee 19)*

An academic entrepreneur who co-founded a spin-off was judged and criticised regarding time management. The academics' ability to balance commercialisation with academic activities is inhibited by misunderstanding managers. These misunderstandings arise as managers do not understand commercialisation, and they are not required to accommodate commercialisation in their assessment reviews. As signalled in the academic entrepreneurs response, academics receive negative judgement from their managers, which inhibits spin-off activity. This demonstrates the disparities between the entrepreneurial university and recognised academic outputs. As stated by this academic entrepreneur:

> *Definitely time management has challenged me coming into this environment as an academic and the fact that my [university] managers don't understand what I am doing. But I am judged by them; I have performance reviews by somebody who doesn't even know what I am doing, or how to do what I am doing. I have a performance review with somebody who is basically an academic. (Interviewee 17)*

Publishing has also caused tension in spin-off development when academics have been restricted to publish, given the stringent conditions on IP protection. Our evidence highlights academics feel obliged to be publishing as this is in their assessment criteria. When academics perceive commercialisation as threatening to their career advancement, this inhibits spin-off

participation. Taking this into consideration with the lack of incentives, academics find commercialisation to be risk oriented. This highlights the tensions that traditional norms of knowledge output and performance measures have for academics in the commercial space. University TTO managers recognise the negative effect that the PBRF system and traditional promotional methods can have for academics:

> *I think one of the key things we've always recognised is that there is more promotional stuff around the traditional things that PBRF measures. And things like that and commercial activity like patenting, and then not publishing because you are in a confidential space, starts to impact on career advancements within academia as well. So I think everyone involved in commercialisation would like to start to see a bit more of a level playing field opposed to the traditional measures of excellence. (Interviewee 2)*

In comparison to this point of view, a number of commercialisation managers have attempted to persuade their academics that both publishing and patenting outcomes are possible. This commercialisation manager finds this requires modifying academic mind-sets so they understand their traditional activities are still possible:

> *But they're not insurmountable and again, often researchers think publish or patent and they would much rather publish, but actually the reality is you do both. (Interviewee 8)*

This perspective is in contrast to a scientist's perspective where they have found it challenging to balance both outcomes. Often university TTOs will assess projects and if there is IP potential, protection is typically filed fairly quickly. During these phases, academics are unable to discuss much of their inventions and there are windows of opportunities where publishing is possible. The findings suggest this was going to negatively affect a scientist who was a part of a spin-off as publishing was a requirement for them to establish an academic career. A supervising academic entrepreneur stated they had to make it explicitly clear to their commercialisation counterparts that publishing for the scientist was critical:

As far as publishing, it is quite important during an academic PhD, to be able to speak about your work and be able to present at conferences, and internal things – we have certain requirements that you have to give a first year talk, you have to be quite freely about things…. it is really important that things are managed in a way that they can still write a thesis, they still have data, they can still publish and present at conferences…it is quite different to a regular PhD. (Interviewee 19)

As elements of the current university landscape inhibit spin-off development, our findings provide evidence to suggest that university changes must be made to lessen the negative effect of traditional norms. Two academics who had recently been involved in spin-off creation explained the importance of having an experienced academic entrepreneur that can act as a role model and mentor. The championing effect a role model has for potential academic entrepreneurs is they are able to minimise the various misconceptions that academics have. For example, this can include the patenting versus publication dynamic. Mentors can also demonstrate how they navigated university incentive systems, which may help in increasing academic interest levels. The benefit of having a mentor is that it also helps equip academics in developing their capabilities. One academic entrepreneurs found that academic experience in situations like industry engagement to be particularly useful:

It is quite difficult I suppose, for academics to have a commercial mind-set. But having a supervisor who is quite commercially focused, it is different to see how he interacts with industry, versus other academics around the university. He was pretty supportive and he has a couple of spin-out companies from the past as well, which is quite good as he already had a bit of an eye for it. (Interviewee 12)

However, the below academic highlights the contrasting experience where confusion can arise when they do not have any potential mentors as they embark on commercialisation adventures:

It was very difficult…I had no one I could go to as a mentor; to go and ask help for. (Interviewee 17)

The findings indicate that when academic entrepreneurs are able to share their experience with their peers, this helps drive the university culture to be more accepting of entrepreneurial activities. The demonstration of real success can be evidence to academics that the possibility of change and new forms of knowledge dissemination are legitimate as this commercialisation manager explains:

> *I think examples are the biggest kind of promoters of what commercialisation is like – if people can see their colleagues are doing well and enjoying it and generating extra money, employing people because they're doing stuff, others will follow. Because if a Ferrari pulls into the carpark, others will think, "I would like a Ferrari as well". So there are cultural aspects that signal how important it is. (Interviewee 8)*

These issues highlighted in *section 4.1.2* discuss how *traditional norms* inhibit the successful implementation of the entrepreneurial university, and thus the generation of spin-off entities. The various elements are interrelated and cause cultural barriers, misunderstandings and split perspectives within the university eco-system.

4.1.3 - Capability Expectations

The second inhibitor and final subsection at the institutional level regard *capability expectations*. The actors in this context include academics, university TTO managers and commercialisation managers. The misunderstandings that arise between these parties regard differences in expectations of what capabilities each of the spin-off actors possess, and the different opinions they have of each other. Capability expectations are included within the institutional level as the perceptions these spin-off actors have regard the entrepreneurial university and its activities. Whilst discussion may include elements from the firm and academic level, capability expectations discuss the unique perspectives each parties have about the commercialisation context.

The findings indicate that tensions arise when spin-off actors have misaligned capability

expectations that lead to miscommunication and different outcomes. The first tension arises between commercialisation managers and academics. Throughout the below illustrations, commercialisation managers often find that academics are limited by their technical scientific perspective, and that they lack the necessary market-related capabilities for commercialisation. This occurs as academics have been perceived as limited in their ability to identify market opportunities. As academics possess a technical background, their capabilities regard how the technology works, but not how the technology can be applied. This often results in academics missing the broader perspectives and opportunities that can be exploited. Whilst academics may have good insights, our findings indicate their insights are not comprehensive market understandings and commercialisation managers find that academics work schedule prevent comprehensive analyses of markets and industries:

> *The researcher is coming at it from a technical perspective, and they can't have a full market perspective of what they are offering and what they can do. Occasionally they will have very good insights, but often it is not always very rigorously analysed to what it can do so that is one of the challenges - to have a broader perspective of what jobs the technology can do and for who, and you need to work that out. And the researchers don't really have the time or the desire to. So that is a limitation. (Interviewee 8)*

In contrast to this commercialisation perspective, an academic entrepreneur who did not go down the TTO pathway has successfully developed and identified market opportunities that have technical application. The academic found that interaction with industry and firms allowed market understanding to be achieved. Whilst the academic had "*not really*" (interviewee 12) had any entrepreneurial experience before, the academic was able to develop skills through IP workshops and searching patent databases. The academic also found that the formation of a business relationship with a manufacturer was a successful route to establish legitimacy. From this position, they were able to seek venture capital funding.

Despite these achievements, the academic entrepreneur found they were "on the back foot" (interviewee 12) when they pitched to investors. The academic felt their interaction with commercialisation managers depicted an unequal balance. As the respondent felt they were expected to be lacking in commercial capability, this left the academic feeling disadvantaged in pitching their proposition. Despite the capability developments, this academic still felt it was difficult to persuade the managers given their non-commercialisation background:

> *You definitely feel on the back foot when you are speaking to investors and commercialisation experts. If you do know about your whole value proposition and you have come up with a basic business plan or application, and hitting all those sorts of points, because it is not your focus, it's like they can almost tell you are not so confident and light on the ground. So it is almost very hard to fight back at that stage and they can almost push you around a little bit which can be quite disconcerting. (Interviewee 12)*

These two perspectives from a commercialisation manager and an academic entrepreneur highlight the differences in capability expectations. The challenge this brings to the spin-off is if commercialisation managers perceive academics as unable to be equipped with market-related capabilities, then they are not facilitating the possibility for development. When academics feel they are not treated equally or with opportunity to equally engage, this also inhibits aligned interaction.

In addition, a commercialisation manager has found that academics mistakenly believe their academics skillsets are transferrable to the commercialisation process. Often researchers who are particularly successful in one area of science will think their knowledge and capabilities will without fail be transferrable to the commercial setting. This is a tension in capability expectations as this commercialisation manager finds the skillsets required for entrepreneurship vastly differ to academia:

> *I think the biggest mistake people can make, and a little bit of academic error – "I am a world*

leader at x, and therefore, that will triangulate to y. I'm the top dog in this, and therefore, I can commercialise technology" - which is a very different skill set. And that can be quite hard and humbling for academics. (Interviewee 10)

Similarly, whilst a large number of commercialisation managers find academics think they can apply their skillsets to areas they are inexperienced at; academics feel commercialisation managers also do the same. As demonstrated in the academic entrepreneur's response below, they have found that business people will often apply their minimal scientific experience in making decisions about the technology. This has led academics finding that their business counterparts can be bullish and overpowering and tend to force their opinion.

One academic entrepreneur feels that commercialisation managers will apply their knowledge from scientific articles in making spin-off decisions. However, academics argue their experience allows them to develop an intuition that determines whether a technology can be pushed for market speed, or if the technology will be underdeveloped:

And the business managers tend to get quite bullish and I'm quite surprised by some business guys; they think they understand it and they don't understand it - they can't. Maybe it's an experience thing; I can get a sense of, "is this is going to work? Is it not going to work? And how well do we know this field?" And you kind of get a feeling for how important that is; "have we done enough work to carry on?" And that is purely an experience thing. People can read some critical papers, but it is not there. And people will often do that; I have the feel for this now, I can look at your results, other people's' results and it's good enough to go. (Interviewee 3)

These perspectives from commercialisation managers and academics indicate the variety of misunderstandings between the two parties. Both parties feel the other is often at times incapable of making justified decisions and they lack the knowledge that is required for technology/market development. The challenge is when these spin-off stakeholders are unable to understand and align their expectations with their counterpart. As explored, the

commercialisation actors are critical for various spin-off components, and so are the academics.

Another perspective to this discussion is from a commercialisation manager who finds that academics are "*clueless*" (interviewee 25) regarding commercialisation as academics will often say, "*now what*" (Interviewee 25). This perspective highlights that academics are dependent on actors like commercialisation manager in developing commercialisation opportunities. This commercialisation manager's perspective portrays academic inabilities as they find academics lack market intelligence in terms of what markets are willing to pay and how commercialisation is conducted:

> *A lot of the academics are clueless and once the technology is developed, they say, "now what?" And that is when the people in suits step in and take it from that point... We have market intelligence – academics have little to no clue about what the market needs are and what the market is willing to pay for. So although we aren't experts in everything, we specialise in [specific industries in the] market in NZ…We are very aware of how the industry works and inefficiencies in the industry and what technologies could plug the gap in making the industry more efficient. (Interviewee 25)*

These perspectives from commercialisation managers are in direct contrast to another interview respondent who founded and developed a spin-off. The academic has found that the key to business development is establishing business relationships and possessing an openness to learn. The academic entrepreneur has not found the commercialisation process to be terribly complicated, and many successes are contributable to searching for opportunities. This academic highlights the necessity of being flexible in order for business opportunities to arise and so good relationships can be developed:

> *The business part is not terribly complicated, most of it is born out of good experiences, developing relationships with people, and business relationships and looking for opportunities to go forward with that. I have never found it as overly complicated and impenetrable.*

(Interviewee 18)

The next difference in capability expectations incorporate all three actors, and regard the identification of IP opportunities within universities. Firstly, university TTO managers find that major spin-off successes are not that common. This perspective is formed on the basis that the reality of spin-off activity is greatly dependent on the technology and whilst all universities are looking for a major deal, the goldmines are rare. In addition, the university TTO perspective is that there are rarely many IP opportunities in universities where action is not being taken. This perspective is rationalised as spin-off activity cannot happen without the academic and because academic interest is so low it makes it challenging to identify IP opportunities without the academic being invested in the process:

> *I think there is a misconception that in the broader world, there is a whole lot of IP stuck in these universities and there's not a whole lot happening and it's just not true. The thing is that if you want to balance that properly, even if there were a whole lot of opportunities that didn't come to life, it can't happen without the involvement of the academic.... It's just not that simple to fish through the academic environment without the academic who knows what they're doing.*
> *(Interviewee 22)*

In contrast, the second perspective on IP opportunities in universities is from an academic entrepreneur who sees that there are many "missed opportunities" (interviewee 3) in universities. The academic explains that their spin-off development could have very easily been a missed opportunity. The academic attributes the commitment of resources and investment to be the factors that continued the academics position. As the academic had pressure to be delivering on these inputs, this kept them going. However, academics who do not have these pressures could give up on their valuable IP which results in lost opportunities:

> *I think there must be lots of missed opportunities or things that just get buried away and don't come to surface. It would have been very easy to just give up and it took that kind of commercial*

energy and commercial environment to come through to get to that other side. And it makes me think people must very often get to that point in academia and think [sigh] that's not going to happen. I think there must be vast opportunities that are left behind in academia. (Interviewee 3)

The third perspective originates from a commercialisation manager and this again differs to the university TTO and academic perspective. The commercialisation manager highlights that their organisation is continuously scanning opportunities within universities, and there are a range of IP opportunities that have success potential. The challenge in this context is that there is lack of investment for these opportunities, opposed to lack of deal flow. This commercialisation perspective directly contrasts to the first illustration by the university TTO manager:

We are actively monitoring most technologies coming out of the four major universities, and to be perfectly honest, there is no lack of deal flow – there is a lack of money. We have our pick of the crop in terms of technologies. (Interviewee 25)

The commercialisation manager also finds that whilst academics are successful at technology development, universities lack the capabilities to solve problems in the "real world". The commercialisation manager hosts the opinion that university TTO managers are inefficient at applying market opportunities to technologies and there is a lack of expertise in the commercialisation context. This inhibits spin-off development because the application of market needs is fundamental to the success of a spin-off and its value proposition. This is likely to present challenges when university TTO managers market need identification is a mismatch to the commercialisation managers perspective:

So it is one thing to develop technologies which I think universities in NZ are very good at, it is a second thing to identify a market need for that technology which is surprisingly difficult and probably the most valuable part of the whole spin-off. Once it has been identified – solving a problem in the real world…. It is not a straight forward process and it is different for every company and there is definitely a lack of expertise in the area; internally with a lot of the

universities…The commercialisation process for technologies in NZ is very inefficient, and we help transition the process. (Interviewee 25)

These three perspectives highlight the challenge in aligning capability expectations. Each party is a key stakeholder in spin-off development and when these different perspectives are held, they highlight the differences in understanding of the entrepreneurial university context. There is a mismatch between the parties where academics may feel they may not be receiving the necessary support, university TTOs feel they are unable to find IP opportunities, and commercialisation managers find that there are IP opportunities; there is just lack of investment capital and sufficient university support. These differences inhibit spin-off development because the significance of each stakeholder means the parties may not be working at maximum potential and there could be a loss of understanding in the entrepreneurial eco-system.

4.2 - Firm level: Misaligned Stakeholders

The second component of our research question regards the inhibitors of spin-off development at the firm level. In this section, the theme is *misaligned stakeholders*. This regards misalignment that is experienced in spin-offs as *management tensions* inhibit venture development. This is considered inhibitors of the spin-off process as the misalignment between the various perspectives result in different expectations and understandings despite being within the same context. The below table summarises the key findings at the firm level:

Table 8: The inhibitors and drivers at a firm level

Role	Details
Spin-off management tensions	● Clashes occur between management actors and scientists in spin-offs. Balance is necessary between the parties for decision making, but altering motives and agendas lead to friction and power struggles where the two backgrounds disagree ● Academics can be challenged in releasing control of the venture when management teams are integrated to contribute business capabilities. Problems occurred when the venture was required to change direction ● Continued from the above point, academics have taken personal offence when changes in business plans must be made ● Differences in thinking and work practices caused conflict as

	scientists felt misunderstood when management teams encouraged alternative processes ● Time management of research, development and technology launch led to conflict between management and scientists. Often management teams push for a shorter time to market, but scientists try to "perfect" the technology ● Commercialisation managers have found academics to be useful only during particular phases of spin-off development and scientists have felt excluded from the spin-off development process ● Problems can arise when academics attempt to adopt management roles when they do not possess the required business capabilities

4.2.1 - Spin-off Management Tensions

Our findings indicate that when spin-off actors disagree, this can cause spin-off management to become hostile and tensions arise in the development process. From our findings, disagreements regarding decisions that are made between the commercialisation actors and academics arise.

The evidence suggest that this occurs when commercialisation expertise are brought onto spin-off management teams to help develop new ventures. When directors and managers have a remote position from the day-to-day occurrences in the venture, academics find their passive involvement to be abstract and meaningless. Whilst their overall input to the venture may be beneficial, an academic entrepreneur identified the director's involvement created barriers, particularly when director's made suggestions without clear guidance. These interactions developed superficial relationships and led academics feeling directors made assumptions about their commercial capabilities and knowledge:

> *The bigger hurdle in my expertise was we had three part time directors where they basically just had time to sit in for a meeting once a week. One of them would suggest, "why don't you put this x, y and z data back together", and I would have no idea, because I have never seen these things before. And the director would be like, "go and do a SWOT analysis", and I'd say ok, "let's go and Google a SWOT analysis". (Interviewee 4)*

Other respondents also experienced similar situations where directors expected them to align

their way of thinking and activities to commercialisation requirements. Tensions developed as commercialisation actors expected scientists to develop timelines and produce the answers for scientific experiments. An academic entrepreneur found these metrics were incompatible and unable to be determined, as science does not align with these measurements. In these circumstances, the academic entrepreneur found commercialisation actors misunderstood how science and scientists work. Moreover, our evidence suggests that academics have felt undermined when commercialisation actors are brought onto the venture with the purpose of supervising scientist activities:

> *The CEO brought in people from the industry to manage me and they wanted me to do a Gantt chart for everything I did and I was just like, "no, this is not how I work. It's not how I work and it's not how it, the science, works". And this is research; I don't know what the answer is so there is no point in giving me a Gantt chart and a timeline because I'm not going to meet them because I don't know what's going to happen tomorrow but it's not how these guys thought. (Interviewee 3)*

Academics have also experienced conflict that has inhibited spin-off coordination and team interaction. Our findings suggest that friction often arises as commercialisation expertise is brought into the spin-off but the different spin-off personalities are unable to balance their various perspectives. The imbalance of business and science inhibits spin-off development because dominating science is likely to result in missed opportunities, and misused resources. On the other hand, business domination will result in weak technical background and limit the IP potential of the venture.

To this end, the evidence suggests spin-off tensions are a challenge because both parties are required for successful development, so a resolution must be achieved. This is evident in an academic entrepreneur's response where tensions with management were experienced. However, the benefit of commercialisation expertise is noticed when they help academics focus

their activities and guide the venture. This was of critical importance to ensure the venture did not prolong unnecessary activities but goals were being achieved. This academic entrepreneur explains:

> *It was hard later on when there were frictions between myself and the management; where it was going to go…So that was quite a hassle and was frustrating for me. I always kind of thought getting the balance between science and the management was critical. And not as easy as it might sound because if the science dominates, we probably would have failed as I would have just hung in there for a bit more data and opened up a few more angles. I probably would have failed… But it took a few more business guys to say "come back here and carry on this way". (Interviewee 3)*

In situations where commercialisation parties are unable to balance their conflicts with academics, this results in unresolved tensions where the spin-off venture is comprised of unsatisfied venture members. As highlighted in the previous illustration, academics can be pressured by their commercialisation counterparts to speed the development process so a shorter time to market is achievable. This is so spin-offs can beat market competitors, achieve a strong market position and reduce development costs.

However, our findings indicate that the push for speed to market launch leaves academics feeling unsatisfied as they feel the technology is underdeveloped and lacks integrity which will not satisfy the end-users. An academic respondent builds on these views when they determined the CEO of the spin-off was premature in market launch. Whilst the commercial decision was made to build customer bases, the academic feels the technology has not had the development necessary to make it distinct from current offerings. In these situations, power struggles between CEOs and academic entrepreneurs are highlighted. This academic entrepreneur recalls:

> *There was a decision to take the product to market at a point in time, and I thought that was*

premature. And I said so at the time, but that nonetheless, it is what happened. I didn't think it was ready. And I think subsequent events have vindicated my point of view. And I understand the imperative to do that as we had to demonstrate some ability to get the customers so we could get the funding, but it is one of those compromise situations where it is difficult. (Interviewee 20)

Another factor as suggested by our findings is that tension arises when commercialisation actors decide to change the direction of the spin-off all together. From our findings, academics have challenged these direction changes as they have built personal attachment to their initial discovery. In addition, academics often develop a particular vision for their technology that they have shaped and nurtured. When commercialisation actors make these decisions, it requires compromise and a balance in perspectives to be achieved if venture members are to be aligned. Often in these scenarios, academics have taken these changes as personal offences opposed to necessary commercial changes. As commented by this academic entrepreneur:

The challenge for me was finding an agreement between me and my CEO who I got into the company to run it. As a founder, you have a different vision and the person who has come from an external environment has their vision and you have to align those. So my vision was to have a product cheap enough so that every student in the world can afford it. But the business side of things was that the executives were saying it's a good dream, but how does the company make money? Those were challenging times for me to let go of my dreams. (Interviewee 6)

A commercialisation manager can build on these tensions where academics may take personal offence as this may have been their first entrepreneurial experience. In these situations, academics often express they are able to make the technology work if they have more research and development time. This causes friction between the two parties, as one pathway must be chosen for the development to continue. As stated by this commercialisation manager:

Academics are by definition attached; it's their baby and the manifestation of their career and livelihood. And then we might come on board and say, "we are going to stop that, and let it go and change direction". They say, "No I don't want to. I think I can make this work, just give me

another six months", and you end up with this potential for a lot of friction there. And so it is a part of saying academics are great, we love them especially when they are at universities getting more funding, pushing the boundaries, generating the next pipeline of IP and patents and conferences and doing what they do really well. (Interviewee 10)

In reverse situations, our findings suggest academics have been in positions where they are encouraging the speed to market launch to ensure strong positioning. This has seen the commercialisation team trying to develop the components that are required to complement the technology in terms of market validation and justification of commercialisation. As highlighted by this academic:

Now days it goes much more smoothly but in the earlier days our goals weren't so much aligned. So I was interested in moving quite quickly trying to get the technology going and some of the externals were trying to build business cases and that type of thing. Now that we have the technology going and the business case, it is smoother sailing. (Interviewee 16)

The final spin-off management tension regards a commercialisation manager's perspective that find academics should only be a part of spin-offs during particular phases. Whilst commercialisation actors have found academics to be useful in research phases where technical development or clinical trials are occurring, academic respondents have felt they were out of the loop and excluded in decision making.

A commercialisation respondent indicated that academics will have less involvement as the venture progresses and the spin-off enters the market launch phase. The approach of having academics only in particular phases highlights that academic skillsets are limited and often it is about assessing whether value can be extracted from the academic with their involvement in the spin-off. The bases of this perspective are that academic capabilities are not integrated into the spin-off to build and extend their capabilities to a variety of tasks:

Typically the academics have a lesser role going forward and that's a typical model with more

into development and less into research. And the balance is when there's research needed to fill the pipeline and companies have employed directly from the TTO, so it is about saying, "they are good at research so do we need them now?" (Interviewee 5)

In contrast to this perspective is an academic entrepreneur who has felt excluded and isolated in the decision making process. Whilst the academic has developed a spin-off with a co-researcher, they do not have management say in the ventures development. The academic has felt that they have limited inclusion in the decision making and are often the last in the venture to find out what is going on:

I don't think we have that [management say], the investors have a development plan and they are doing that with their management team. I think having seen all the excitement and getting funding, we have nothing to say. We have very little part in this and that is a bit hurting, and they have negotiated with the TTOs - that we inventors didn't know - that anything we do in that area, we now have to run past them, and give them the option to invest in or take up. (Interviewee 17)

The first commercialisation perspective signifies that academic skillsets are valued at specific phases. Then, the second respondent argued that academic entrepreneurs are excluded from the decision making process and were unaware of managerial decisions that had been made. The final perspective is from a university TTO manager who finds that problems arise when academics are reluctant to let go of the spin-off, or accept their role in the venture. Problems arise when academic capabilities are mismatched for the requirements of commercialisation, but the academic intends to be the CEO of the spin-off. Often tensions arise when the academic lacks the required interpersonal skills, business skills and commercial understanding. When academics are unaccepting of their position, this can strain the venture progression:

The problem arises when the inventor/academic wants to hang around and wants to be

something they aren't going to be – that is when the real problems arise. We have seen where the inventor believes they should be the CEO of the company and they have no business skills. Or they should be the CTO, but they can't talk across the board to a range of different people – they can only speak at their technical level. And investors will want that, but they want them to be able to talk at other levels and that can be a real challenge. (Interviewee 21)

If there is no agreement between the spin-off stakeholders regarding academic inclusion, obstacles in terms of team formation and interaction are likely to ensue. This also presents a challenge at the institutional level because the spin-off stakeholders are misunderstanding the expectations and plans of each party.

4.3 - Academic Level: Learning

The third part of our research question explores the inhibitors and drivers of spin-offs at the academic-scientist level. In this section, the theme is learning. This regards adaptation and the final subsection within the learning theme is academic *entrepreneurial attitude*. Whilst these two elements are considered drivers that have allowed spin-offs to be successful in their development, there are also elements within each subsection that have inhibited the spin-off process. Evident in the following discussion are scenarios where academics were reluctant or challenged in their ability to adapt and accept change which acted as an inhibitor to the spin-off process. The below table highlights the key findings at the academic level:

Table 9: The inhibitors and drivers at an individual level

Role	Details
Adaptation	● Academics learn how to apply their scientific capabilities to a commercial setting. ● Academics adapted their problem solving from research-based to market-based as they learned the importance of market validation and commercial applicability. Academics adjusted their processes to be customer-oriented, opposed to research interest-oriented ● Academics learned how to communicate with investors and how to interact with industry/firms ● Academics learned how to focus their activities to one specific area when often their inventions can be applied to multiple industries and applications. This regarded academics learning

	the concept of minimum viability ● Academics adapted to the requirements and criteria advised by investors and management team as they seek funding. Scientists began to meet development milestones which guaranteed resources.Learning curves occur as spin-off ventures cannot typically be benchmarked against existing firms
	● Scientists identified that academia can often lead to career complacency and the dynamic activities in spin-offs resulted in the development of entrepreneurial behaviours and a tenacious attitude ● Academics initially find it challenging to embrace spin-off development because of the lack of security and the feeling of isolation ● Commercialisation managers highlight that academics become less risk-averse and possess entrepreneurial characteristics that are necessary to continue the growth of the venture ● Despite academic growth and adaptation, they can still be driven by research and often grounded in academic theory

4.3.1 - Adaptation

The first element of discussion is academics learning how to adapt in the commercialisation process. Given academics primarily come from a non-commercial background, their journey in spin-off ventures are a unique learning experience.

Academics begin to adapt to the commercialisation process as they must apply their scientific discovery to a commercial setting. Our findings suggest this ensures the spin-off identifies a unique market need and it solves a problem in the market. It is essential academics are able to adapt to the requirements and necessity of identifying a unique selling proposition as this helps the venture secure investment and funding. The findings suggest that when this market need has been identified, this is the point at which a spin-off is identified as a possible commercialisation route. This academic entrepreneur recalls:

> *We did a lot of research and identified that there was a need in the industry for testing in the area so that was the inception point for the spin-off - identifying that there was a customer need in the market. (Interviewee 16)*

The evidence suggests spin-offs will launch their technology on the premise of their identified opportunity where the spin-off team must be able to incorporate local and national market

scanning to understand how they can apply their discovery. The process of market analyses entails further research and development to understand the features of the technology and how this can be exploited in the marketplace. Whilst this facet of firm creation is not always an instant success, academics learn how to work with clients and tailor their discovery to the particular market they have identified. This process ensures academics are adapting to the market need, and customer preferences, opposed to their personal interests. As commented by this academic entrepreneur:

> *One factory had a particular need and was particularly open to the idea. So we spent a lot of time with them and ensuring that what we were going to offer was what we needed and it was going to tick the boxes. And we didn't get it quite right, but close enough that we are still going. And really did a lot of testing to ensure that each site had similar needs. (Interviewee 16)*

Our findings highlight the challenge in the identification of market opportunities often arise when academics are required to "speak a different language to investors" (interviewee 12) when they are pitching their market assessments to venture capitalists. This process can be a learning curve for academics as they adapt to the requirements that investors will be searching for, opposed to focusing only on the technical aspects. This academic entrepreneur recounts this challenge:

> *It was very difficult because it takes you out of your comfort zone in terms of what you are comfortable talking about. As a scientist, you just want to talk about the science, but I was doing presentations where I knew less than 1/5th of it would be on the science. So talking about other people's [areas of expertise] in analyses of markets; you're not really comfortable talking about. (Interviewee 12)*

Our findings signal the additional benefits of these market assessment processes are that academics understand opportunities that can be exploited which allows them to become intimately familiar with the capabilities and potential of the scientific discovery. These

assessments allow spin-offs to identify where problems may exist - nationally and internationally, and how academics can adapt their technologies to these markets. This ensures academics are thinking of how their technology can solve new problems, which is a learning experience for them. This is critical for building the foundational base of a spin-off that will survive business challenges and a spin-off that can grow. The academic continues:

> *We now have offices in NZ and [overseas]…I included a list of future possible industries that we could target and [this industry was] there because I thought there could be some application…and I could see that health and safety legislation in NZ was behind the rest of the world and no one is moving towards doing this more dangerously, so I thought there was an opportunity to remove people from dangerous situations. (Interviewee 16)*

The evidence suggests that this can often lead to the identification of multiple opportunities and problems by which the technology can solve. Depending on the context, some technologies may solve large market problems. Investors encourage academics to seek large market opportunities that have the potential for maximum return. This is a new learning experience as this typically results in investors encouraging academics to engage with industry and established firms. Through these processes, they are able to develop a better sense of their everyday operations and how their technology may apply to that particular context. When academics learn how to engage and approach firms, this improves their commercialisation skills and academics can adapt to new situations. This has often led to the identification of larger problems that had not been realised in the initial market analyses as this academic explains:

> *Originally we thought we have been making this particular product and this would be perfect for medical applications but it wasn't actually until we started talking to manufacturers that they said there are bigger issues out there and medical applications might look great on a research paper, but things like [specific industry context], is a huge global issue. And they really helped direct the application. (Interviewee 12)*

One way in which academics are able to pursue larger markets is by assessing adjacent markets to which the technology would originally reside within. This enables assessment of how technologies can be stretched and tailored to different industries that have similar needs. This process simultaneously stretches academics thinking as they determine how their technology will align and integrate into established markets. These elements were highlighted as critical components in the KiwiNet Investment Committee (IC) meeting. From observations, the IC members highlighted the importance of aligning technologies to existing products in the market. Whilst distinct selling points must be recognised, spin-offs must also understand their fit into existing markets. This requires academics to adapt their technologies so they can align and work in conjunction with other market offerings. IC members encouraged academics to have conversations with industry firms. These elements were critical in satisfying investors when capital is allocated.

In other scenarios, spin-offs may identify niche markets that hold equally strong opportunities. An academic entrepreneur finds this has helped develop the business model as they undergo learning curves during these unfamiliar phases. The process of identifying problems establishes the evolution of the firm and all of the latter decisions that will be made. These are learning experiences for academics as their concepts are novel and must be applied in novel manners this academic highlights:

> *We have identified a problem that wasn't just our problem, but lots of people around the world, and similar situations. Now it wasn't a big market, but very much a niche market. But it gave us a beginning insight into the potential commercialisation of that technology. And associated with that, we began to explore, "well if we did this, how would this run?" And this was really an evolution of understanding how it would run. (Interviewee 18)*

The evidence highlights commercialisation managers have dedicated spin-off development to the successful identification of market needs. When a market need has been clearly identified,

this provides guidance and clarity to the entire venture and the stakeholders that are involved. In these cases, academics have learned to adjust their technical developments to match the opportunity. When these aspects are aligned and market understanding has been achieved, the spin-off is equipped to gain momentum and purpose which is of utmost importance in spin-off establishment. The commercialisation manager responds:

> *I think a couple of things ensured the venture kept going and moved through the development stages. 1) Identification of the unmet need and the work that we did at the TTO – is there an IP proposition and 2) is there a market opportunity. And the work around both those areas was significant and validated there is a market opportunity for this which kept it moving. (Interviewee 5)*

An academic entrepreneur builds on this view, finding that their learning curve appeared as the market need helped guide venture development and decision making. This is particularly important for academic development and learning as they are operating in unfamiliar business territory. The lessons that academics learn in the phases of identifying solutions helps narrow their focus and purpose within the spin-off. This is applicable to academic entrepreneurs as their inventions are typically unable to be benchmarked against other firms:

> *So sometimes there are always stories about companies who have developed solutions for problems that don't exist. But we were always happy we had a huge clinical need, and those were my visors that gave me the ability to make wise choices about our projects. (Interviewee 3)*

Whilst the importance of identifying a market need is critical, the findings provide evidence to suggest that academics have not always found market assessment and evaluation to be a smooth process. An academic entrepreneur noted that when they were able to narrow their focus in activities to a particular area, this changed their work style. Opposed to the spin-off continuously searching for new opportunities, the spin-off is able to successfully exploit one particular area which then provides development guidance. This demonstrates the academics'

ability to adapt to the necessity of focus, opposed to constantly looking out for new opportunities:

> *So as soon as we started to focus in one area, it narrowed us down and the day to day work changed slowly. It did shift away from looking out for new opportunities to "let's get this one product developed"... it was more about commercialising one idea we had quite well. (Interviewee 4)*

It is often a learning experience for academics as they transition their career into a hybrid entrepreneurial position. This is where academics are often unable to understand how a technology can be taken to market and the various uses it could have, besides the domain the technology originates from. Moreover, MBIE outcomes aim to make changes to society and ensure research is relevant with the potential to make an impact, but academics have found it challenging to understand how they would be able to make changes to industry. Through these learning processes of understanding the market and the functions of the technology, this contributed to their spin-off development, as well as personal learning in the commercialisation process:

> *It was very difficult to work out how we could take that to market and make a change to clinical outcomes so we started to think about how we might find other funding. (Interviewee 3)*

Moreover, an academic entrepreneur identified they are currently seeking ways in which their technology will have specific market application. Whilst it has been identified that the technology is broadly applicable, the spin-off must identify a niche market where they can hold a strong position and seize market share. This requires academics to focus, commit and evaluate pathways. This academic make the point that business mind-sets must be adopted to answer these questions which require a switch from the academic mind-set:

> *I think it is about focus, and one of the benefits of our technology is that it is very broadly applicable so we could make a product for almost anything. But actually, that leads us with a*

challenge from a business perspective that we need to find a niche that we can dominate and expand from there. So we actually need to just pick something and focus on it. And that is not so much a science driven question, that is a business driven question and that is what the company is working on. (*Interviewee 19)*

Moreover, scientists are not required to take the time to evaluate and assess market opportunity in their academic roles. Whilst the importance of value proposition may be explained to academics and highlighted in commercialisation workshops, the significance of value proposition is sometimes unrealised until later stages. When the venture is progressing through development and difficult decisions must be made, this is when the significance of value proposition is often highlighted. The academic entrepreneur has learned from the commercialisation process that value propositions underpin the unique advantage which allows spin-offs to exploit their technologies as they enter the market:

Definitely the whole idea around value proposition – it is something that is really important especially for investment companies, to have that nailed down. And as a scientist, it is something that you have heard about when you go to workshops, but it is something you never really take the time to sit down and do competitive analysis. And that is something that can really make or break new technologies. (Interviewee 12)

The findings also suggest that academics learn about the concept of minimum viability throughout the commercialisation process. A major inhibitor of spin-off development is the inherent tension academics face between exploring new opportunities, versus exploitation which regards refinement in a particular area. Academics are challenged by their ability to focus their resources and time to their chosen market need, opposed to exploring how the technology can be improved or tinkered with. This root of this issue arises as scientists are not known to share their inventions with their peers within the development and improvement processes, but most likely when the technology is refined and perfect.

To counteract these potential distractions, commercialisation actors introduce the concept of minimum viability to academics. The concept of minimum viability takes the technology to a stage of development where it can be released, even though it is not fully developed and perfect. The importance of minimum viability is often seen when investors and commercialisation actors are often looking to launch a product into the market. This is due to the necessity of speed and the importance of sustaining and securing resources. The academic is able to make further refinements in later versions of the technology as academics cannot be spending multiple years on R&D:

> *The idea of iteration as well, and the whole minimal viable product style of things; as a scientist you particularly don't really want to talk about things until it is perfect. And the ideas of just getting the bare minimum down and out the door is something you struggle with until somebody explains it to you, and say "if you want this to succeed, you have to get something out there and you can't just do R&D for ten years". (Interviewee 12)*

Often in these situations, commercialisation managers have found it to be crucial to emphasise to academics that minimum viable product is essential. This requires the academic to commit to the technology and focus their efforts in producing a concept to a level that will allow the next phase of development to begin. When this is achieved, improvements on the technology can be made at later stages. Commercialisation managers often find they are reassuring academics that the absolute perfection in their technologies are able to be achieved at later stages such as through product versions 3 or 4.

Parallel to the concept of minimum viability is the notion of learning to deal with, and meet development milestones. Given that academics are sometimes inhibited by their ability to achieve technological development to a minimum viable standard, opposed to perfection, commercialisation actors will often create milestones for academics. This ensures that academics are able to achieve minimum viability where resources and funding can be sustained

throughout the venture. The notion of putting milestones in place means that when academics have satisfied the requirements, then they will receive the next round of funding or resources. A commercialisation manager explains:

> *Minimum viable product is key. Not the absolute perfection, because that can come in product version 2, 3 or 4, or it can work in a program that sits alongside them. I think for us, it is agreeing what that end result will be and we try to seek advice from external expertise like KiwiNet or Return on Science to understand what our minimum viable product is. Even if it isn't a product, but getting it to look like one where we understand what it's performance criteria will be and knocking those down and putting milestones in place that aren't about making it look pretty. I think academics are inquiring minds so they will always want to improve on something. (Interviewee 21)*

The initiation of milestones was developed as a pathway to assist scientists in maintaining their focus through the often ambiguous stages of spin-off development. Our findings indicate milestones are often used to incentivise academics. The result is that academic who are tinkering, opposed to focusing, will not achieve their milestone and will thus not be granted their resources. This results in academics learning to integrate milestones into their activities.

The establishment of milestones also holds strategic importance for spin-off development because this enables academics and their spin-offs to receive funding for their venture. Our findings suggest the power in these situations lie with the commercialisation actors as it acts as an insurance policy to ensure all requirements are achieved before large investments are made into academics and their capabilities. A commercialisation manager indicates the basis of milestones is also dependent upon the academics appeared interest in the venture:

> *So money talks often and these investors are paying for the job to get done. So often we won't set up a business - we won't invest in a business until all those things are clear…And if everyone is not brought into that since day 1, we don't write a cheque. (Interviewee 8)*

Our findings highlight university TTO managers to also be supporters in milestones as they have recognised from past experiences the importance of incentivising academics to ensure they are focused in their activities and timelines. Based on this premise, university TTO managers will pay on delivery and cease payment if the academic goes off track:

> *If they don't want to do it, then they won't get paid by us. So we milestone things and that is something we have done much better now than in the past and we will pay on delivery. So we do buy our academic time and consumables and resources. And if it is going off track, we will stop. (Interviewee 21)*

The use of milestones is also evident in the KiwiNet IC meeting process where academics that have been granted funding have milestones set in place. From observation, the IC members unanimously agreed that one particular research project was only to be accepted on the basis that milestones would be established and subsequently achieved. If the IC were dissatisfied with milestone achievement, the project would be disabled.

However, there is potential for academics to choose their research and development activities over the requirement of the milestone if they are unable to adapt. If the academic is uncomfortable with learning about business requirements and funding deadlines, the academic is able to return to their academic work without consequence. The academic may find that they are in trouble with their head of department as this may have been a loss in additional funding, but there is no real consequence to the academic if they were not invested in the spin-off, a commercialisation manager highlights:

> *If you're academics in these start-ups, they know they won't get the next round of funding if they don't hit these milestones which means they can't tinker, they have to just focus. So clearly we have much more control and they have a huge vested interest. And if they are still at university, then that is the trade-off you make, they can say, "well I will do this anyway, no skin off my nose. Might mean I get my head slapped by the head of department, because we didn't come through*

on what you guys wanted", and that is the kind of trade-off. (Interviewee 10)

4.3.2 - Entrepreneurial Attitude

The second subsection within the learning theme is entrepreneurial attitude. As highlighted in section 4.3.1, academics are required to learn new processes and skills in order to be successful in developing a spin-off. Academics have developed new capabilities where they adopt a new attitude to business activities and approach.

Indicated in our findings, scientists have found the importance of tenacity in spin-off development. The findings indicate the importance of tenacity as academics have been attuned to comfort and security from their academic career. Complacency in academia often occurs as scientists are not personally committed to research projects. Besides research grants and department resources, there is no pressure from stakeholders.

To this end, it can be easier for academics to give up on their research projects. However, scientists find that tenacity in spin-offs enable academics to go down particular pathways. Our findings signal that academics develop their entrepreneurial attitude as they are frequently required to step out of their comfort zone and endure challenging periods. From these experiences, academics are often exploring new pathways as they attempt to achieve goals and milestones that have been set for them. The distinctions in these activities can result in academics developing tenacity as they endure these phases and scientists can learn the importance of an entrepreneurial attitude. This academic explains:

> *I'm really kind of convinced from my whole story, the importance of tenacity. And it's incredibly important, and so many other things are considered important, but I think tenacity really is a massive thing… In academia, it is too easy to not be tenacious because you are following your nose and so you think, "oh that's not going to work" so we'll just trot off there. And commercialisation forces you to go to places you might be uncomfortable because you have to go there. (Interviewee 3)*

Moreover to this point, the data suggests that unique skillsets are developed as academics face capability and resource limitations. Given that a venture or an idea may have a set list of requirements that will ensure the project is a success, entrepreneurs should not be disabled by their shortcomings. Despite the fact that academics may not be experts in commercialisation, the academic can find that learning and openness to new experiences are the most valuable aspect. When academics are able to withstand ambiguous situations, and embrace the unknown, this can highlight the lessons they have learned in entrepreneurial experiences. The prospect of failure and success are both opportunities to learn and academics must be resilient and committed in their activities for execution. Moreover, the benefit that is extracted from executing ideas and creating tangible outputs is explained by a scientist:

> *So I can put on a piece of paper - this is what it could look like and this is how we will tackle it and these are the skill sets we need. But that doesn't mean if you're not an expert, and you get an idea and you think, "How can I do this thing", what I say is, "don't let that affect you, or hold you from building that idea". As execution and turning your idea into tangibility is important and makes life worth living, even if it is a loss or a failure, you can learn from it. (Interviewee 6)*

The necessity of tenacity and entrepreneurial drive is also highlighted in a commercialisation manager's perspectives as they find academics that have a positive attitude will drive a spin-off to be successful. Academics that learn to take risks also demonstrate growth and entrepreneurial attitude. Key qualities like academics that are keen and hungry, and have the capacity to learn and absorb new processes are appreciated in spin-off development. The commercialisation actor recognises this to be the bases of a well-functioning spin-off team as these ideals are valued over highly skilled scientists that are untrainable:

> *The best chance for the spin-off is having somebody who will take risks and if I look at our staff, they all have the right attitude. You can teach skill but you can't teach attitude. If somebody wants to learn and is keen and hungry, that beats people who are super skilled and untrainable any day. (Interviewee 10)*

However, university TTO managers recognise that whilst academics may develop an entrepreneurial attitude and are driven to achieve successful outcomes, they are often still grounded by theory that their academic careers have instilled. Our findings indicate this can be a challenge to academics as the requirements of commercialisation can often be conflicting with their academic commitments. In these situations, academics face trade-offs. For example, if academics are faced with research problems where they have the opportunity of solving a real world problem, the requirements within this problem are likely to excite and stimulate the academic. However, problems that are easier to fix, seems less exciting and less motivating according to a university TTO manager:

> *This particular person and a lot of others we work with, they are quite grounded by the theory and the research elements still motivates them. So the things they probably get most excited about are where an opportunity is lined up with a real world problem but it is actually a really difficult problem to solve. And those are the things that seem to be most motivating. If it is something that lines up with a problem but that is a pretty easy fix, then that's not as exciting, it doesn't seem. (Interviewee 11)*

Our results indicate academics have found commitment challenging due to risk and the feeling of insecurity. This occurs as academics can feel isolated in the start-up process as they are in a distinct role to their academic career. When academics are able to overcome these barriers, the respondent finds that this is in part attributable to entrepreneurial intuition. The ability to envision short and long term goals helps academics drive the development of the venture. In these circumstances, a short and long-term mind-set accommodates day-to-day micro-details, whilst keeping the overall spin-off vision in mind. This entrepreneurial attitude of mixed time horizons enable academics to progress through ambiguous development phases. This is evident in the scientist's recount:

> *I think part of it is entrepreneurial intuition, I think one of the things that only some people can do is to keep in mind the big picture and the details at the same time because many of these*

problems are detail, but you have to actually also be looking at that 5, 10, 20 year goal. (Interviewee 15)

In addition, the findings highlight that academics often feel insecure in their capabilities when they are pressured by commercialisation managers and investors. This occurs as academics realise resource shortages yet they must meet deliver their expected targets. This is likely to affect academics whose living and success is dependent on the execution and development of the spin-off venture. Further problems arise as business and technical setbacks begin to inhibit the growth of the venture. Then, this poses a threat to the development timelines and thus threatens the achievement of milestones that academics must meet:

The biggest obstacle is probably when you are in a start-up; you are isolated and you don't have the comfort or cushion of time and money that you did have in academia. You have to deliver something; it has to be done. And if you don't, you won't get any money and you're looking at not making a living anymore. So there is quite a lot of pressure there when you realise how much in this you are on short supplies and you have a whole thing you rely on like delivering things on time and as soon as those things start blowing out, your timeline is put out. (Interviewee 10)

The evidence suggests that academics learn the importance of entrepreneurial commitment as they seek investment to fund the spin-off. Often spin-offs are pre-revenue, which results in seeking investment which will decide whether spin-offs can continue activity, or if they need to seek alternative paths of action. During these ambiguous phases, academics find their future is undetermined, especially for recent PhD graduates who do not have income sources. This subsequently results in anxious academics that doubt their capabilities. The ability to stay with the venture is reliant on entrepreneurial attitude:

It is definitely securing investment; that was a bit of a struggle and a gamble. We decided we would do this pre-incubation phase where they would essentially decide whether or not they want to invest for a three month period and we did that pretty much immediately after I handed in my PhD. So we started in April, working on that for three months but the investment didn't

come through until literally the week before Christmas. So it was a huge amount of time where I was pretty much second guessing myself and having zero income for about 7 months. So it all paid off in the end and that was difficult, that was a huge problem. (Interviewee 12)

In comparison, another respondent experienced stress and anxiety when spin-offs required multiple funding rounds. The academic was not required to invest any personal capital, but the risks appeared later in the venture when promise and delivery were expected from the ventures stakeholders. The need to satisfy stakeholders tests the academics ability to continue their performance, and maintain their entrepreneurial spirit, despite the pressures they face:

I didn't have to put up my own cash and the level of risk when I started was quite low. But now we are playing in a much larger way. If you like in gambling - we are laying much larger bets now and back then the incubator seeded the company with $200k and I think we have raised $2.5m so there are a lot of people who expect results and there is a lot of money riding on our success. So that is a fair bit of responsibility as well. (Interviewee 16)

CHAPTER 5 – DISCUSSION

This study explores the key influencing factors in spin-off development at an institutional, firm and individual level; an area that has received incomplete attention to date (Chau, Gilman & Serbanica, 2016; Soetanto & Jack, 2016). To address this knowledge gap, the research discusses the inhibitors and drivers of academic spin-offs.

This chapter discusses the key findings of this research and links these findings with existing literature in the field of academic entrepreneurship. The first section 5.1 discusses the key influences in spin-off development. It focuses on the iterative inhibitors and drivers at the institutional, firm and individual level. In doing so, this section discusses the significance of our findings in relation to the research question:

What are the key influences in spin-off development?

5.1 - Key Influences in Spin-off Development

Institutional level

The findings suggest that at the institutional level, there is one driver and two inhibitors that are key influences in spin-off development. Firstly, the entrepreneurial university is driven by the need for universities to acknowledge and *implement government policies*. This need arises as universities are increasingly adopting entrepreneurial ideals as triple helix interactions intensify (Etzkowitz et al. 2000). Our research builds on the triple helix literature, as our findings provide evidence to suggest that universities are fostering the 'third mission'. This is reflected in our findings that signal university management like VCs and PVCs support entrepreneurial activities and encourage commercialisation which help legitimise the activity, as seen by university TTO managers and commercialisation managers. University management foster entrepreneurial knowledge transfer as they expect scientists to be incorporating translational activities into their research agendas. This fits with the description that

universities are experiencing increasing pressures to leverage techno-sciences knowledge so contributions to economic development can be achieved (Philpott et al. 2011).

Rasmussen & Borch (2010) posit that in order for universities to facilitate entrepreneurship, they require capabilities that create new paths of action, and balance both academic and commercial interests. We support this as recognised from our study that universities are encouraging commercialisation activities, but they are limited in these proposed capabilities. Firstly, the ability to create new paths of action is dependent on the ability to decouple traditional academic processes so new business opportunities can be achieved (Rasmussen & Borch, 2010). Our findings highlight that universities possess the capabilities that allow academics to explore new business ideas, however, the limitations of these capabilities is that the *traditional norms* of the university challenge spin-off development. The ability to create new paths is limited as academic entrepreneurs and commercialisation actors highlight the need for academics to be incentivised in commercialisation activities. The lack of incentives that acknowledge commercialisation activities result in academics working in a split university culture where, according to our results, approximately 10% of academics are interested in commercialisation (interviewee 2, 8 & 22) and around 10% think it is "the devil" (interviewee 8). The negative effect this may have on spin-off development is supported by the literature as entrepreneurial behaviour is critical to the prosperity of ventures in competitive environments and this success appears to be influenced by culture and the level of environmental dynamism (Walter, Auer & Ritter, 2006). This may in turn reflect the potential competitive advantages given the firms individual resources. Whilst this institutional level discussion regards actors at the individual level, the source of tension occurs from institutional level factors.

The findings indicate that university review mechanisms and culture does not balance academic and commercial interests. Often local cultures like this reject entrepreneurial activity when academics attempt to engage in commercialisation (Lundqvist & Middleton, 2013). Our findings

suggest that academics need to balance their entrepreneurial career with their academic career, but university capabilities are limited in helping scientists find the balance between academic and commercial interests. The ability to achieve balance between various goals of teaching, research and economic development is highlighted as pivotal in the entrepreneurial university (Philpott et al. 2011). The challenges that arise in balancing academic and commercial commitments occur as an academic entrepreneur explained they, "*spent quite a bit of time in [the spin-off] doing company related things but sort of unpaid as part of my university job"* (Interviewee 9). This balance becomes more complex because the combination of research and commercialisation become synonymous with one another and the distinctions are blurred.

Complexities arise as advocates of the norms of open science disagree with sponsors who support commercialisation (Wurmeseher, 2017). This occurs as there are academics in the university eco-system who find that the entrepreneurial ideal is incompatible with university purposes (Etzkowitz et al. 2000). We extend this position as our findings suggest that a portion of academics do not support commercialisation, or are glad other academics are fulfilling entrepreneurial outcomes, but it is not of interest to them. These split perspectives highlight the differences in culture within the university context, complicating the deployment of new review mechanisms and incentives. Whilst these challenges affect academics at the individual level, it is distinct to the institutional level due to the university environment and management capabilities.

The literature indicates that tensions arise as academics believe commercialisation results in secrecy (as a result of IP protection) and pose a threat to the dissemination of new knowledge (D'Este et al. 2013; Jain, George & Maltarich, 2009). We extend this as our findings portray two perspectives on this issue. Firstly, commercialisation actors illustrate their attempts to convince academics that publishing and patenting are simultaneously possible. The second perspective is from the academic as they have found patenting can inhibit their publishing agendas if they are

bound to non-disclosures during IP protection phases. A portion of academics found tensions increased as they were required to negotiate their need for publishing and that it had to be managed in such a way that findings and publishing was possible. This is consistent with the literature where secrecy is sometimes necessary and there are pragmatic concerns regarding timing of patenting (Jain, George & Maltarich, 2009).

Role models were also found to help drive the spin-off process when academics experienced in commercialisation could help fellow scientists. Our findings highlight that role models are academics who are able to share their experiences and transfer commercialisation capabilities. This is consistent with literature that role models can play an important part in spin-off creation (Rasmussen & Borch, 2010). This has proven beneficial when role models are able to mitigate commercialisation misconceptions, and guide academics through ambiguous phases. When there is a lack of internal entrepreneurial role models and absence of wholesome entrepreneurial culture, this adversely affects entrepreneurial efforts (Philpott et al. 2011).

Another key influence is how differences in *capability expectations* inhibit spin-off development. This contributes to spin-off literature because our findings suggest that key spin-off actors like management teams, scientists and investors hold varying perspectives on the capabilities that the respective parties possess. The literature highlights that these stakeholders are critical links in spin-off development (Rasmussen & Borch, 2010). We contribute to the literature as we find that despite these stakeholders' importance, it is unlikely these parties are operating at their fullest capacity given the misunderstandings in expectations and differences in opinion. Whilst it is recognised in the literature that business relationships need to be seized so strategic plans can be enacted (Vohora, Wright & Lockett, 2004), our findings indicate this may be challenged by the differences in expectations. Based on the importance of these stakeholders, their mutual understanding of one another and their expected roles in facilitating commercialisation is important.

In our study, we find that tensions arise as a number of commercialisation managers have found university TTO managers to be lacking or have incomplete commercialisation capabilities. This finding extends the literature that highlights academics are not always benefitted by university TTO assistance (Van Weele, van Rijnsoever & Nauta, 2017). From our findings, commercialisation managers have indicated that the capabilities needed to identify market insight and market applicability is lacking. Our findings suggest that universities are capable of producing scientific results, but the transformation into market outcomes is inhibited by limited commercialisation skillsets.

Additionally, a number of commercialisation managers find academics are also limited in their ability to identify market opportunities. They find academics lack commercial understanding. This is consistent with the literature as Soetanto & Jack (2016) find that academics are typically challenged with market uncertainty and are restricted in their entrepreneurial knowledge. In comparison, our findings provide evidence that some academics have felt as if they were unequal to commercialisation experts as they find they can be "*bullish*" (interviewee 3) and commercialisation actors "*push you around a little bit*" (interviewee 12). This aligns with the literature as the differences that these stakeholders have regarding capabilities are barriers to development (Neves & Franco, 2016). Moreover, these obstacles arise as stakeholders have different objectives, understandings and organisational processes (Millet et al. 2016).

The final key inhibitor is when tensions arise as commercialisation managers feel academics are only needed during particular phases of spin-off development. Our findings suggest that at times some academics have often felt excluded from the decision making process and they can be the last to find out information. The consequences of these actions is the misunderstanding between the spin-off actors regarding each party's motivations and intentions with venture participation. These conflicts contribute to the literature as the entrepreneurial team is not a static concept, and as spin-offs progress through development, the contribution of the founders

typically decline (Colombo, Musary & Wright, 2011). This typically occurs when processes must be institutionalised and longevity of entrepreneurial outcomes is desirable (Colombo, Mustar & Wright, 2010). From our findings, the reason for the founders decline in contribution may be questioned if their lessened involvement is due to the perception from commercialisation actors that their skills are less transferable.

This section discussed the institutional level contributions to the literature. Our findings suggest that entrepreneurial universities are encouraged by VCs and PVCs, but there are restrictions with the traditional norms and incentives within universities. Tensions arise not only with university management, but also department management. As discussed, there are elements of individual level actors within the institutional level of analysis, but the challenges that occur effect these actors because of the institutional environment and context.

Firm Level

Key influences in spin-off development were also recognised at the firm level as *misaligned stakeholders* lead to spin-off *management tensions*. Firstly, this was identified as an inhibitor in venture development because academic entrepreneurs clashed with their commercialisation and university TTO managers. In the findings, these tensions materialised in conflicts where the balance between science and business was not equal within the firm. Specifically, the findings illustrate that academics and commercialisation actors experienced conflict as business and science values clashed. This often regarded timing, focus and market/technology understanding. These tensions are highlighted in the literature as occurrences that arise when academic capabilities need to be complemented with managerial competencies (Miozzo & DiVito, 2016). The inability to align interests and decisions will inhibit the ease and achievement of a dominant market position. We contribute to the literature as our findings suggest these conflicts are likely to cause problems for spin-off development because it leads to miscommunication and lack of synergies. The literature highlights that successful

commercialisation of innovations require complementary assets and alignment between academics and management (Paradkar, Knight & Hansen, 2015). This is unlikely to occur if balance is not realised, and the complexity increases as technology start-ups operate in complex and turbulent environments.

We also find that spin-offs incorporate a variety of actors, depending on the capabilities that are required. Whilst this does add to the complexity and tensions in opinion differences, this enables spin-offs to leverage complementary capabilities and to navigate difficult development phases. This supports the literature, as it is recognised that a variety of capabilities are required to successfully overcome critical juncture points (Vohora, Wright & Lockett, 2004). However, in order for this to be achieved, coordination and flexibility from management is required to overcome ambiguous phases in spin-offs (Bjornali, Knockaert & Erikson, 2016). This is evident in our findings as IP protection has been recognised as a critical phase within spin-off development, and this is often where university TTO managers are able to assist scientists through these phases. Escobar et al. (2017) highlighted the complementary capabilities that university TTOs have by assisting scientists with their managerial limitations, so activities such as patent application is successful. The inclusion of these capabilities is critical to ensure firms make strategic decisions that enable the venture to intentionally grow beyond mere survival, viability and sufficiency (Miozzo & DiVito, 2016).

The variety of actors within a firm contribute to the creation of valuable and rare resources (O'Shea at al. 2005). Due to the unique path and development in which spin-off resources are sourced, firms are able to exploit these resources as they produce value-creating strategies that are inimitable by others (O'Shea et al. 2005). These unique resources are highlighted in spin-off creation as tacit knowledge is engrained in spin-off development as scientists integrate capabilities and resources with commercialisation actors (O'Shea et al. 2005). Scientists often possess the expert knowledge and talent that is necessary for technology to be transferred and

successfully commercialised (O'Shea et al. 2005). Therefore, these resources are much more difficult for other universities and spin-offs to imitate. Finally, O'Shea et al. (2005) found evidence to suggest that the shared involvement between industry (government and commercialisation) parties, with academics may foster unique spin-off emergence given their valuable financial and commercial resources. This influences technology transfer to the marketplace.

Individual Level

The findings suggest that at the individual level, there are two drivers that are key influences to spin-off development. Firstly, academics are required to *learn* and *adapt* their thinking and work style to the requirements of the commercialisation process. This saw academics learning the value of market need and opportunity identification. This is supported by literature that highlights the challenge academics face in market application as they apply commercialisation to a technology focus, opposed to a market-oriented focus (Festel, 2015). This was indicated in our findings as a large number of commercialisation actors often found academics had to learn how to conduct market assessments and opportunity identification. This saw academics adopting exploration strategies to look at technology and market domains to find opportunities (Soetanto & Jack, 2016). We find that learning is a key driver where academics are able to learn about commercialisation processes as they realise the importance in market need where it later provided them with visors and directed their future activities. This is reflected in our findings that show successful spin-offs have scientists that are able to adapt to the necessary requirements that commercialisation managers search for when investing in new technologies. While this is supported in the literature that academics must possess entrepreneurial commitment, it is significant because it offers new insights about what academics are able to learn and in what instances these learning experiences arise. Additionally, from a resource-based perspective, it is the way in which individuals within the firms are able to use value

creating competencies they have obtained that may lead to superior economic positions (Miozzo & DiVito, 2016). This path creation of new learning capabilities is unique to the firm's environment and to the niche market that the technology is a product from (Lubik & Garnsey, 2016). This ensures firms are able to build a sufficient resource base that can assist in creating competitive advantages (Lubik & Garnsey, 2016).

Our findings indicate that when academics were able to transition their focus from research and exploration, to exploiting an identified market need, the day-to-day work changed for scientists. This finding extends, and is significant to the literature because it offers insight regarding how scientists are able to adjust their mindset and work patterns. The literature supports the need for a research idea to be transformed into a commercial opportunity where balance is needed between exploration and exploitation (Walter, Auer & Ritter, 2006). This proved critical as Rasmussen & Borch (2010) identify that resource endowment to spin-offs influence the way that technology transfer occurs, and thus how learning is achieved. Our findings extend this notion as commercialisation actors controlled allocation of resources to influence the academics ability to transition from exploitation activities to exploration activities. Furthermore, as previously highlight, spin-offs are heterogeneous in nature and it is this, opposed to homogeneity that gives each firm its unique character and resource bundling, allowing such capabilities (O;Shea et al. 2005).

Within the entrepreneurial university, this notion of incentivising resources is recognised as milestones. Commercialisation actors have found milestones to be effective in incentivising academics and keeping them focused. Commercialisation actors indicate milestones are effective in ensuring value creation, opposed to just idea initiation. This is evident as university TTOs offer support during development where they incentivise academics to ensure academics are enabling successful technology transfer (Escobar et al. 2017).

Also closely related to milestones is the concept identified in our findings – minimum viability.

The need for academics to achieve minimum viability in their technologies highlights the importance of milestones as academics cannot be conducting R&D for many years. Whilst universities are strong in their R&D capabilities, academics must utilise these skills to the benefit of the spin-off development, opposed to personal research exploration interests (Philpott et al. 2011). The literature finds the necessity for academics to be applying their R&D skills to venture progression because technologies often require speed to development as there are pressures to ensure technologies do not become obsolete (Wu, 2007). We extend the literature as our findings indicate that there is a mindset switch that is required to shorten development time and ensure market position.

The next key influence that is a driver to spin-off development is the academic entrepreneurial attitude and commitment. Academics have learned to be tenacious and accepting of activities outside of their comfort zone as the boundaries of the spin-off have pushed their experiences and increased their commercialisation exposure. This aligns with the literature, highlighting that entrepreneurial attitude is recognised as an important factor in new organisational success (Walter, Auer & Ritter, 2006). Entrepreneurial behaviour is fundamental to the prosperity and development of new ventures, particularly as technology spin-offs are characterised by intense innovative competition (Walter, Auer & Ritter, 2006).

Our findings signify that academics are capable of adaptation when they recognise the venture requires such change, in order to progress to the next stage of development. This supports the literature, which finds when academics are unable to adapt, often their preferences disrupt development processes when their expectations are unrealistic and mental barriers prevent change (Neves & Franco, 2016). Our finding is also in support of Vohora, Wright & Lockett (2004) identification that spin-offs must have entrepreneurial commitment especially during unforeseeable events. This was demonstrated in the scientist's determination and perseverance throughout periods of uncertainty, particularly as spin-offs sought additional funding, or had

uncertainties about the development process. This is highlighted in the need for spin-offs to be able to redesign routines that enable them to adapt to their environmental conditions (Kindstrom, Kowalkowski & Sandberg, 2013; Teece, 2012).

When ambiguous phases in development occurred, entrepreneurial attitude proved critical as nascent ventures are required to make decisions that transform idea creation to value creation (Rasmussen, Mosey & Wright, 2015). We contribute to the literature as we find that scientists became tenacious in the entrepreneurial process and would adapt in complex situations; capabilities they had learned. Scientists learned the importance of market value and how their technologies can be applied to particular applications. Our findings highlight the entrepreneurial attitude of the scientists was critical in ensuring the venture kept progressing to continue growth and satisfy various business elements, gradually contributing to the competitive advantages of the firm. This aligns with the spin-off literature that finds entrepreneurial attitude and tenacity is critical during clinical testing, regulatory processing, manufacturing and distribution (Miozzo & DiVito, 2016). Moreover, this is particularly important to spin-offs as these activities rely on capital funds from investors as spin-offs are not typically progressive in developing revenue streams (Miozzo & DiVito, 2016).

Additionally the literature highlights the resource constraints that academics are likely to face. It is acknowledged that commercially viable opportunities require unique resources that are often lacking to universities and academic entrepreneurs (Bathelt, Kogler, & Munro, 2010). From our findings, academics have adapted to resource constraints and limitations like lack of experience as they identify that entrepreneurial drive and reconfiguration enables these obstacles to be overcome. Finally, as resource bundles are heterogeneous, when universities are in their pursuit of technology transfer, universities and faculty whilst learning, are simultaneously providing technical expertise and resources to their fellow faculty and students, equipping them with codified and tacit knowledge (O'Shea et al. 2005). This knowledge

dissemination to the academic and student community is unique to the technology transfer activities the university is partaking in (O'Shea et al. 2005).

5.2 - Theoretical Implications

This section builds on the institutional theory and addresses the interrelated aspects of culture, tradition and history and how this impacts organisations and its entrepreneurial success. The institutional theory regards the regulatory and cultural influences that guide new entrepreneurial organisations. This has proven critical in this research as academic spin-off development is dictated by governmental drivers and academic entrepreneurs are driven by their university cultural surroundings.

Tolbert, David and Sine (2011) found in their entrepreneurship and institutional theory research that there is a relationship between entrepreneurship and the institutional theory. We find that institutional theory is related to entrepreneurial activity as the university context dictates the drivers and inhibitors that academics and new firms face. This affects the opportunities that academics identify as it is related to their institutions (Bercovitz and Feldman, 2007).

Our research provides a novel lens to understand academic entrepreneurship as we consider various important perspectives within the spin-off context. As the institutional perspective suggests, organisations evolve over time (Bruton, Ahlstrom & Li, 2010) and the various perspectives explored in this study may help understand the nature of these occurrences and how the key actors and environment will shape spin-off development. The perspectives within the spin-off ecosystem may also be particularly influential as institutional theory suggests that legitimacy as the key driver, influences firm resources, survival and performance - all of which are related to the actors in spin-off development (Zhao et al. 2017).

Moreover, the institutional lens has been considered complementary to the RBV as these contemporary positions suggest assessment of strategic action can be undertaken (Zhao et al. 2017). We support this position as the key influences in spin-off development is dictated by the environment and culture, whereby resources and capabilities that academic entrepreneurs have

access to are then obtainable. Our findings support Simeone, Secundo and Schiuma (2016) as they find institutions affect the development of entrepreneurial activities and the ability to create value.

Through the RBV, we have identified that human capital (commercialisation actors), and organisational resources (investment and knowledge) does indeed influence spin-off development. In support of Powers & McDougall (2005) research, we find that the RBV perspective helps understand academic entrepreneurship given the important role of the university as the institution that shapes spin-offs. In addition, we find that the types of resources and resource combinations are influenced from university resources that are available, thus highlighting the significance of entrepreneurial capabilities in facilitating spin-off development.

CHAPTER 6 – CONCLUSION

The aim of this research was to explore the key influences in spin-off development. To do so, it focused on the inhibitors and drivers that occur from three levels of analysis – institutional, firm and individual level.

What are the key influences in academic spin-off development?

a. **What are the inhibitors and drivers at an institutional level?**
b. **What are the inhibitors and drivers at the firm level?**
c. **What are the inhibitors and drivers at an individual level?**

These questions were explored from respondents within the academic entrepreneurship commercialisation context. Data was collected from 25 in-depth interviews with key actors in academic spin-offs (academic entrepreneurs, university TTO managers, business/technology incubator managers, government actors and investors). These interviews were supplemented with direct observations from two full-day KiwiNet Investment Committee Meetings. Data was analysed using a multi-stage coding process which regarded both inductive and deductive analysis, and pattern-matching.

Based on the findings of this analysis, this research makes a significant contribution by exploring the inhibitors and drivers to understand the key influences in spin-off development. Specifically, it was identified that entrepreneurial universities have the support of their top management, but specific university capabilities are lacking that would help minimise the cultural rigidities and barriers that traditional norms present to academics. The inhibitors at the institutional level inhibit aligned capability expectations amongst spin-off actors as they perceive their spin-off counterparts to have varied capabilities and commercialisation knowledge. At the firm level, spin-off management tensions were found to inhibit spin-off development as commercialisation perspectives clashed with academic perspectives.

Imbalances between science and business as well as power struggles facilitated misaligned stakeholder tensions which inhibited cohesive development and understanding. Finally, the individual level of analysis reflected on the entrepreneurial attitude that academics develop, as they learn and adapt to reflect their new environment in spin-off activity.

6.1 - Contributions to Literature

Our work contributes to the emerging body of literature on academic entrepreneurship and the entrepreneurial university. This is achieved as we explore the inhibitors and drivers in spin-off development. As we explored the key influences in spin-off development, our findings are both conceptually and practically important, given the three levels of analysis: institutional, firm and academic.

Firstly, it extends entrepreneurial university literature as we have examined the spin-off and academic entrepreneurs from three levels of analysis. This is important because we find there has been insufficient exploration of how spin-offs develop, taking into consideration the inhibitors and drivers that are the key influences. This is novel as we incorporate a variety of perspectives that contribute to the spin-off eco-system. Thus by providing an in-depth insight into spin-off development, this research sheds light on new venture development and how it is challenged and promoted.

Moreover, this research positions these inhibitors and drivers as interrelated processes. The entrepreneurial university and top management facilitate commercialisation through support, but are limited in their ability to facilitate an entrepreneurial environment and traditional norms present challenges. Similarly, the ability to manage academic and commercialisation outcomes appear to depend on these university management systems and initiatives.

Secondly, by exploring the firm level of spin-offs, we contribute to the spin-of literature as we highlight the complexities that new ventures undergo as they attempt to conform to institutional norms and overcome development barriers. An important implication of this

finding is that the interrelated inhibitors and drivers to the spin-off process are more complex than the literature indicates. Spin-offs experience tension as their variety of stakeholders must be satisfied as various capabilities and knowledge must converge.

Thirdly, these findings also shed light on the academic entrepreneurs in spin-offs. It identifies that academics have the ability to adapt their processes and mindsets to new methods and the success of these outcomes are driven by opportunities that arise, as well as having the necessary support mechanisms to do so. We highlight the tensions that academics face as they experience a changing university environment where local norms are in conflict. An important implication of this finding is that despite these inhibitors, scientists who are interested in commercialisation have created alternative pathways beside the traditional route of excellence.

Existing literature highlights the importance of specific university capabilities in fostering academic entrepreneurship (Rasmussen & Borch, 2010), and understanding university mechanisms and how public policies determine incentives (Toole & Czarnitzki, 2016). Industry partners, investors and governmental support agencies provide access to resources that are necessary for spin-off growth (Rasmussen & Borch, 2010). This is supported in our findings as support initiatives are evident in KiwiNet where industry and government resources are leveraged to facilitate academic entrepreneurship.

In terms of understanding university mechanisms, Van Geenhuizen & Soetanto (2009) illustrate that a university culture with insufficient incentives will constrain start-up and early growth phases of the venture. More recently, Escobar et al. (2017) find that scientists may be more interested in the research itself opposed to 'quantity' of outputs produced. To this end, they find that a potential solution could be to incentivise academics with monetary means that fulfil extrinsic motivations. This signals that the drivers within universities where academics are encouraged by VCs, may be negated by the inhibitors that arise from the traditional norms.

However, literature also highlights that whilst the capabilities that universities develop may cause inhibitors during spin-off development; their capabilities are path dependent and in some ways intertwined to the external sources of the university (Rasmussen & Borch, 2010). Similarly, this study finds that universities feel much more of an obligation to be conducting commercialisation activity, but their requirement of satisfying a variety of stakeholders like academics, and external government and society stakeholders make this complex. For example, universities attempt to fulfil government initiatives of commercialisation, but not all of their internal academic stakeholders are interested in fulfilling this mission. This highlights the heterogeneity and context of spin-offs because academic participation in spin-offs differs. Not all academics will leave their university position, and some academics will split their time.

Collectively, this is important because the findings imply that the inhibitors and drivers within the entrepreneurial university result in academics having to make trade-off decisions. Consequently, the implementation of entrepreneurship and ways in which trade-offs can be mitigated is dependent on university culture, structures and rules of the institution (Escobar et al. 2017). This affects the individual level factors like motivations and intentions of academics in commercialisation (Escobar et al. 2017). Therefore, our research suggests that academics must be incentivised and motivated to engage in commercialisation, just as they are incentivised to conduct publication work. Universities must continue to evolve and react to the triple helix developments, and adjust their nature to align with internal and external eco-systems. This contributes to theory building by better understanding management in entrepreneurial universities and academic participation in commercialisation.

As the institutional perspective suggests, organisations evolve over time and adopt industry tradition where institutions develop expectations that are deemed appropriate actions for firms (Bruton, Ahlstrom & Li, 2010). In practice, however, the overall similarity between university management where commercialisation is not incentivised may depict universities conformity.

As Etzkowitz (2011) identify that the core competency of the university has extended to some business functions, this may be extended if universities are able to create more compelling justification for commercialisation participation. This is reinforced as the academic entrepreneurs decision making framework is guided by their attitude towards external actors like commercialisation actors, and their attitude towards unexpected and ambiguous events (Maine, Soh & Dos Santos, 2015).

The attention turns to the spin-off actors; their misaligned expectations and understandings of the academic entrepreneurship context must be managed. Our research provides insight to which our respondents have varied perspectives on the same topic. Industry interaction between academics and commercialisation actors has found to be misaligned where tensions arise whilst commercialisation actors attempt to facilitate commercialisation. This regards academics and commercialisation managers finding that capabilities are limited from one another. We have shown how their alignment in the commercialisation eco-system is necessary, yet perspectives and expectations often differ.

Related to this, Rasmussen & Borch (2010) find that universities require specific capabilities that enable the spin-off process so conflict is avoided with other university stakeholders. Perhaps misaligned expectations arise as universities do not possess the specific university capabilities that enable the spin-off process. Bruneel, D'Este & Salter (2010) find entrepreneurial activities can be fostered through university-industry interaction which can build trust. However, scholars have argued that tensions can arise when academics have a lack of entrepreneurial understanding; there is a lack of entrepreneurial culture and an insufficient academic promotional model that may not reward academics (Philpott et al. 2011). Given that these are facets evident in our research, this may suggest that this affected academics ability to appropriately build trust.

Our final focus is on the tensions that arise during venture development as academics must

adapt their approach to the commercialisation context. The research also sheds light on the importance of academics learning how to adapt and incorporate commercialisation activities into their research. This research demonstrates that spin-off development is enabled when academics learn, adapt and adopt an entrepreneurial attitude. The adoption of an entrepreneurial attitude can be understood through Jain, George & Maltarich (2009) contribution that role identity helps understand academics decision making. Based on their distinction between supply side and demand side of opportunity identification, we extend the literature as we find that characteristics of supply and demand side are simultaneously evident in the respondents of our research. For example, academics have experienced demand side characteristics where contextual activities of external government drivers encouraging commercialisation have led to their entrepreneurial activities. Similarly, supply side explains why some academics can recognise entrepreneurial opportunity better than other academics. However, our findings show that these are interrelated facets as academics identify opportunities and have an entrepreneurial attitude, but this is enabled by drivers of commercialisation that support these activities and top university management. To this end, we identify that the contextual conditions in demand side help shape the entrepreneurial attitude of academics from the supply side. As stated earlier, this highlights the interrelated aspects of commercialisation and the institutional drivers flow on to effect spin-offs at this individual level.

6.2 - Managerial Implication

Based on these findings, this research points to a need for actors within the spin-off context (scientists, university management, university TTO managers, commercialisation managers and government actors) to consider these key influences at the institutional, firm and individual level. This research suggest that university management should consider the consequences and inhibitors that may arise as traditional norms of the university are still prevalent and dominating over commercialisation. Whilst top management encourages commercialisation, these consequential inhibitors that occur throughout spin-off development are interrelated to

the entrepreneurial university. Our findings highlight that in order to combat inhibitors at the institutional level, universities should make it clear to academics if there is the possibility of returning to academia post-spin-off development, or at a time the academic chooses. This helps mitigate the mental barriers that academics develop, as they find the academic promotional model can professionally punish academic entrepreneurs (Philpott et al. 2011). A part of this issue is the review mechanisms within universities as our findings highlight the current culture of universities value traditional methods of excellence, and the lack of commercialisation incentives inhibit the adoption of commercialisation. This requires universities to change mindsets and to develop mechanisms that highlight the complementarity between publishing and patenting. By demonstrating to scientists that there is room for both activities, this may minimise the perception that commercialisation requires trade-off decisions to be made.

In addition, university management should also consider cultural change at the department level. Our findings suggest that department managers have judged academic entrepreneurs and do not understand their commercialisation activities, yet are performance evaluated by these individuals. To progress the entrepreneurial university and adoption of entrepreneurial activity, the cultural barriers and misunderstandings within departments must be mitigated. University management should consider carefully how they can best add value to commercialisation participation and increasing the acceptance of entrepreneurial activity.

Closely related, our research encourages university TTO managers to pay close attention to the relations and understandings with their investor counterparts. Specifically, managers may need to ensure their market assessments are aligned with investor expectations, to mitigate differences in perspective between university TTO managers and investor/commercialisation managers.

For scientists, our findings point to a need for experienced academic entrepreneurs to transfer their knowledge with potential academic entrepreneurs. The purpose of role models within

commercialisation is as experienced academics are able to mitigate the misconceptions academics may have, as well as contribute to a shift in mindsets and local cultures. Through these channels, academics may be more prepared to undertake entrepreneurial ventures as their actions are guided by others in similar situations. The knowledge transfer of experience and entrepreneurial knowledge may also minimise the negative perception that commercialisation managers hold about academics' capabilities in commercialisation.

Our findings suggest there is a mismatch in expectation with commercialisation managers and academics as scientists have at times felt undermined, micro-managed and powerless against their commercialisation counterparts. To help minimise these issues, we suggest that the level of involvement - from both the commercialisation team and academic team - must be understood. Commercialisation managers should ensure they clearly understand the expectations and motives of the scientists a part of the venture. For spin-offs that will encompass continual/desired input from scientists, these expectation understandings may help balance the power and control.

Balance must also be extended to the decisions that are made regarding market launch and development time. Our findings offer significant insight to the tensions that arise as academics and commercialisation actors disagree on time management.

6.3 - Future Research and Limitations

This research is an exploratory attempt to recognise the key influencing factors in spin-off development. A logical extension to this research would be to examine the role that government, (MBIE) and industry (firms) play in spin-off development. Existing literature identifies the importance of the triple helix on entrepreneurial activity (Philpott et al. 2011). It is recommended that future research explore how these two stakeholders influence the institutional, firm and individual level, to understand how they inhibit or enable spin-off development. Moreover, given the heterogeneous findings regarding technology and spin-off

development, research exploring the influence of stakeholders prior to spin-off creation may be fruitful.

There are several limitations of this research that future research could address. Firstly, this research draws on the perspectives of scientists, university TTO managers, commercialisation managers and government actors. Although this approach provided rich contextual data, future research could explore these perspectives from a process-oriented perspective to narrow the focus on the development process and when exactly inhibitors are likely to arise. By capturing these specific micro-processes that occur throughout spin-off development, understanding may be achieved of how various parties perceive barriers to be overcome.

There is more room to integrate university management perspective - from VC to department managers, to understand the local barriers that arise in spin-off development. For the entrepreneurial university to be successful, understanding is required on how all stakeholders can be satisfied and where attention must be paid. Moreover, a better understanding is required on how the various stakeholders involved in spin-off development are able to better align their interests to minimise misaligned perceptions and expectations.

In conclusion, the purpose of this research was to explore the key influencing factors in spin-off development, to shed light on the inhibitors and drivers that occur. This research illustrates key influencing factors at the institutional, firm and individual level and helps spin-off actors to recognise the inhibitors and drivers that are likely to occur from a range of sources. By exploring these factors from a variety of perspectives, the current research provides notable insight into the key influencing factors in spin-offs and the academic entrepreneurship context.

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APPENDICES

Appendix 1: Invitation Email to Participants

Subject: Initiation for interview: Academic Spin-off Research

Dear _____,

My name is Josephine Tan and I am a Master of Commerce student in Management at the University of Otago in Dunedin.

My area of research is the entrepreneurial activities of universities and research scientists. I have a particular interest in researching academic spin-offs, how they grow, what strategic capabilities are involved and what challenges are encountered at different stages of their development.

I am interested in speaking with research scientists who are involved in academic spin-offs or who are involved in academic entrepreneurship activities more generally, as well as commercialisation experts involved in this space.

To this end, I am contacting you to see if you would be willing to participate in my research. Given the context, I believe your experience and knowledge in this area as the ____ would make a really valuable contribution to my research.

Your participation in this research would involve an interview with me (either in person or by phone) for no more than one hour. I am looking to complete all interviews before the end of February. An official information sheet and consent form would be supplied to you in advance of this interview.

Please note that ethical approval (D16/410) for this study has been received from the University of Otago.

Yours Sincerely,

Josephine Tan
Master's Candidate
Department of Management, University of Otago
josephine.tan@otago.ac.nz
Mobile: +6420 403 880 45

Please feel free to contact me or my supervisor with any questions you may have.

Dr Conor O'Kane
Department of Management
conor.okane@otago.ac.nz

Appendix 2: Information Sheet

Reference Number: *D16/410*
January 2017

The Role of Dynamic Capabilities in Academic Spin-offs

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?

This project is being undertaken as part of Josephine Tan's Master of Commerce thesis. The study examines how dynamic capabilities are manifested in the initiation and development of academic spin-offs. Semi-structured interviews will be conducted to understand the dynamic capability development of key spin-off actors.

What Types of Participants are being sought?

This research seeks participants with knowledge and/or experience of the spin-off process. Specifically we seek participation from spin-off management teams (academic entrepreneurs), Research & Enterprise Directors and Technology Transfer Directors across all eight New Zealand Universities - University of Otago, University of Auckland, University of Canterbury, Auckland University of Technology, Victoria University, University of Waikato, Massey University and Lincoln University.

It is anticipated that 30 participants will be interviewed. At the completion of the project, the participants will be notified and they will have access to reading the thesis.

What will Participants be asked to do?

Should you agree to take part in this project, you will be asked to participate in an interview lasting approximately 60 minutes. During this interview, you will be asked for your personal experiences and knowledge with the spin-off development process.

This project involves a semi-structured, open-questioning technique. The general line of questioning will focus on the strategic capabilities used throughout the spin off development process. The exact nature of questions which will be asked have not been pre-determined in

advance, but will depend on the way in which the interviews unfold. The interview questions are attached.

What Data or Information will be collected and what use will be made of it?

The data collected will be used to inform an understanding of the strategic capabilities that influence the spin-off development process. This data is being collected for research purposes only and will not be used for commercial purposes.

This project involves both structured and open-questioning techniques. The general line of questioning includes strategic capabilities used during the spin-off process. The precise nature of the questions that will be asked have not been determined in advance, but will depend on the way in which the interview develops. In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s).

The interview will be audio recorded and the recording will be used solely for research purposes in referring back to the responses to the participants made. The data collected will be securely stored in such a way that only those mentioned below 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 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.

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 your anonymity. You will not be named or identified in subsequent reports or outputs and only Josephine Tan will know of your involvement in this research. The results will also be provided to each participant at the conclusion of the study if preferred.

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.

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:-

Josephine Tan

Department of Management

University Telephone: (03) 479 8133

Email: josephine.tan@otago.ac.nz

Dr *Conor O'Kane*

Department of Management

University Telephone: (03) 479 8121

Email: conor.okane@otago.ac.nz

This study has been approved by the Department stated above. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics 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.

Appendix 3: Consent Form

Reference Number: *D16/410*
January 2017

The Role of Dynamic Capabilities in Academic Spin-offs

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. Personal identifying information (e.g. audio recordings from MP3 files) 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;

4. This project involves both semi-structured and open-questioning techniques. The general line of questioning includes strategic capabilities used in the spin-off development process. 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.

5. 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.

I agree to take part in this project.

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

.....
(Printed Name)

Appendix 4: Interview Schedule

Theme	Question	Follow-up Questions
Starting	1. Could you tell me about any spin-offs you have been a part of?	What motivates you to commercialise research results?
	2. What is/was your role with _____?	
	What stages has _____undergone to transform it from an idea into a commercial venture?	What was the initial development point for the spin-off? Who were the key people involved? What capabilities have those people bought? When were these people essential to the development of the spin-off?
Understanding	3. What are the most challenging stages that has currently undergone in the pursuit for commercialisation?	Can you give me any examples of obstacles you have faced? In the venture developing? In terms of networking, or relationships, or strategy How did you overcome these obstacles? What did you do to progress from one stage of the spin-off development to the next? What do you think will challenge you in the future? How do you think you will need to change/adapt?
	4. What were some of the key decisions made throughout the development?	How do you think capabilities and skills changed/developed?
Development	5. What challenged you as an academic coming into this commercialisation environment?	Where do you think your limitations were?
	6. What do you think are the critical success factors that ensure _____will grow, survive and continue to make revenue?	What are the capabilities that spin-offs struggle to obtain or access?

		Is there a stage in the spin-off process where capabilities develop or change significantly?
Spin-off	7. What is the status of the spin-off? Where do you categorise its development or growth?	What are the ambitions for your company? What are the ambitions in terms of growth? Have your objectives changed much?
	8. What outside parties were/are involved in your company?	What capabilities did they bring to the team? What capabilities/skills are lacking? How were these relationships managed? Did any problems occur?
	9. How do you stay in touch with what is happening in your area of research and industry?	How do you know you have a competitive edge against others in the market? How do you handle new competitors?
	What capabilities/resources do you think that government agencies bring to the development of academic spin-offs?	
	What capabilities/resources do you think that industry parties bring to the development of academic spin-offs?	
	10. Do you have any plans for future spin-offs?	Have you had any results that could have been spin-offs, but it didn't happen?
	11. Could you tell me what the importance of academic entrepreneurship is to you?	Why do you think spin-offs are important for entrepreneurial universities? What value do you think spin-offs bring?
	Recommend appropriate participants	

Appendix 5: Sample Excerpts from Direct Observation Notes

Excerpt one: taken from 30/03/17

… *The IC provides guidance on the processes the start-up needs to undertake: the entrepreneurs need to be able to quantify and confirm numbers opposed to assumptions based on lab work so the IC can be ensured they are still tracking economic viability. The IC explains that the entrepreneurs need to ensure their activities and focus is in the big markets as that is where the attraction for investment comes from and where they would invest. The IC want to see different verticals of analysis. By vertical, they mean other side avenues that have potential. The IC says they answered the need, but what is the difference?*

Excerpt two: taken from 10/05/017

… The purpose of the emerging innovator fund is to encourage and facilitate entrepreneurship and personal development. If something technical comes out of it that is just a bonus. But the focus is on commercial personal development. IC: have you learned any more commercialisation concepts? Have you thought about design thinking? Do you know what I mean by design thinking? The IC would like to know your own personal learnings and any developments you have noticed. We are not just focused on the technical development, but what you have learned from these experiences

Appendix 6: Interview Protocol

1. Research Question

What are the key influences in academic spin-off development?

a. *What are the inhibitors and drivers at an institutional level?*
b. *What are the inhibitors and drivers at the firm level?*
c. *What are the inhibitors and drivers at an individual level?*

2. Interview Documents

Information form(Appendix 2) & Consent form (Appendix 3)

3. Interview Checklist

Pre-interview

- Check interview timetable to clarify date, phone number and time
- Consent forms (emailed ahead of time)
- Information sheet (emailed ahead of time)
- Questionnaire
- Digital voice recorder and backup
- Pens
- Notepad
- Check digital voice recorder storage space
- Check digital voice recorder batteries and sound quality of venue
- Review interview questions

During interview

- Greet and thank
- Ask for consent to record (remind of confidentiality)
- Start recorder
- Provide participant with information and consent form
- Briefly go through information sheet
- Ask if any questions
- Ask to sign consent form

Post interview

- Transfer voice recording to computer; label: [yymmdd]_[participantname].mp3
- Backup voic recording to GoogleDrive
- Type up any paper notes from interview
- Transcribe interview
- Email participant to thank

4. Interview schedule

See appendix 4

Appendix 7: Ethical Approval Documents

Ethical Approval Application

Form Updated: September 2016

UNIVERSITY OF OTAGO HUMAN ETHICS COMMITTEE APPLICATION FORM: CATEGORY B

(Departmental Approval)

Please ensure you are using the latest application form available from: http://www.otago.ac.nz/council/committees/committees/HumanEthicsCommittees.html

1. University of Otago staff member responsible for project:
O'Kane Conor Dr

2. Department/School:
Management, School of Business

3. Contact details of staff member responsible *(always include your email address)***:**

Conor.okane@otago.ac.nz; ph: 479 8121

4. Title of project:

The role of dynamic capabilities in academic spin-offs

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

Staff Research	[redacted]**nes**	
Student Research	[redacted]**nes**	Josephine Tan
Level of Study (e.g. PhD, Masters, Hons)		Master of Commerce
External Research/ Collaboration	**Names**	
Institute/Company		

6. When will recruitment and data collection commence?

December 2016 onwards

When will data collection be completed?

March 2017

7. Brief description in lay terms of the aim of the project, and outline of the research questions that will be answered (approx. 200 words)**:**

Drawing on the dynamic capabilities perspective, this study examines how dynamic capabilities are manifested in the initiation and development of academic spin-offs. Academic spin-offs are a form of academic entrepreneurship where knowledge from R&D spill-over and stimulate innovative activities (Algieri, Aquino & Succuro, 2013). Spin-offs contribute to national and regional economies and are an important avenue for knowledge transfer in universities.

We adopt a process oriented approach to understand how dynamic capabilities are developed and deployed by academic entrepreneurs in New Zealand based academic spin-offs. Dynamic capabilities (Teece et al. 1997) explore three main classes (sensing, seizing and reconfiguring). Emerging literature indicates dynamic capabilities provide a valuable lens with which we can understand spin-offs (Rasmussen & Borch, 2010; Soeanto & Jack, 2016). The fundamental question of this project is therefore to explore how strategic sensing, seizing and reconfiguring dynamic capabilities influence the initiation and development of academic spin-offs.

The research will contribute to emerging literature on dynamic capabilities in entrepreneurial universities (Leih & Teece, 2016; Yuan et al. 2016). This research will also provide practical implementations for managers to better achieve spin-off success.

8. Brief description of the method:

Semi-structured interviews will be conducted to explore what, and how dynamic capabilities are used in spin-offs. Participants will be chosen based on their availability and experience of spin-offs. It is anticipated that participants will include the spin-offs management team (academic entrepreneurs), Research & Enterprise Directors and Technology Transfer Directors across all eight New Zealand Universities - University of Otago, University of

Auckland, University of Canterbury, Auckland University of Technology, Victoria University, University of Waikato, Massey University and Lincoln University.

The student will approach participants via email and then arrange a suitable time for the interviews to take place. It is expected that the interviews will last approximately 60 minutes. Each interview will be recorded with participant consent. The interviews will be analysed with a thematic analysis through NVivo.

The general line of questioning will focus on the capabilities the actors used and the capabilities that are perceived as being important throughout the spin-off development process. Participants will be made aware of the open ended questioning technique and if at any time the participants feel hesitant or uncomfortable, they have the right to decline to answer any particular question(s).

Data will be stored in a safe and secure manner where only the researcher and supervisor have access to it. Hardcopies, audio recordings and external storage media (e.g. USB sticks) will be stored securely in the Department of Management and access to computer files is restricted by password protection.

At the end of the project, any personal information regarding the participants will be destroyed immediately. As required by the University's research policy, any raw data from the research will be retained in storage for five years, after which it will be destroyed.

9. Disclose and discuss any potential problems and how they will be managed:

We do not anticipate any problems. A consent form will be used in each interview for every participant and they will be made aware of the fact the interview will be audio recorded. The participants will remain anonymous in any written form and the raw data will remain confidential. Only the named researcher will have access to the raw data (e.g. audio recordings from MP3 files).

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

Name (please print): …….

Date: .....

**The signatory should be the staff member detailed at Question 1.*

ACTION TAKEN

☐ Approved by HOD ☐ Referred to UO Human Ethics Committee

☐ Approved by Departmental Ethics Committee

Signature of **Head of Department: .....

Name of HOD (please print): …….

Date: .....

**Where the Head of Department is also the Applicant, then an appropriate senior staff member must sign on behalf of the Department or School.

Departmental approval: *I have read this application and believe it to be valid research 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 approval and consent for the application to be forwarded to the University of Otago Human Ethics Committee (to be reported to the next meeting).*

References used in this application

Algieri, B., Aquino, A., & Succurro, M. (2013). Technology transfer offices and academic spin-off creation: The case of Italy. *The Journal of Technology Transfer, 38*(4), 382-400.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic management. Strategic management journal. 18(7), 509-533

Rasmussen, R., & Borch, O. J. (2010). University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities. *Research Policy*, *39*(5), 602-612.

Soeanto, D., & Jack, S. (2016). The impact of university-based incubation support on the innovation strategy of academic spin-offs. *Technovation*, *50-51*, 25-40.

Leih, S., & Teece, D. (2016). Campus leadership and the entrepreneurial university: A dynamic capabilities perspective. *The Academy of Management Perspectives*, *30*(2), 182-210.

Yuan, C., Yang, L., O Vlas, C., & Peng, M. W. (2016). Dynamic capabilities, subnational environment, and university technology transfer. *Strategic Organisation*, Vol. no., 1-26.

IMPORTANT NOTE: As soon as this proposal has been considered and approved at departmental level, the completed form, together with copies of any Information Sheet, Consent Form, recruitment advertisement for participants, and survey or questionnaire should be forwarded to the Manager, Academic Committees or the Academic Committees Administrator, Academic Committees, Rooms G22, or G26, Ground Floor, Clocktower Building, or scanned and emailed to either gary.witte@otago.ac.nz. or jane.hinkley@otago.ac.nz

INFORMATION SHEET TEMPLATE: NOTES FOR APPLICANTS
(Delete all notes and prompts before providing to Human Ethics Committee)

The template on the following pages is a guide for providing information to potential participants before they agree to take part in the research project. Not all of the suggestions or headings on this template will necessarily apply to all projects. Delete those that do not apply and/or make the necessary amendments. An Information Sheet is written in the form of a customised letter of invitation to each target group of research participants. It must contain all the information they need in order to make an informed decision about whether or not they wish to participate in your research. What are they asked to do? What will they experience?

An Information Sheet is expected to be submitted with the application for ethical approval in all Category A applications and most Category B Reporting Sheets. The Information Sheet template can be used as a prompt for a cover letter introducing the research even in cases where a formal written Consent Form is not used, e.g. an anonymous survey.

The Information Sheet should be written in simple, clear language (free from jargon and technical terms) that is age and culture appropriate for your participants, so that they can fully understand what they will be doing and experiencing. This is the principle of Informed Consent.

The Information Sheet you submit with your application should be the final version you intend to provide to your participants. All traces of the prompts in italics from the Human Ethics Committee to the researcher should be removed and it should be carefully proof-read for spelling, grammar and formatting.

Reference Number: *D16/410*
January 2017

The Role of Dynamic Capabilities in Academic Spin-offs

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?

This project is being undertaken as part of Josephine Tan's Master of Commerce thesis. The study examines how dynamic capabilities are manifested in the initiation and development of academic spin-offs. Semi-structured interviews will be conducted to understand the dynamic capability development of key spin-off actors.

What Types of Participants are being sought?

This research seeks participants with knowledge and/or experience of the spin-off process. Specifically we seek participation from spin-off management teams (academic entrepreneurs), Research & Enterprise Directors and Technology Transfer Directors across all eight New Zealand Universities - University of Otago, University of Auckland, University of Canterbury, Auckland University of Technology, Victoria University, University of Waikato, Massey University and Lincoln University.

It is anticipated that 30 participants will be interviewed. At the completion of the project, the participants will be notified and they will have access to reading the thesis.

What will Participants be asked to do?

Should you agree to take part in this project, you will be asked to participate in an interview lasting approximately 60 minutes. During this interview, you will be asked for your personal experiences and knowledge with the spin-off development process.

This project involves a semi-structured, open-questioning technique. The general line of questioning will focus on the strategic capabilities used throughout the spin off development process. The exact nature of questions which will be asked have not been pre-determined in advance, but will depend on the way in which the interviews unfold. The interview questions are attached.

What Data or Information will be collected and what use will be made of it?

The data collected will be used to inform an understanding of the strategic capabilities that influence the spin-off development process. This data is being collected for research purposes only and will not be used for commercial purposes.

This project involves both structured and open-questioning techniques. The general line of questioning includes strategic capabilities used during the spin-off process. The precise nature of the questions that will be asked have not been determined in advance, but will depend on the way in which the interview develops. In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s).

The interview will be audio recorded and the recording will be used solely for research purposes in referring back to the responses to the participants made. The data collected will be securely stored in such a way that only those mentioned below 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 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.

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 your anonymity. You will not be named or identified in subsequent reports or outputs and only Josephine Tan will know of your involvement in this research. The results will also be provided to each participant at the conclusion of the study if preferred.

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.

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:-

Josephine Tan

Department of Management

University Telephone: (03) 479 8133

Email Address: josephine.tan@otago.ac.nz

Dr *Conor O'Kane*

Department of Management

University Telephone: (03) 479 8121

Email Address: conor.okane@otago.ac.nz

This study has been approved by the Department stated above. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics 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.

Reference Number:
D16/410
January 2017

The Role of Dynamic Capabilities in Academic Spin-offs

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. Personal identifying information (e.g. audio recordings from MP3 files) 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;

4. This project involves both semi-structured and open-questioning techniques. The general line of questioning includes strategic capabilities used in the spin-off development process. 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.

5. 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.

I agree to take part in this project.

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

.....
(Printed Name)

Projected Interview Schedule

Theme	Question	Follow-up Questions
Starting	Could you tell me about your role as a commercialisation manager?	
Understanding	Could you explain the general spin-off process?	What stages are involved? How long does each stage typically take? What are some of the critical decisions made throughout this process? Who makes these? Do you see a typical development process for spin-offs?
Development	What are the biggest challenges spin-offs are likely to face?	What stages are these challenges most likely to be at? From your experience, how did the spin-offs overcome these obstacles?
Capabilities	What do you think are the critical success factors in spin-offs?	What are the capabilities that spin-offs struggle to obtain or access? How do you think spin-offs core capabilities change/develop over time?
Strategy	How do you think spin-offs maintain their relevancy?	How do you think they stay competitive?
External	How does the university effect the development of spin-offs?	
Spin-off specific	What was the initial development point for the four Otago spin-offs? (Pacific Edge, Photonic Innovations, Ubiquitome, Upstream Med Tech)	Did the academics intend for a spin-off to develop? Were the academics pursuing commercialisation activities? Have they had any entrepreneurial experience previously?

		Do you think these academics consider themselves to be entrepreneurs?

Theme	**Question**	**Follow-up Questions**
Starting	Could you please tell me about your area of research?	Did this transform into a spin-off? What was your idea? Very broadly, how did this spin-off come to be? Who were the key people involved?
	What is the importance of academic entrepreneurship to you?	To what extent was the spin-off an intended outcome?
Definition and context *Purpose: understanding contextual setting*	Could you please explain why you think spin-offs are important in the context of emerging entrepreneurial universities?	What value do you think they deliver?
	Could you please explain to me what you think are the critical success factors of your spin-off?	Why are these particular features essential?
Spin-off specificity *Purpose: understanding this particular organisation/individual*	Could you please explain to me a bit about the NZ *relevant* industry and how your spin-off fits into it?	
	What is the status of your spin-off?	Do you see your spin-off as a market-leader in your field? What are your ambitions and timeline expectations for growth etc?
	Could you please explain what the main activities for your management team are?	Is there overlap between the various divisions? What are the responsibilities that you have? What are the essential roles that have to be fulfilled?

	Can you please explain how your spin-off was developed? *What helped you progress from one stage to the next?*	What stages were involved from initiation to commercialisation? What were the key challenges in each stage? Why do you think you were able to progress to that next stage? How did you manage these challenges or new comings? What new skills and capabilities do you see personally and team wise that you didn't before?
Process of growth/change *Purpose: Understanding the development and progression through the various stages*	Can you think of any obstacles you faced throughout the development process of your spin-off?	Do you think these were situations you felt were turning points? How did you adapt to those situations? What do you think was the most challenging stage for your spin-off development?
	Did your team composition limit or challenge your ability in attracting external investment and recognition?	
	Did you go through a university affiliated incubator or TTO process?	How did this assist the spin-off creation process? What skills and capabilities can you dedicate to the incubator/TTO? Did you find you were able to overcome barriers that were hindering innovative activities?

	At the time of your organisational inception, what were the industries conditions?	In terms of competitors? Did you do competitive mapping? How do you stay in touch with what is happening in your area of research and industry? How do you know you have a competitive edge? What about in terms of governments and policy? University regulations – what inside the institution helps or hinders you? How have these changed over time?
	How did your organisation distinguish itself from other competitors at the time of inception?	How does it now?
	In terms of your objectives, what have you achieved?	How did you ensure these objectives were achieved? Have your objectives changed much? What are you hoping to achieve?
Relationships & stakeholders *Purpose: Understanding what capabilities were required to achieve this*	What outside parties were/are involved in your spin-off?	How did you manage these relationships? These problems? Did you actively search for new relationships?
	Can you please explain the internal team make-up?	How has this developed or changed? What capabilities do these team members bring?
	How will your organisation maintain relevance?	How do you stay up to date with changes in your industry?

	What value do you bring to the spin-offs development? What skills are you lacking?	How challenging do you think this will be?
Future opportunities	How do you identify opportunities?	What do you think you will need to do to identify opportunities in the future? To what extent does the external environment determine your decision to enact upon opportunities?
Learning activities	How do you balance new opportunities and R&D with exploiting current activities?	What challenges do you find in exploring new possibilities and exploiting what you are currently doing? *For example: exploring new possibilities could be R&D to look at entering new markets, whereas exploiting could be refining your current processes to be more efficient.*
	How do you share knowledge throughout your organisation?	Is it important to transfer knowledge?

Initial Ethics Letter

D16/410

Academic Services
Manager, Academic Committees, Mr Gary Witte

16 December 2016

Dr C O'Kane
Department of Management
Division of Commerce
School of Business

Dear Dr O'Kane,

I am writing to let you know that, at its recent meeting, the Ethics Committee received a copy of the Reporting Sheet relating to your Category B ethics proposal entitled "**The role of dynamic capabilities in academic spin-offs**".

For your future reference, the Ethics Committee's reference code for this project is:- **D16/410**.

The Committee appreciates that Category B proposals may commence as soon as approval has been obtained at departmental level and that, in some instances, the research or teaching may be well advanced or even completed by the time the Reporting Sheet is received by the Committee.

In the case of this particular proposal (**D16/410**), the Ethics Committee has recorded its status as **Approved HOD** , and has asked me to pass on it's views to you as follows:-

Consent Form

The Consent Form needs to be reviewed. Please delete the template prompt at the top "[Delete any clauses that are not required and ensure the numbering is correct]", which is an instruction for the researcher, and please ensure the items are numbered consecutively.

Where the Committee has commented, a written response is expected. Where any amendment to your documentation has been requested, please provide a copy of the amended documentation to attach to the record of the application. Please note that the Committee is always willing to enter into dialogue over the points made.

Yours sincerely,

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

c.c. Professor S Grover Department of Management

Confirmed Ethical Approval Letter

D16/410

Academic Services
Manager, Academic Committees, Mr Gary Witte

17 January 2017

Dr C O'Kane
Department of Management
Division of Commerce
School of Business

Dear Dr O'Kane,

I am writing to confirm for you the status of your proposal entitled "**The role of dynamic capabilities in academic spin-offs**", which was originally received on December 7, 2016. The Human Ethics Committee's reference number for this proposal is **D16/410**.

The above application was Category B and had therefore been considered within the Department or School. The outcome was subsequently reviewed by the University of Otago Human Ethics Committee. The outcome of that consideration was that the proposal was approved.

Approval is for up to three years from the date of HOD approval. If this project has not been completed within three years of this date, 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

Appendix 8

Codes for Data Analysis Stage 3

Pressures to be impactful	Institutional	
Academic norms	Institutional	
Mindsets	Institutional	
Work balance	Institutional	
University changes to support commercialisation	Institutional	
Incentives	Institutional	
Identifying a market need	Institutional	
Focusing activities on the identified market need	Institutional	
Academic focus	Institutional	
Minimum viable product	Institutional	
Overcoming technical setbacks	Institutional	
Industry/consumer/market standards	Institutional	
Adaptation to seize opportunities	Individual level	Firm level
Adaptation to learn	Individual level	
Difficulty in change	Individual level	
Changes in perspective	Individual level	
Entrepreneurial tensions	Firm level	
Risk/entrepreneurial commitment challenges	Firm level	
Team interaction	Firm level	
Team necessities	Firm level	
Decision making	Firm level	
Tension between management and scientists in decision making	Firm level	
Different aims	Firm level	
Value in differences	Firm level	
Science and business balance	Firm level	
Market response	Firm level	
Resources	Firm level	
Market level limitations	Firm level	
Government/university limitations	Firm level	
Resources for the next stage	Firm level	
Sustaining resources	Firm level	
Essential venture resources	Firm level	

Essential personnel resources	Firm level	
Business acumen	Firm level	
Academics perceive they have skills required	Firm level	
Perspectives that commercialisation is just unfamiliar	Firm level	
Business people	Firm level	
Differences in mindset and approach	Firm level	
Business people don't give us a chance	Firm level	
Agreement	Firm level	
Misconceptions about commercialisation activity	Firm level	
Different perspectives about the skills	Firm level	