



A Multi-Level Exploration of Academic Intentions to Participate in Academic Entrepreneurship

PhD Thesis

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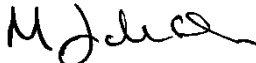
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30th September 2020

Declaration

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Abstract

Academic entrepreneurship is playing an increasingly important role in many governments national and regional growth strategies. Drawing on the academic entrepreneurship and regulatory focus theory literature, and applying a multilevel perspective, this thesis explores why university academics intend to engage in commercialisation (spin-off or start-up companies and licensing university research) or engagement (collaborative research, contract research, continuous professional development and contract consulting) activities, and the role contextual factors play in the entrepreneurial process.

Using a mixed methods research design, this research explores academic entrepreneurship through a sequential-exploratory, multi-study approach. The first study is exploratory and qualitative, with results highlighting the importance that actors in an academic's local contextual play in the entrepreneurial process. The findings allowed a testable conceptual model, hypotheses and a survey to be developed. The second study tests the conceptual model using hierarchical regression, based on a survey of 818 academics working in 14 Scottish universities. The results reveal that the stronger an individual's chronic promotion focus, the stronger their intentions to participate in commercialisation and engagement activities. The stronger their chronic prevention focus, the weaker their intentions to participate in engagement activities. When local contextual direct and indirect effects are considered, leaders and work group colleagues have different influences on an academic's entrepreneurial intent.

The third study explores whether the contextual factors identified affect academics working in STEM and non-STEM disciplines differently. The findings suggest that the individual and local contextual factors are broadly similar for both disciplines. This thesis contributes to a greater understanding of academic entrepreneurship, by drawing on regulatory focus theory to explain how academic leaders and work group colleagues can affect an academic's entrepreneurial intentions. Finally, the thesis contributes to the regulatory focus theory literature and argues that multi-level research is required to better understand different forms of entrepreneurship.

“Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others . . .”

William James (1890), *The Principles of Psychology*, I: 403–404

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Abbreviations

IP Intellectual Property

MRA Multiple Regression Analysis

OLS Ordinary Least Squares

SFC Scottish Funding Council

STEM Science, Technology, Engineering and Mathematics

TTO Technology Transfer Office

VIF Variance Inflation Factor

Chapter 1 Introduction

1.1 Introduction to the Thesis

The concept of entrepreneurial universities, embracing the exploitation of the knowledge held within their boundaries (Etzkowitz, 2003), is playing an increasingly important role in governments' science and regional development strategies (Mowery & Sampat, 2005). In many countries, governments have implemented policies aimed at encouraging universities to exploit knowledge assets for financial gain, in a bid to increase economic competitiveness, through stimulating growth in regional economies (Breznitz, O'Shea, & Allen, 2008; Lambert, 2003). These policies, combined with increased pressure on public research funding (Gulbrandsen & Smeby, 2005), are reshaping the way in which universities consider practices which are aimed at encouraging academics to participate in academic entrepreneurship, through exploiting their inventions and/or knowledge. The recent Covid-19 pandemic is having a significant impact on university income streams and regional economies and will continue to do so for the foreseeable future (Advisory Group on Economic Recovery, 2020). This means academic entrepreneurship is likely to play an increasingly important role in helping to resolve some of these issues.

To date, research on academic entrepreneurship has evolved along two distinct streams, each of which focuses on a different way of exploiting university research and knowledge. The first, which has attracted significant attention, describes commercialisation activities, where attempts are made to spin-off or start-up companies and to license university research (Di Gregorio & Shane, 2003; Rothaermel et al., 2007; van Burg et al., 2008). Although financial returns are highly uncertain, successful exploitation attempts can increase cash flows and the financial stability of a university, department, research group or individual academic, for many years. The second, more recent stream of research, academic engagement (Perkmann et al., 2013), has been concerned with university-industry linkages where academics participate in contract-

based knowledge related exchanges with non-academic organisations, for pre-agreed financial benefit to the institution, research group and individual (Perkmann et al., 2013). These interactions have a long history in academia and include activities such as collaborative research, contract research, continuous professional development and contract consulting (D'Este & Patel, 2007; Perkmann & Walsh, 2008; Hughes & Kitson, 2012). Many external organisations recognise these activities as important mechanisms to allow inventions, or know-how, to be transferred efficiently into their environment (Hughes & Kitson, 2012). The income from participation in engagement activities is typically higher than the income derived from attempting to exploit university intellectual property through licensing or spinoffs (Perkmann et al., 2013). Academic participation in engagement activities is often carried out based upon contractual agreements, with relatively swift financial returns on investment. Timescales and resource commitment are pre-determined which in turn may lead to participation in engagement activities being perceived as a lower risk option, when compared to commercialisation activities.

These two research streams can therefore be combined and considered as two competing ends of a risk-reward spectrum with commercialisation activities (spin-offs, start-ups and licensing) with uncertain outcomes at one end and lower risk engagement activities (university-industry linkages) with more certain outcomes at the other. When viewed in this context, Abreu and Grinevich (2013, p. 408) redefined academic entrepreneurship as “any activity that occurs beyond the traditional academic roles of teaching and/or research, is innovative, carries an element of risk, and leads to financial rewards for the individual academic or his/her institution.”

To date, our understanding of the entrepreneurial process within academia has largely focused on academic's working in science, technology, engineering, and mathematics (STEM) disciplines. This is unsurprising as researchers have historically identified that opportunities to behave entrepreneurially in STEM related disciplines have been higher, when compared to other disciplines (Laukkanen, 2003; Abreu & Grinevich, 2013). As a result, the extent of academic participation in engagement and commercialisation activities beyond the STEM disciplines has not often been

acknowledged in the wider literature, primarily due to an absence of data on the participation of academics who work in non-STEM disciplines (Hughes & Kitson, 2012; Abreu & Grinevich, 2013). While historically there has been lower levels of commercialisation arising from non-STEM disciplines, the opportunities to exploit research are increasing, as a result of the rise of digital technologies (Grimaldi et al., 2011). However, a limited number of researchers are emphasising the significance of research carried out beyond the STEM disciplines (Abreu & Grinevich, 2014). This is important as the contribution of non-STEM disciplines towards a university achieving their goals could be vital, particularly as these disciplines represent a significant proportion of the academic population (Hughes and Kitson, 2012; Abreu & Grinevich, 2013). In addition, if universities wish to maximise the number of academics participating in entrepreneurial activities, there is a need for greater understanding of how academics behave and are influenced, in the non-STEM disciplines too.

Irrespective of the academic discipline, or mode of academic entrepreneurship pursued, prior research has suggested that academics vary significantly in their motivation to take entrepreneurial action (D'Este & Patel, 2007; Hayter, 2011; Lam, 2011; Perkmann et al., 2013; Roach & Sauermann, 2010). Previous research into academic entrepreneurship has identified a number of individual, organisational and institutional antecedents that can assist researchers and policy makers, in an attempt to make sense of what factors affect the academic entrepreneurship process (Markman et al., 2008). These factors that enable or inhibit entrepreneurial activities within universities have been the subject of a number of research articles, which have covered institutional-level factors (e.g. Grimaldi et al., 2011; Kenney & Patton 2009), organisational-level factors (e.g. O'Shea et al., 2007; D'Este & Patel, 2007) as well as individual-level factors (e.g. Krabel & Mueller, 2009; Clarysse et al., 2011; Abreu & Grinevich, 2013). Perkmann et al's. (2013) review of the literature on commercialisation and university-industry relations suggested that academic participation in commercialisation and engagement activities may be part of a multi-level phenomenon, in the sense that it may be determined by the characteristics of the individual, the organisational and institutional context in which they work.

Contextual factors in academic entrepreneurship are a less well understood area with

peers, social norms and organisational norms all being identified as potentially affecting an academic's motivation to participate in entrepreneurial activities (Louis et al., 1989; Bercovitz & Feldman, 2008; Stuart & Ding, 2006; Tartari et al., 2014; Perkmann et al., 2013; Rasmussen, Mosey & Wright, 2014; Kenney & Goe, 2004). In the wider entrepreneurship literature, context has been identified as “understanding when, how, and why entrepreneurship happens and who becomes involved” (Welter, 2011, p.166). This is also important for the field of academic entrepreneurship, as Gartner (1993) identified that researchers should recognise the context in which entrepreneurship takes place. Researchers have tended to underestimate the influence of external factors and overestimate personal factors when making judgements about the behaviour of other individuals (Brannback & Carsrud, 2016). As a result, context has often been ignored in research conducted across the field of entrepreneurship, with researchers assuming that context impacts everyone equally and is often studied by using a few control variables (Brannback & Carsrud, 2016). To date, few studies have sought to understand how context helps shape decision making, as to why academics engage in commercialisation and/or engagement activities (Stuart & Ding, 2006; Bercovitz & Feldman, 2008; Hayter, 2011; Libaers & Wang, 2012; Perkmann et al., 2013; Tartari et al., 2014; Rasmussen, Mosey & Wright, 2014). It seems that certain contextual factors (institutional and/or organisational) can impact academic entrepreneurship but there is a lack of research in these areas, particularly those which adopt a multi-level analysis of the academic's local context. Perkmann et al. (2013) identified that there is a current lack of understanding in relation to how different contextual factors affect academics participation in engagement and commercialisation activities and how these relate to different academic disciplines. Greater consideration of this research area is therefore required, in order to understand what the significant contextual factors are and how they interact with individual motivations. This thesis therefore focuses on academic entrepreneurship and the individual and the significant contextual factors (direct and indirect) that can affect academic participation in commercialisation and engagement activities.

Therefore, the following research question is posed: which individual and contextual factors encourage or discourage academic participation in more or less uncertain entrepreneurial activities?

In order to answer this question, this thesis draws on regulatory focus theory (Higgins, 1997 & 1998) in an attempt to explain the individual and contextual factors that promote and/or hinder an academic's motivation to act entrepreneurially. Regulatory focus theory defines two self-regulatory systems, known as promotion focus and prevention focus that influence an individual's behaviour and choices. Regulatory focus theory posits that individuals adopt either a prevention focus (a focus on the costs and perceived benefits of avoiding failure) or a promotion focus (a focus on the perceived benefits and costs of not achieving success) (Higgins, 1997 & 1998). At any time, both self-regulatory systems exist, but one system will dominate the other, due to either situational triggers (Crowe & Higgins, 1997) or an individual's chronic predisposition (an established personality trait) when situational triggers are lacking (Higgins, 1998).

The following sections of this chapter outline the aims of the thesis and research objectives proposed to address this knowledge gap, through a literature review and four related empirical studies. The chapter then concludes with an overview of the chapters of the thesis.

1.2 Thesis Aim

The overall aim of the research was:

To investigate the individual and contextual factors that encourage or discourage academics in Scotland to participate in commercialisation and/or engagement activities.

This broader aim was developed to explore not only an academic's intention to participate in commercialisation (i.e. more uncertain outcomes; spin-offs / licensing) and/or engagement (i.e. more certain outcomes; contracting/collaboration/professional

development) activities within the Scottish university context, but also to explore if certain factors in their institutional, organisational and local contexts affect their entrepreneurial motivation and subsequent intentions. This aim was in part influenced by recent research articles and a consensus amongst researchers that some contextual aspects of academic entrepreneurship are not well understood (Bercovitz & Feldman, 2008; Stuart & Ding, 2006; Tartari et al., 2014; Perkmann et al., 2013; Johnson, Monsen & MacKenzie, 2017). Prior studies into understanding academic entrepreneurship have tended to focus on individual factors and have mainly excluded the impact of contextual factors, when seeking to understand the entrepreneurial behaviour of academics. This was highlighted by a number of leading academic entrepreneurship scholars in their review of the commercialisation and engagement literature. A greater understanding is required of how different contextual factors affect academics participation in both engagement and commercialisation activities and how these relate to different academic disciplines (Perkmann et al., 2013).

The thesis was therefore designed to provide some explanation of both the individual motives and to identify the main contextual factors that affect academic entrepreneurial intentions in relation to commercialisation and engagement activities. The research aim is explored through three research objectives, which are set out in the following section.

1.2.1 Research Objectives

It is the knowledge gap relating to the unexplored issues surrounding which individual and contextual factors and how they might interact to shape an academic's intentions to participate in commercialisation and/or engagement activities that led to the first research objective:

Objective 1: To consider the individual and contextual factors that influence academic participation in entrepreneurial activities.

The first objective was initially explored using a qualitative research study and relates to the need to better understand how or which institutional, organisational and individual factors affect participation in commercialisation and engagement activities.

Objective 2: To evaluate the identified individual and contextual factors that affect academic participation in commercialisation and engagement activities in Scottish universities.

The second research objective considers the contextual factors identified in study 1 and how these directly and indirectly affect an academic's entrepreneurial intentions. Specifically, in study 2 the individual motives and the effect of leaders and work group colleagues on academic participation in commercialisation and engagement activities across the Scottish academic population, are explored.

Objective 3: To explore if contextual factors impact the intentions of academics to participate in commercialisation and engagement activities differently, between STEM and non-STEM academics.

The final research objective is explored through study 3 which was designed to test whether academic participation in commercialisation and engagement activities is driven by similar or different individual and contextual factors for academic's working in STEM and non-STEM disciplines, and to whether they are different types of phenomena that need to be dealt with separately by researchers and policy-makers.

1.3 Research Approach

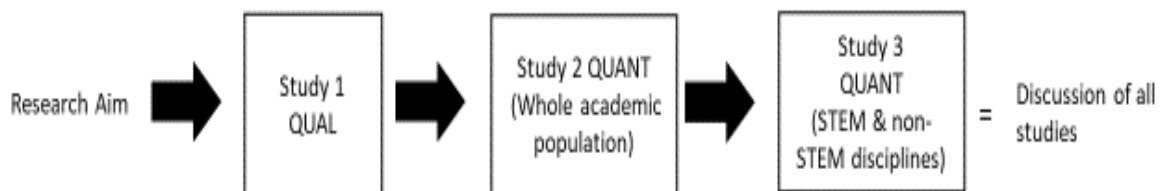
Taking into account the academic entrepreneurship literature and the implementation of outcome agreements by the Scottish government which include a drive to increase the level of participation in commercialisation and engagement activities, it was decided that a multi-step approach to the PhD would enable a deeper exploration of this relatively (at the time) unexplored area. In addition, it would also allow for some of the empirical chapters to be submitted to appropriate journals for review and publication.

The data collection for the qualitative study (study 1) was conducted between November 2013 and February 2014 and consisted of 24 interviews with academics across three Scottish universities. These findings allowed a testable conceptual model, hypotheses and a survey to be developed.

The data collection for the quantitative studies was undertaken between May 2014 and the final wave of responses was completed in June 2014 with a total of 818 useable responses collected. It is planned that study 2 the findings from the Scottish academic population and a submission to an academic journal will take place in the coming months. The results from the STEM academic population (part of study 3) were submitted to an academic journal for review in 2016 and the findings were published in the Journal of Product Innovation Management in 2017.

As a result of the approach taken, study 1 identified the main individual and contextual factors that impact entrepreneurial behaviours and allowed a testable conceptual model, hypotheses and a survey to be developed. Studies 2 and 3 relate to exploring the conceptual model and are linked to the broad research aim. A mixed methods approach was employed, using qualitative and quantitative methods, to develop and explore different facets of a conceptual model. The research design is displayed in Figure 1. This approach taken suggested that an alternative approach to thesis structure and writing was required.

Figure 1 Research Approach



As a result of the approach taken, chapters 4 – 6 are standalone, in that they contain elements of literature review and all feature methodology, findings and a brief discussion of the findings. The thesis overview is presented in the following section.

1.4 Thesis Overview

The thesis structure is designed to meet the needs of the subject area, the philosophical approach and the research design. A review of the literature (Chapter 2) is followed by a chapter 3 which addresses the philosophical underpinning of the thesis and the research design. The next chapter (Chapter 4) is empirical and presents both the methodology and results of an exploratory, qualitative study (Study1) which investigated the individual and contextual factors that affect participation in academic entrepreneurship. The findings of study 1 allowed for a conceptual model to be developed and suggested that regulatory focus theory would be a suitable lens to understand the multi-level effects identified, this is explored further in the quantitative studies. The three chapters (Chapters 5 – 7) that follow introduce the quantitative multi-level empirical studies along with the methodology adopted and the findings. The first, chapter 5, tests the conceptual model on the whole Scottish academic population. The two chapters that follow (Chapters 6 and 7) focus on academics working STEM and non-STEM disciplines. All these quantitative studies test the multi-level conceptual model and explore the individual and then the direct and indirect contextual factors and how they impact academic participation in commercialisation and engagement activities. A general discussion and conclusion chapter then follows (Chapter 8) which considers the contribution of the three empirical studies against the research objectives and considers the impacts on our current knowledge.

A summary of each chapter is as follows, chapter 2 initially explores the concept of the entrepreneurial university and how there is now increased significance for universities to become drivers of both national and regional economic growth. The chapter then continues by introducing academic entrepreneurship and how research has

developed along two distinct streams, a narrow focus (commercialisation activities) and a wider focus (engagements activities) representing the different channels through which knowledge transfer occurs. Abreu & Grinevich's (2013) definition of academic entrepreneurship which encompasses both commercialisation and engagement activities is outlined and justified. Next, the predominance and income generated from commercialisation and engagement activities since 2013 are analysed and the spectrum of activities used in this PhD is presented. The importance of understanding context in entrepreneurship research and the main institutional and organisational contextual factors identified by the Perkmann et al. (2013) review of the academic entrepreneurship literature and how there is a greater need to understand context is discussed. Finally, regulatory focus theory (a motivational and attentional theory) is introduced, its use in the entrepreneurship literature is outlined and its ability to potentially better understand how multi-level factors (situational factors and reference points) can impact an individual's entrepreneurial motivation is discussed.

Chapter 3 introduces the PhD's research design. Firstly, postpositivist and constructivist worldviews are discussed and critiqued. The worldview that is adopted in this PhD is pragmatism which offers an alternative to the other research philosophies identified. The research objectives that were formulated propose that a mixed methods approach is required. A pragmatist worldview reinforces this by allowing researchers to use and analyse narrative and numerical forms of data (Creswell, 2014; Teddlie & Tashakkori, 2009). A mixed methods approach is required, allowing researchers to focus their attention on the research question and adopt the most suitable methods (Creswell, 2014; Teddlie & Tashakkori, 2009). This chapter introduces the main approaches for collecting mixed methods data and makes the case for a sequential exploratory, multi-phase design where an initial qualitative study is followed by quantitative studies.

Chapter 4 presents the results of the exploratory qualitative study (Study 1) which investigated the individual and contextual factors that have the potential to impact participation in academic entrepreneurship in Scottish universities. This concept explored the individual, organisational and institutional factors through conducting semi-structured interviews with academics. The results indicated that at the individual

level academics are faced with an increasing number of competing demands, as to where they should focus limited attentional capacity. The academic's local organisational context was identified as being the most important contextual factor. In particular, it was recognised the behaviour and actions of academic leaders and work group colleagues have the potential to positively and negatively affect an academics motivation to participate in commercialisation and/or engagement activities. This study highlighted the local contextual nature of academic entrepreneurship and provides a more in-depth understanding at a conceptual, empirical, and theoretical level. These findings allowed a testable conceptual model, hypotheses and a survey to be developed. Chapter 4 is then followed by three further quantitative chapters (Ch.5, 6 & 7).

Chapter 5 investigates the individual entrepreneurial motivation and the direct and indirect effects that academic leaders and work group colleagues have on Scottish academics' commercialisation and engagement intentions by drawing upon regulatory focus theory. This multi-level study tests the hypotheses created in chapter 4 by analysing the 818 responses that were collected from academics, working in fourteen Scottish universities. The study highlighted the positive and negative direct and indirect affects that academic leaders and work group colleagues can have on an academic's intention to participate in commercialisation and/or engagement activities.

Chapter's 6 and 7 explore the third multi-level study at a more granular level. The conceptual model and hypotheses developed in chapter 4 are again used to test whether any individual and local contextual factors differences exist between academics working in STEM and non-STEM disciplines and their intention to participate in commercialisation and/or engagement activities. In chapter 6, the 395 responses from academics working in STEM disciplines are analysed. Within chapter 7, the responses from the 423 academics who work in the non-STEM disciplines are analysed.

Chapter 8 presents an overarching discussion of the results of all three studies and explores the implications of the findings for the research aim and objectives. The data for the studies is used, where appropriate, with all three objectives. The chapter contains a discussion of the individual and contextual factors that promote or prevent participation in commercialisation and/or engagement activities. The individual motives

and direct and indirect effects that the local contextual factors on firstly the whole academic population and then STEM and non-STEM disciplines are explored. The chapter contains a reflection on the contextual nature of academic entrepreneurship and presents the main contributions of the thesis. An evaluation of the conceptual model is undertaken. Finally, theoretical and implications for practice are presented, along with suggestions for future research.

Chapter 2 Literature Review

2.1 Introduction to the Literature Review

The purpose of this chapter is to review the literature associated with academic entrepreneurship accounting for the background, development and debate surrounding the concept. There is a growing body of evidence demonstrating that academic engagement in entrepreneurial activities is considered to be an important mechanism which positively effects regional and national economic growth (Mueller, 2006; Rogers et al., 2001; Wennberg et al., 2011). As a result, there has been an emergence of international and national policies which are aimed at promoting increased levels of interaction between universities, business and society (Grimaldi et al., 2011; D'Este & Patel, 2007; Aldridge & Audretsch, 2011). Despite academics playing a key role in this process, there is limited research which seeks to understand how contextual factors can affect academic participation in entrepreneurial activities (Kenney & Goe, 2004; Rasmussen, Mosey & Wright, 2014; Tartari et al., 2014; Bercovitz & Feldman, 2008; Johnson et al., 2017). In order to develop a clearer understanding of the field of academic entrepreneurship, this chapter will provide a review of the relevant academic entrepreneurship literature and will also set out the theoretical foundations to investigate the contextual factors and their impact on academic intentions to participate in entrepreneurial activities across Scottish universities.

The first section of this chapter explores the concept of the entrepreneurial university and the evolution of universities over time. The second section introduces and explores the narrow and wider definitions of academic entrepreneurship as a field of research. This includes an exploration of the range of entrepreneurial activities that academics can participate in and the definition of academic entrepreneurship that will be used in this thesis is established. Next, the two main categories of entrepreneurial activities that academics can participate in are discussed which comprise both commercialisation activities (licensing technologies and starting companies) and engagement activities (continuous professional development, collaborative research,

contract research and consultancy). Finally, the spectrum of academic entrepreneurship activities that will be used in this thesis is outlined and discussed. The third section of the chapter considers interactions of multi-level factors. These include individual, organisational and institutional factors that have been found to affect academic participation in commercialisation and engagement activities. Finally, the fourth section of the chapter focuses on regulatory focus theory which will be used as a framework to investigate the local contextual factors and their impact on academic intentions to participate in entrepreneurial activities.

2.2 The Entrepreneurial University

In recent years, with the increased significance of universities as drivers of both national and regional economic growth, a large body of research has begun to use entrepreneurship frameworks to investigate how academics participate in entrepreneurial activities (Mars & Rios-Aguilar, 2010; D'Este & Patel, 2007; Aldridge & Audretsch, 2011). As a result, academic engagement in entrepreneurial activities has been referred to as 'academic entrepreneurship' within the wider literature. When the US introduced the Bayh-Dole Act in 1980, this led to similar policies being adopted by governments across the world and has led to universities acting more entrepreneurially in an attempt to commercialise and exploit academic knowledge and research outputs. This has resulted in a significant increase in the level of engagement by academics in different entrepreneurial activities (Rothaermel et al., 2007). The concept of the entrepreneurial university and the evolution of universities over time will be discussed in the next section.

The phrase entrepreneurial university dates back to Slaughter and Leslie's (1997) book; *Academic Capitalism: Politics, Policies and the Entrepreneurial University* where they discuss that faculty and universities need to become more active in respect to how they react and deal with the changing internal and external demands. Etzkowitz (1998) also used the term 'entrepreneurial universities' to describe academic institutions which

integrated economic development as a university mission, in addition to the core academic functions of teaching and research. As a result, universities have come a long way from their medieval origins as institutions that were primarily dependent on charitable donations into institutions capable of generating regional economic growth and of playing a primary role in society.

Etzkowitz (2013) describes the entrepreneurial university as an “efflorescence of embryonic characteristics that exist ‘in potentio’ in any academic enterprise” (Etzkowitz, 2013, p.487). The entrepreneurial university can therefore be thought of as an institution that has the ability to be innovative, take risks, recognize and create opportunities, respond to challenges and to manage such changes to arrive at a more promising position for future prosperity (Urbano & Guerrero, 2013). As a result, both the academic culture and the academic environment have had to change in order to generate added value in all activities and to manage the shifts to become more entrepreneurial (Urbano & Guerrero, 2013). Consequently, the role of the modern university has evolved in similar ways to the national economies, from institutions being driven by the need for physical capital, to being driven by the quest for new knowledge and finally being driven by entrepreneurship (Thorp & Goldstein, 2010).

2.2.1 Evolution of the Entrepreneurial University

The modern concept of universities first arose in Europe during the Middle Ages when European civilisation was developing rapidly. This was at a time when society was becoming more complex with the Roman church, local and national governments requiring educated priests, administrators, lawyers, physicians, and clerks for business (Scott, 2006). In order to fulfil this demand, universities began to emerge to take on this mission of teaching society. As a result of this demand, universities have a long history of teaching, with the University of Bologna founded in 1088 (University of Bologna, 2017) being recognised as the oldest, continuously operating university in the western-world. While in the United Kingdom, the University of Oxford is the oldest university in the English-speaking world with teaching in one form or another existing there since

1096 (University of Oxford, 2017); the oldest university in Scotland is the University of St Andrews, which has been a formal seat of learning since 1410 (University of St Andrews, 2017).

The first academic revolution began during the 19th-century where in addition to the traditional function of teaching, a second mission of original inquiry through research became an important goal, which is thought to have first emerged through the founding of the University of Berlin in 1810. By 1900, the German university model with its teaching and research missions had influenced, to varying degrees, higher education throughout the world, leaving many legacies such as; the integration of teaching and research missions, academic freedom for professors, greatly expanded fields of study and applied research. These concepts were carried abroad during the 19th century by foreign students, visitors, and professors who were observing or working in Germany (Scott, 2006). The idea of the research university quickly spread to the United States of America, towards the end of the 19th century firstly being adopted by Johns Hopkins University (in 1876) with Stanford University following suit in 1891 (Rogers et al. 2001). This academic revolution subsequently transformed the university into a research and teaching centre with Thomas Henry Huxley, writing that while the medieval university had “looked backwards and professed to be a storehouse of old knowledge, the modern university looks forward and is a factory of new knowledge” (Huxley, 1892, in Pattnaik & Pandey, 2014 p.44).

After the second world war, huge investment in plant and equipment drove many economies to prosperity (Audretsch & Phillips, 2007). However, with the advent of globalisation it was recognised by policy makers in many countries that to maintain competitive economies in the future, they need to be able to maximise the benefits from publicly funded academic research and knowledge that is created within universities to assist in generating economic growth, increase employment and national competitiveness. However, it had been long recognised that public investment in university research does not automatically generate economic growth and prosperity and there was a need for the outputs of academic research to be more accessible in order to contribute to innovation, competitiveness and ultimately economic growth to benefit the

wider economy (Audretsch & Phillips, 2007). As a result, this had led to a further academic revolution, where universities in many countries, have been encouraged by their respective governments to adopt a third mission (Leydesdorff & Etzkowitz, 1997). In addition to teaching and research, they aim to contribute to society and economic development directly through the transfer of knowledge held within their boundaries (Chapple et al., 2005).

Throughout the majority of the twentieth century, many universities were reluctant to become directly involved in licensing activities and their commitment to open science and unique governance structure served as a barrier to the commercialisation of university research (Siegel, 2004). However, in 1980 the US congress enacted the Bayh-Dole Act in an attempt to increase the transfer of technology from university research towards commercialisation with the responsibility for the transfer of technology resulting from publicly funded research at universities being transferred from the government to the universities themselves. Prior to this act, policies were in place that meant that outputs from research supported by public agencies had gone strictly to the US government and nobody could exploit such research without tedious negotiations. As the patenting activities of universities are often built on research collaborations between university and industrial partners this meant a number of channels of technology and knowledge exchange including, publishing, conferences, training for industry researching, consulting were required (Mowery & Sampat, 2005). This in turn opened up the possibilities for firm formation by faculty members and the licensing of technologies to industrial partners. Ultimately factors such as the declining availability of public funding of university research (Gulbrandsen & Smeby, 2005), as well as subsequent changes in government legislation across many countries, helped stimulate the level of knowledge that was transferred from universities into the market place (Chapple et al., 2005).

2.3 Academic Entrepreneurship

As universities exist to create and disseminate knowledge, knowledge-transfer is core to the university mission (Cullen, 2008) and this transfer or exchange of knowledge for commercial gain is primarily achieved through academics identifying opportunities to act entrepreneurially (Abreu & Grinevich, 2013; Perkmann et al., 2013). To date, research on academic entrepreneurship from within academia has evolved along two distinct streams, each of which has a different focus on the channels through which knowledge transfer occurs. The first, which has attracted significant attention in the wider literature, has defined academic entrepreneurship in a narrow manner to describe academic engagement in spin-off or start-up companies and to license university research (Di Gregorio & Shane, 2003; Rothaermel et al., 2007; van Berg et al., 2008; Fini et al., 2010; Siegel & Wright, 2015). The second, which is a smaller body of research, has seen other authors use academic entrepreneurship to represent academic engagement across a much wider spectrum of knowledge-transfer activities (Louis et al., 1989; Klofsten & Jones-Evans, 2000; Abreu & Grinevich, 2013; Johnson, Monsen & Mackenzie, 2017). Therefore, the following sections of this chapter will analyse the different ways entrepreneurship within academia has been researched and defined in order to select an approach appropriate to this study.

2.3.1 Academic Entrepreneurship: A Narrow Focus

The significance of the formation of companies emerging from academic research, as a mechanism for stimulating regional economies and generating income for both the academics who founded them, their universities and the wider economy (Shane, 2004, Wright et al., 2004), has led to a large body of research. This research, drawing on the narrow term ‘academic entrepreneurship’ has focused on understanding university spin-off companies. Shane (2004), in his study of academic entrepreneurship in the United States, Canada and the United Kingdom focuses almost exclusively on spinouts, which he defines as “a new company founded to exploit a piece of intellectual property

created in an academic institution” (Shane, 2004, p. 4). Although the focus of this research stream has increased slightly it has typically centred on a narrow range of knowledge transfer activities which use university intellectual property and has concentrated on understanding, the patenting and licensing of research outputs (Jensen et al., 2003; Markman et al., 2005; Siegel et al., 2003) and company formation (Di Gregorio & Shane, 2003; Murray, 2004; O’Shea et al., 2007; Stuart & Ding, 2006; Lockett et al., 2005).

There are good reasons as to why this has led to a relatively narrow research focus; one is that these commercialisation activities are typically considered to most closely reflect research undertaken in the wider entrepreneurship literature; another is these activities are easy to quantify, as the number of patents filed, licenses granted or the number of firms created can easily be counted as they are officially filed, and their economic impact, such as the number of jobs created, can often be estimated. In their study of European academic entrepreneurship Wright et al. (2007) identified a taxonomy of three types of spin-off companies that typically emerge from universities; venture capital backed spin-offs, prospector spin-offs, and lifestyle spin-offs. The first type, venture capital backed spin-offs are typically established by a team of renowned researchers and venture capitalists in order to commercialise a particular technology. The second type, prospector spin-offs typically comprises university laboratories formed through external public or private funding, with the goal of producing products that are commercially valuable. The third type, lifestyle spin-offs are typically formed by academics in order to provide contract research and/or consultancy services.

Siegel and Wright (2015) discuss that academic entrepreneurship has changed dramatically over the last few years, as when these activities were first developed in universities, there was a strong emphasis on patenting and licensing and very little attention being paid to the start-up dimension. However, more recent research undertaken by Fini et al. (2010) found that the majority of businesses (around two thirds) started by academics actually occur outside the university intellectual property system and are not based on disclosed and patented inventions. Their study highlighted that non-patent-based companies emerging from universities (start-ups) are distributed across

a wider range of disciplines than patent-based spin-offs, which highlights a problem of research focused on patent-based academic entrepreneurship.

Even though there is no clear consensus in the wider literature on the definition of an academic entrepreneur, these different classifications have assisted researchers in understanding the different roles played by individual academics in the commercialisation process. For example, Meyer (2003) differentiates between the academic entrepreneur and entrepreneurial academic and unsuccessful policy attempts to promote greater academic entrepreneurship. According to Meyer (2003), even though public policies are aimed at promoting 'academic entrepreneurs' forming fast growing firms, in reality these policies have instead led to a rise in 'entrepreneurial academics' who instead form companies in order to pursue their own research interests, which as a result, often hinders fast company growth.

Other studies have attempted to delineate the definition of academic entrepreneurship by instead considering the role of the academic. For example, whether the academic is the founder of a company established mainly with the objective of commercialising technological innovations, or the level of academic involvement (full-time or part-time) and the existing relationship with the university, or the orientation of the company (whether growth oriented or technology oriented) have also been used to define an academic entrepreneur (Nicolaou & Birley, 2003; Meyer, 2003). As a result, the term academic entrepreneur has often been used in the wider literature to differentiate academics who have engaged in the formation of companies from those who have not. However, researchers have also identified that academics have found it difficult to balance their time between the competing demands of managing their core academic duties whilst simultaneously participating in the formation and management of companies (D'Este & Patel, 2007; Markman et al., 2008). These difficulties can also lead to delays in bringing technologies to market as a result of external organisations having academics involved in the commercialisation process. The fact that company formation can be very risky and time consuming (Franklin & Wright, 2001) has also been highlighted within the wider academic entrepreneurship literature.

Other critics have concluded that there is a flaw in universities having a strategic focus on the formation of spin-offs, given the highly skewed nature of licensing income and the small proportion of spin-offs that achieve commercial success (D'Este & Patel, 2007). This is because only a small percentage of university research undertaken has any intellectual property of commercial value, this leaves the majority of research, know-how and therefore most academics outputs, underutilised (Cullen, 2008). Mowery & Libecap, (2005) have also been critical of the technology-transfer system in the United States and claimed that the need exists for having multiple channels between university and industry. University spin-offs represent only one mechanism by which academic research results can be transferred to the marketplace.

Based on the discussion above, it is clear that the narrow definition of academic entrepreneurship has been used to study the role of the academic in firm formation and licensing activities, their role in this process, the effectiveness of their engagement in the process, as well as highlighting the implications and limitations of participating in these knowledge-transfer activities.

2.3.2 Academic Entrepreneurship: A Wider Focus

While the literature on the narrow definition of academic entrepreneurship has primarily focused on licensing and spin-off creation, some researchers define academic entrepreneurship as an academic's participation across a wider spectrum of knowledge-transfer activities (Johnson, Monsen & MacKenzie, 2017; Abreu & Grinevich, 2013; Louis et al., 1989; Klofsten & Jones-Evans, 2000; Bird & Allen, 1989).

In a seminal research paper by Louis et al. (1989), they define academic entrepreneurship as “the attempt to increase individual or institutional profit, influence, or prestige through the development and marketing of research ideas or research-based products” (Louis et al., 1989, p.110). A similarly broad definition of academic entrepreneurship has been adopted by other researchers who believe that it should represent academic participation across a spectrum of commercialisation activities (Klofsten & Jones-Evans, 2000; Abreu & Grinevich, 2013; Louis et al., 1989). For

example, Klofsten & Jones-Evans (2000) studying academic entrepreneurship across two European countries (Sweden and Ireland) defined academic entrepreneurship as an academic's participation in activities that fall outside the normally accepted duties of academics, where they conclude that "any activity outside of teaching and personal research could be termed as entrepreneurial" (Klofsten & Jones-Evans, 2000 p.300).

The wider definition of academic entrepreneurship has also been used to study the broad range of entrepreneurial activities that academics can participate in. As per the narrow definition, this wider definition has also been of use to compare and contrast different academic entrepreneurial activities. Researchers have found that academics have a higher propensity to participate in collaborative research, contract research, consulting and external teaching than participating in firm formation or licensing activities (Hughes & Kitson, 2012; Abreu & Grinevich, 2013; Perkmann et al., 2013). This important, but much smaller stream of research, has often been concerned with linkages between universities and non-academic organisations, where academics participate in knowledge related exchanges for personal, financial and social benefits (Tijssen, 2006; Hughes & Kitson, 2012; Abreu & Grinevich, 2013; Perkmann et al., 2013; Hughes et al., 2016).

D'Este & Patel (2007) surveyed 1,528 UK academic staff and found that other knowledge-transfer activities are often deemed to be more important outputs than firm creation or licensing research, in relation to economic impact, and are often carried out on a more regular basis and by a larger number of academics. The higher levels of participation in these forms of entrepreneurial activities, compared to licensing and start-up spin off activities, may be due to reduced level of time commitments, lower costs and the need for fewer university resources. Knowledge-transfer activities such as collaborative research, contract research or consultancy, are often an important first step in setting up or expanding existing academic facilities, such as research groups. Over time, this can lead to increased commercial outputs for individuals or research groups (Abreu & Grinevich, 2013; Franzoni & Lissoni, 2006; Perkmann et al., 2013). As a result, the income generated from these knowledge-transfer activities is typically

significantly higher than the income derived from exploiting university intellectual property (Perkmann et al., 2011).

Researching a broader spectrum of knowledge-transfer activities allowed Jain, George, & Maltarich (2009) to study the role identity of academics, when undertaking a range of entrepreneurial activities and found that an academic's identity changes. They discovered that academics call to mind rationales for involvement, when considering undertaking entrepreneurial activities that are congruent with their academic role identity. This leads to them taking on a "hybrid role identity that comprises a focal academic self and a secondary commercial persona" (Jain et al., 2009 p.922).

To make sense of the different knowledge-transfer activities, some researchers have differentiated between different forms of academic entrepreneurship. In their study of 22,000 UK academics, Hughes & Kitson (2012) used the all-encompassing term "knowledge-exchange" and mapped the responses of academics across four overarching themes. These themes represented commercialisation activities and were comprised of people-based activities, problem solving activities and community-based activities. They identified twenty-seven ways that academics can exploit their research and knowledge, to create economic impact and used these themes to create understanding around this. Link et al. (2007) considered the propensity of academics to participate in three forms of technology transfer: the transfer of commercial technology, joint publications with industry and consulting, the authors define these activities as informal technology transfer.

Abreu and Grinevich (2013) and Perkmann et al. (2013) have argued that having a narrow focus on academic entrepreneurship has a number of important shortcomings related to the considerable variation across academic disciplines and the extent of academic participation across different knowledge-transfer activities. This is primarily due to the different types of knowledge prevalent across the different academic disciplines, and the extent to which it can be protected using formal intellectual property protection methods. These authors argue that the academic entrepreneurship literature, which has been predominantly focused on spinouts and licensing, should be extended to also include other knowledge-transfer activities that are also entrepreneurial in nature.

In order to differentiate between knowledge-transfer activities Abreu and Grinevich (2013) proposed two categories; formal and informal commercialisation. The first category, classified as formal commercial activities, encompasses activities traditionally studied in the academic entrepreneurship literature, which are licensing and company formation. The second category, classified as informal commercial activities, covers activities that occur via commercial transactions but are based on knowledge that cannot easily be protected using formal methods, such as patents. Informal commercialisation where IP protection is less appropriate, or more difficult to obtain or implement, is common across a wide range of academic disciplines and has frequently been overlooked within the academic literature (Abreu & Grinevich, 2013). This led to Abreu and Grinevich redefining the term academic entrepreneurship in the UK and they define it as “any activity that occurs beyond the traditional academic roles of teaching and/or research, is innovative, carries an element of risk, and leads to financial rewards for the individual academic or his/her institution” (Abreu & Grinevich, 2013, p. 419). In addressing this same issue, Perkmann et al. (2013) use the terms “academic engagement” which refers to knowledge-related interactions of academics with non-academic organisations. These engagement activities include consulting, collaborative research, contract research and informal knowledge transfer relationships, and are used to differentiate certain forms of academic entrepreneurship from “commercialisation” activities, which they define as intellectual property creation, licensing and firm formation. Although Perkmann et al. (2013) argue that any informal forms of technology transfer are typically formalised through contracts and are therefore not technically informal.

This wider definition of academic entrepreneurship is helpful for understanding the myriad of ways that academics can participate in a broad range of entrepreneurial activities. It allows researchers to compare and contrast different academic entrepreneurial activities in relation to frequency of occurrence, income generation and economic impact. A summary table (Table 1) of the terms used, and the wide range of entrepreneurial activities examined by researchers, is presented below.

Table 1. Research Articles: Definitions and Activities

Author(s)	Definitions relating to entrepreneurial activities of academics	Entrepreneurial activities examined
Perkmann et al. (2013)	Academic engagement- Knowledge-related collaboration by academic researchers with non-academic organisations and commercialisation activities	<ul style="list-style-type: none"> ➤ Collaborative research ➤ Contract research ➤ Consulting ➤ CPD ➤ ad hoc advice and networking with practitioners ➤ Licensing ➤ Spinouts
Abreu and Grinevich (2013)	Academic entrepreneurship- Formal and Informal commercialisation	<ul style="list-style-type: none"> ➤ Licensing ➤ Spinouts ➤ Consultancy ➤ Contract research ➤ Informal advice ➤ Public lectures
Hughes & Kitson (2012)	Knowledge exchange	<ul style="list-style-type: none"> ➤ People-based activities ➤ Problem-solving activities ➤ Commercial activities ➤ Community-based activities
Philpot et al. (2011)	Form of academic entrepreneurship - Hard and Soft Activities	<ul style="list-style-type: none"> ➤ Patenting & licensing ➤ Spinouts/firm formation ➤ Consultancy ➤ Contract research ➤ Industry training ➤ Publishing ➤ Grantsmanship
Fini et al. (2010)	Academic efforts to commercialise inventions that they have disclosed	<ul style="list-style-type: none"> ➤ Spin-offs ➤ Start-ups ➤ Patents

	within the intellectual property system established by university administrators.	
D'Este & Patel (2007)	Academic efforts to benefit from greater university-industry linkages	<ul style="list-style-type: none"> ➤ Meetings and conferences ➤ Consultancy and contract research ➤ Creation of physical facilities ➤ Training (company employees) ➤ Joint research
Link, Siegel and Bozeman (2007)	An analysis of the academic engaging in informal university technology transfer	<ul style="list-style-type: none"> ➤ Transfer of commercial technology ➤ Publication with industry scientists ➤ Industrial consulting
Shane (2004)	Academic entrepreneurship -The establishment of a new company to exploit a piece of intellectual property created in an academic institution.	<ul style="list-style-type: none"> ➤ University spin-offs
Klofsten & Jones-Evans (2000)	Academic entrepreneurship- Entrepreneurial activities outside the normally accepted duties of academics, which are recognized by educational establishments in many countries as teaching and personal research.	<ul style="list-style-type: none"> ➤ Large scale science projects ➤ Contracted research ➤ Consulting ➤ Patenting/licensing ➤ Spin off firms ➤ External teaching (e.g. professional development courses) ➤ Sales ➤ Testing
Bird & Allen (1989)	Academic entrepreneurial activities.	<ul style="list-style-type: none"> ➤ Sponsored research ➤ Consulting ➤ Start up a firm
Louis et al. (1989)	Academic entrepreneurship- Entrepreneurial activities	<ul style="list-style-type: none"> ➤ Large scale science ➤ Supplemental income (Consulting)

	<p>which attempt to increase individual or institutional profit, influence, or prestige through the development and marketing of research ideas or research-based products.</p>	<ul style="list-style-type: none"> ➤ Industrial support for university science ➤ Patenting ➤ Direct commercial involvement.
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2.4 STEM and Non-STEM Disciplines and Academic Entrepreneurship

Researchers have identified that opportunities to behave entrepreneurially in STEM-related disciplines are higher when compared to other disciplines (Laukkanen, 2003; Abreu & Grinevich, 2013). However, the extent of academic participation in engagement and commercialisation activities beyond the STEM disciplines has not often been acknowledged in the wider literature, primarily due to an absence of data on the participation of academics who work in non-STEM disciplines (Hughes & Kitson, 2012; Abreu & Grinevich, 2013). In their large scale UK survey which investigated breadth and depth of academic knowledge exchange interactions, Hughes & Kitson (2012) found that whilst the proportion of academics in the non-STEM disciplines who are involved in commercialisation activities is below the levels found in the STEM disciplines, academics from social science, arts and humanities and health disciplines are actively participating in commercialisation activities. Abreu & Grinevich (2013) found that the formation of spinouts is relatively common in business and media and the creative arts disciplines, which they say reflects the entrepreneurial nature of academia in non-STEM disciplines. The authors also found that high numbers of academics in non-STEM disciplines have formed a consultancy business based on their research. However, Hughes & Kitson (2012) found that in terms of academic participation in engagement activities a different picture emerges, where the researchers found that academic participation across STEM and non-STEM disciplines was much less skewed. A final key factor to emerge from the Hughes & Kitson (2012) UK wide study, is that the vast majority of the respondents 22,129 (65.7%) who had participated in knowledge

exchange interactions, were not working in STEM related disciplines, meaning that studies which focus on STEM disciplines are omitting the majority of academics from their studies. Hughes et al. (2016) conducted a second follow up survey which covered the period 2012-2015 and received 18,177 responses. The study found that, 6% of academics have taken out a patent; 3% have taken out a license; and 3% have formed a spin-out in the three years prior to the 2015 survey. They found that participation in engagement activities varied in importance by discipline. They found that participation in joint research reported was reported by 45% of respondents while around 30% of respondents involved in consultancy and contract research.

2.5 Definition of Academic Entrepreneurship

The above critique of both the ‘narrow’ and ‘wider’ definitions of academic entrepreneurship, provides the justification for the definition of academic entrepreneurship that should be used in this thesis. The selected definition should be aligned with the research question and allow the objectives of the thesis to be met. The main objective of this research is to investigate the nature of academic participation in entrepreneurial activities. This encompasses how the academics context might shape their decision to participate in these activities, within the general academic population and to also explore if differences exist between academics working in both STEM and non-STEM disciplines. A narrow definition of academic entrepreneurship that generally focuses on company formation and licensing would be limiting for this research. If meaningful policies and a greater understanding of the antecedents of academic entrepreneurship are to be understood, it is important to consider a much wider spectrum and therefore definition, of academic entrepreneurial activity. As previously stated, Abreu and Grinevich define academic entrepreneurship as “any activity that occurs beyond the traditional academic roles of teaching and/or research, is innovative, carries an element of risk, and leads to financial rewards for the individual academic or his/her institution” (Abreu & Grinevich, 2013 p.408). This thesis includes an analysis of entrepreneurial activities that are either innovative and carry an element of risk and/or

can lead to financial rewards for the individual their department/research group or their university.

The literature provides details of the wide-ranging dimensions of the academic's entrepreneurial activities that academics can participate in. Commercial forms of research, which include collaborative research and contract research with non-academic partners (Abreu & Grinevich, 2013; Louis et al., 1989; Perkmann et al., 2013); company formation (Bird & Allen, 1989; Shane, 2004; Renault, 2006); licensing of intellectual property (Klofsten & Jones-Evans, 2000; Fini et al., 2010; Abreu & Grinevich, 2013); consulting (Bird & Allen, 1989; Louis et al., 1989; Jones-Evans, 1998; D'Este & Patel, 2007; Abreu & Grinevich, 2013; Perkmann et al., 2013) and training for industry (Louis et al., 1989; Klofsten & Jones-Evans, 2000; D'Este & Patel, 2007). Other researchers have included alternate measures of academic entrepreneurship such as patents, invention disclosures (Louis et al., 1989; Klofsten & Jones-Evans, 2000; Fini et al., 2010) and measures such as public lectures (Abreu & Grinevich, 2013).

As there are a wide range of entrepreneurial activities that academics can participate in, a wider definition of academic entrepreneurship will be used in this thesis and will be based on the definition provided by Perkmann et al. (2013). As previously discussed, many 'informal forms' of technology transfer are typically formalised through contracts and are therefore not informal (Perkmann et al., 2013). The terms 'engagement activities' (knowledge-related interactions such as CPD, collaborative research, contract research and consulting) and 'commercialisation activities' (licensing and company creation), will therefore be used in this thesis.

Based on this wider definition of academic entrepreneurship, several activities that generate significant amounts of income for universities and academics have been identified from the literature and the Higher Education – Business and Community Interaction (HE-BCI) Surveys that have been identified as academic entrepreneurial activities, both commercialisation and engagement activities that occur beyond the traditional academic roles of teaching and/or research. These entrepreneurial activities are innovative, carry an element of risk, and can lead to financial rewards for the individual academic, their department/research group or their university. As discussed

above, these activities include consultancy, continuous professional development (training for industry), contact research, collaborative research with non-academic partners, licensing technologies and firm formation and form the basis of discussion and analysis that follows.

2.6 Predominance of Commercialisation and Engagement Activities

The commercialisation and engagement activities that have been identified above are discussed in more detail in the following section, with supporting data from the Higher Education – Business and Community Interaction (HE-BCI) Surveys, published by the Higher Education Statistics Agency. These annual surveys which measure the trends across a range of commercialisation and engagement activities between UK universities, industry and the wider economy will provide data from across a range of entrepreneurial activities from the ‘commercialisation of new knowledge through the provision of professional development, consultancy and services to activities that are intended to have direct social benefits’ (HEFCE, 2012 p.1).

2.6.1 Commercialisation Activities

The following section will cover the commercialisation activities (company formation and licensing income) with supporting evidence drawn from the Higher Education – Business and Community Interaction (HE-BCI) Surveys.

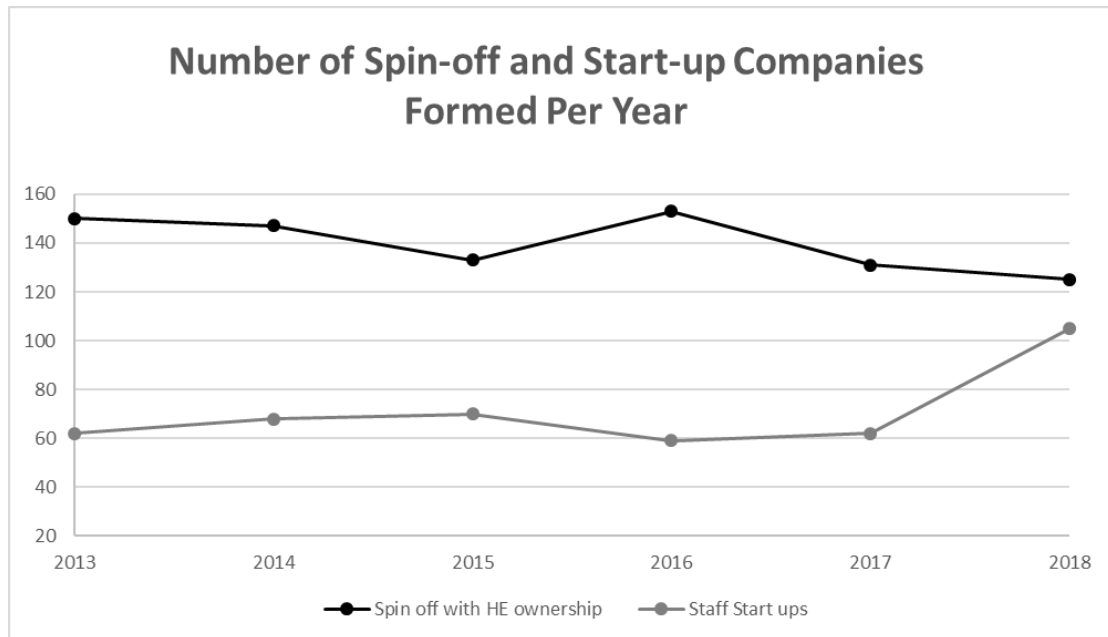
2.6.1.1 Company Formation

Firms emerging from universities operate at the nexus of academia and the marketplace. As a result, investing into university spin-offs is often only suitable for high risk investors and government funding agencies due to the illiquidity of the investment, high levels of uncertainty, failure rates and the time to profitability (HEFCE, 2015). Companies emerging from universities, however, have been found to be a

successful method for bringing scientific discoveries to the marketplace, although this is highly affected by the availability of limited resources such as seed funding and financial backing. With a spin-off company, a university engages in risky investments into its own IP, with often significant expenditure on business planning, market research and the building a management team who are capable of creating a high-value venture (HEFCE, 2015). The term spin-off has been used to describe the establishment of a new company to exploit a piece of intellectual property created in an academic institution (Shane, 2004). However, research undertaken by Fini et al. (2010) found that the majority of businesses started by academics actually occurs outside the university intellectual property system and are not based on disclosed and patented invention and are known as 'start-ups'. Start-up companies are businesses set up by academics and are distinct from spin-off companies as they are often not specifically based on IP emerging from a university but are often related to the academics' areas of expertise (HEFCE, 2015).

For the purpose of this study, company formation is defined as the academic's intention to start a company (spin-off or start-up) in order to exploit research outputs or academic knowledge which have been developed within the university setting. The number of spin-off companies emerging annually from academia has slowly fallen over the past five years decreasing from 150 in 2013 to 125 in 2018, a decline of over 16% over the five-year period. The number of start-up companies that were reported emerging annually from academia have increased over the past five years from 62 in 2013 to 105 in 2018, an increase of almost 70% over the five-year period (Figure 2).

Figure 2. Number of UK University Spin-off and Start-ups



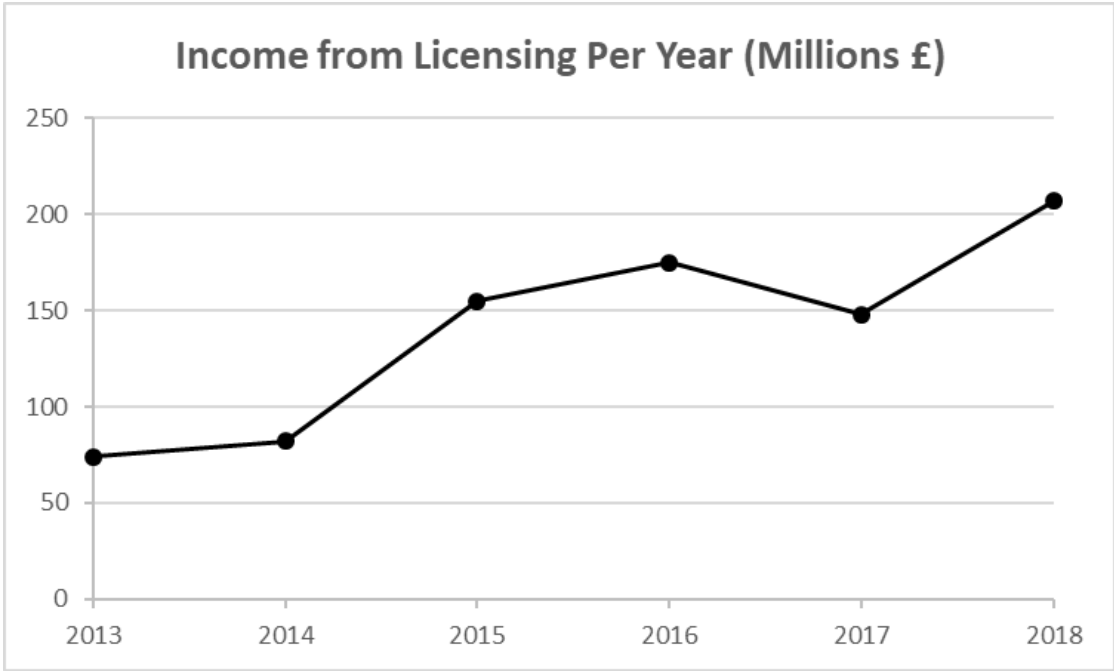
Source: HE-BIC surveys 2013-18

2.6.1.2 Licensing of Intellectual Property

Licensing university research has historically been the most popular method of assigning IP (Chapple et al., 2005) coming out of universities. The university identifies areas of knowledge it believes to have commercial value and invests money in protecting and marketing that knowledge for a future financial return. Bercovitz & Feldmann (2006) outline that these licenses provide companies with the right to use IP generated from university research in a codified form of either patents or trademarks and these formal commercialisation transactions typically involve selling a business the rights to use a university's inventions in return for up-front payments, on-going royalty payments, or, increasingly, equity stakes in the company. In addition to the potential revenues for universities, this mechanism offers an easy way to demonstrate to policy makers that their university is actively engaged in disseminating research results to industry. As a result, many universities are constantly increasing their portfolio of

intellectual property (HEFCE, 2015). This suggests that a university with a successful licensing portfolio should, over time, be able to generate more revenue than the costs associated with protecting and marketing the IP. The selling of university IP often impacts the academic(s) who created the innovation, as they will often have to work closely with the business partner to support the introduction or integration of the technology purchased in order to successfully grow their investment. Total income from academic engagement in licensing activities has risen steadily in the university marketplace over the past five years increasing from £74 million in 2013 to £207 million by 2018, an increase in total income of 174% over the five-year period (Figure 3).

Figure 3. UK Intellectual Property, Licensing Income



Source: HE-BIC surveys 2013-18

2.6.2 Academic Engagement Activities

The section that follows will explore the academic engagement activities (collaborative research, contract research, consultancy and continuous professional development) used within this thesis, with supporting evidence from the Higher Education – Business and Community Interaction (HE-BCI) Surveys.

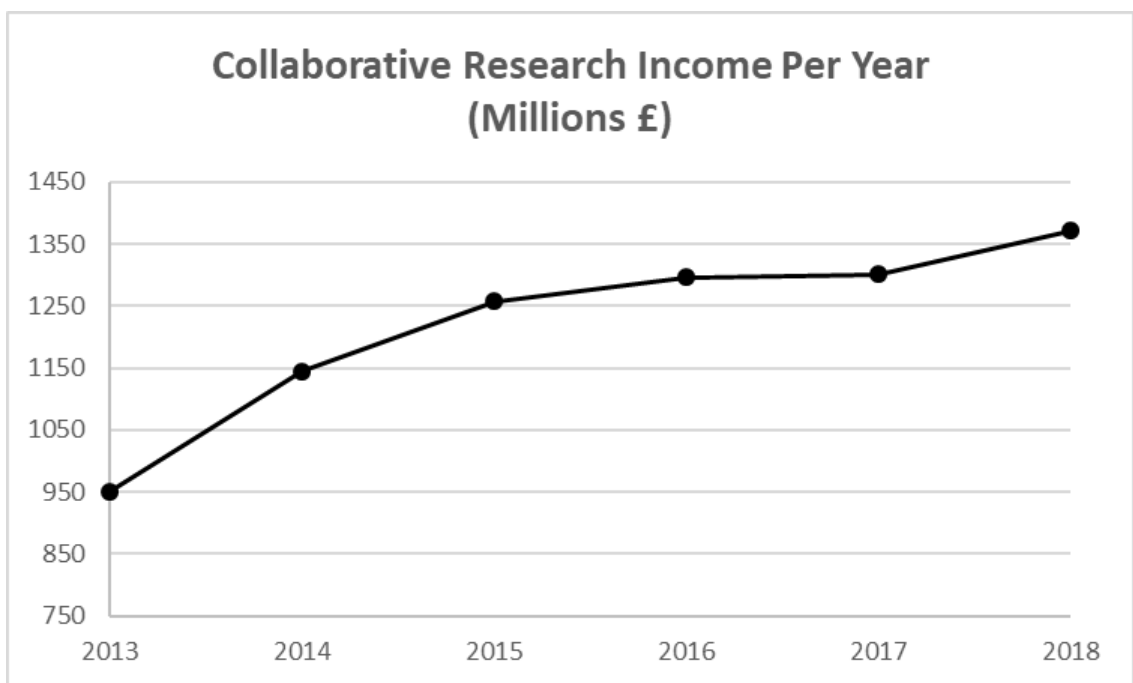
2.6.2.1 Collaborative Research

Collaborative research refers to agreements between non-academic partners and universities aimed at them co-operating on research and development projects (Hall et al., 2003), where it can be leveraged and multiplied by additional public sponsorship (Behrens & Gray, 2001). However, the parties involved will often agree the legal specifications of the research regarding the ownership of any resulting intellectual property (Bercovitz & Feldmann, 2006) with the fruits of the research generally being shared among all the partners. The reasons why businesses outside of academia engage in collaborative research are that it provides them with the opportunity to absorb and develop leading-edge knowledge, as well as the access to potential post-graduate level graduates who have been working on the project (Wright et al., 2008). Bekkers & Bodas Freitas (2008) have found that the level of industry support for collaborative research varies considerably by academic discipline and countries.

UK research councils, who often funded 'blue sky' research, have recognised that there is a need to engage in programmes that demonstrate a real business benefit from which successful new products, processes and services can emerge (Cullen, 2008). As a result, collaborative research projects now need to involve two or more collaborators, including one from business which typically has a commercial focus, but which generally has no direct commercial outcome (HEFCE, 2015). The university and company work together to develop 'enabling' science, bringing the benefit of industrial collaboration to the university. In these relationships there are "few commercial pressures, milestones or

potential infringements of academic freedom” (Cullen 2008, p.94) this can lead to business viewing collaborative research as a ‘risky undertaking’ as there is no immediate payoff and funds are therefore only likely to be given to trusted partners (Perkmann & Walsh, 2008). Income from academic engagement in collaborative research activities has risen steadily in the university marketplace over the past five years increasing from £951 million in 2013 to £1,371 million by 2018, an increase in total income of 44% over the five-year period (Figure 4).

Figure 4. UK Collaborative Research Income



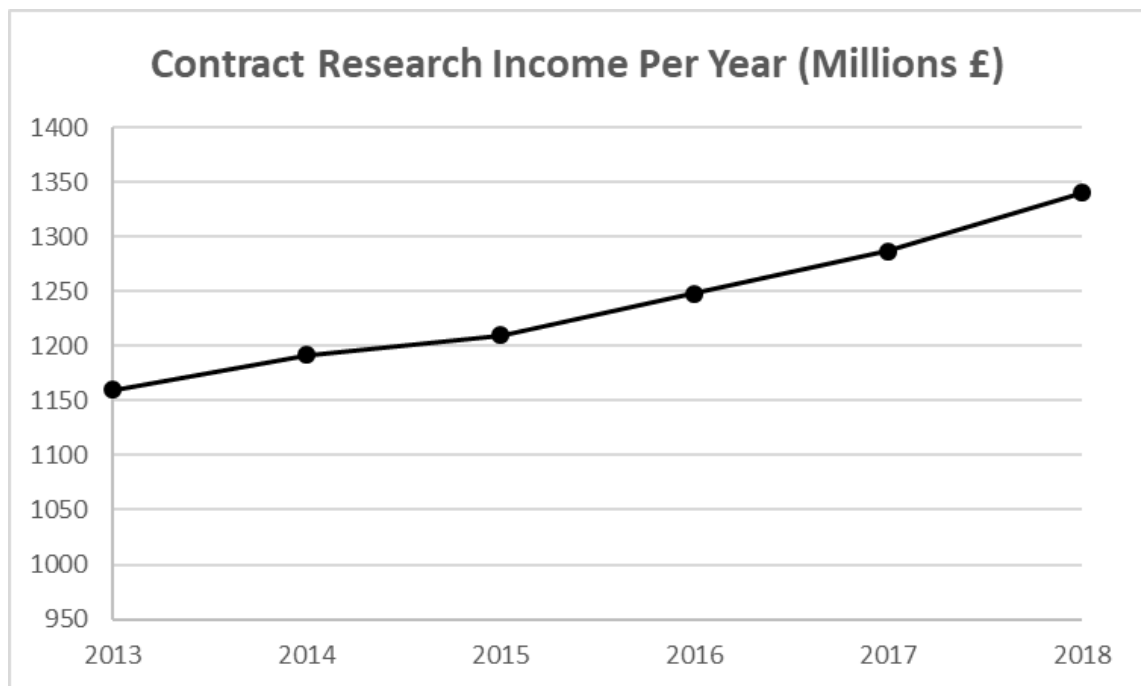
Source: HE-BIC surveys 2013-18

2.6.2.2 Contract Research

Contract research refers to research that is usually designed to answer specific questions or to conduct experiments or procedures specifically on behalf of the funder to

deliver measurable outcomes. As universities provide knowledge that covers a broad spectrum of disciplines, this enables them to be ideally suited to provide expertise, facilities and experience covering across a wide range of sectors. However, van Looy et al. (2011) found that in terms of contract research, firms that engage academic partners tend to favour universities with strong scientific capabilities. As contract research is unambiguously commissioned by the funder, this often means the work is usually more applied than in collaborative research agreements (Perkmann & Walsh, 2008). As a result, no significant new IP is expected to emerge from the work and the university is typically content for the funder to own any foreground IP and the ownership of the resulting intellectual property (HEFCE, 2015). Income from academic engagement in contract research activities has risen steadily in the university marketplace over the past five years increasing from £1,160 million in 2013 to £1,340 million by 2018, an increase in total income of 15.5% over the five-year period (Figure 5).

Figure 5. UK Contract Research Income



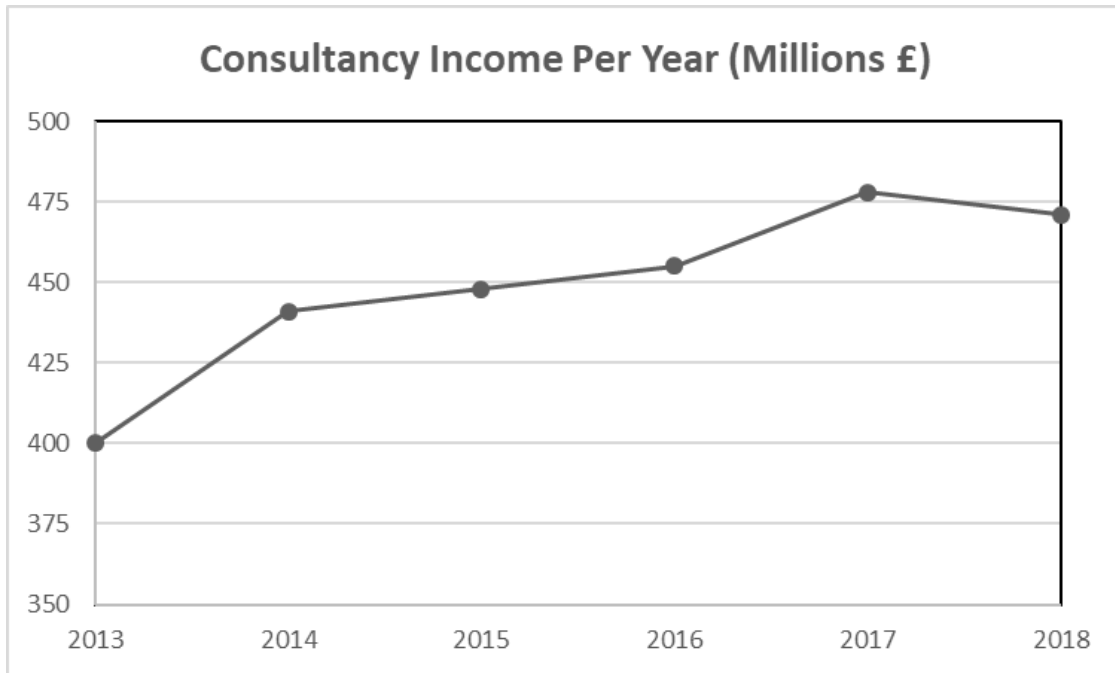
Source: HE-BIC surveys 2013-18

2.6.2.3 Consulting

Consulting can be defined “as the provision of a service by academics to external organisations on commercial terms” (Perkmann & Walsh 2008, p.1885). Consulting therefore refers to the sale of academic expertise in order to solve a specific problem (Klofsten & Jones-Evans, 2000), with the work carried out being paid for at a market rate. Consulting is usually provided on an individual basis by academics with consulting projects typically being commissioned directly by the external organisation. Any income generated from the consulting project often can be taken as additional earned income for the academic involved, but alternatively many universities allow academics to place the money directly in dedicated research accounts in order to support their research. Consulting typically does not involve original research and is usually carried out on a contractual basis or sometimes on an ongoing basis, where academics take an ongoing role as members of a scientific advisory board (Haeussler & Colyvas, 2011).

Consulting agreements are typically made between the individual academic with the university’s only role in the process being to set policies about the acceptable amount of time academics are able to devote to consulting beyond their normal academic duties, conflicts of interest and the use of university resources (Bozeman & Gaughan, 2007). Income from academic engagement in consulting activities has risen steadily in the university marketplace over the past five years increasing from £400 million in 2013 to £471 million by 2018, an increase in total income of 17.75% over the five-year period (Figure 6).

Figure 6. Consultancy Income



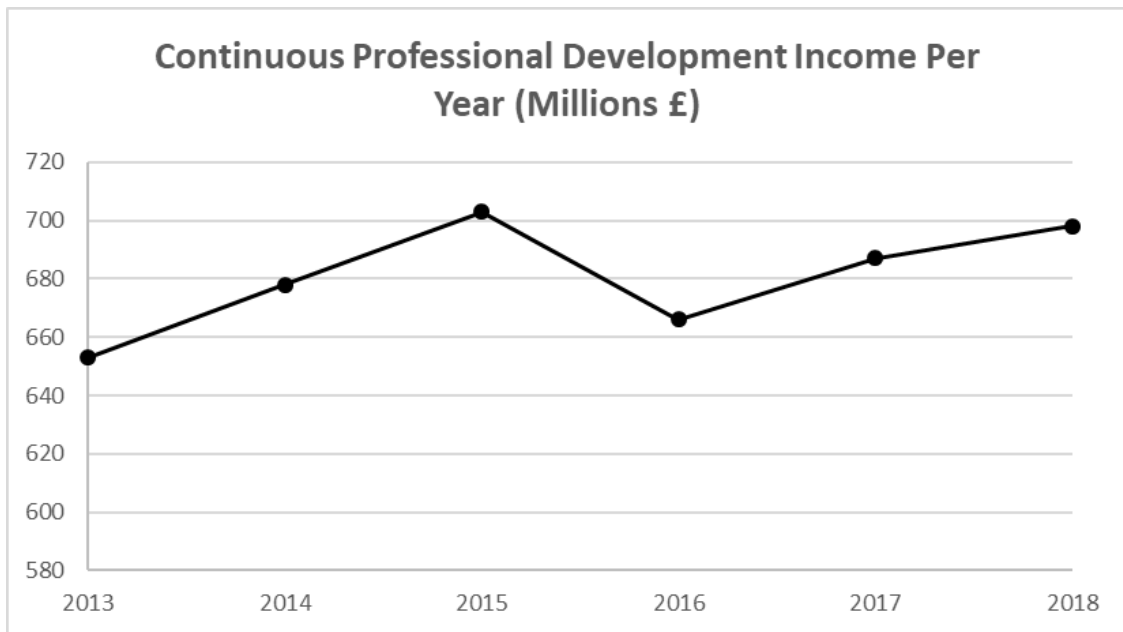
Source: HE-BIC surveys 2013-18

2.6.2.4 Continuous Professional Development

Continuous professional development (CPD) is viewed as an important activity for higher education institutions (HEFCE, 2015). Increasingly companies have recognised the need to continually develop the skills of their employees through education and training. This has been highlighted in the wider research with employee training being viewed as an important mechanism not only for industry up-skilling but to also generate income for universities (Hughes & Kitson, 2012). CPD is also a common activity that academics may engage in. Klofsten & Jones-Evans (2000) surveyed 1857 Swedish and Irish academics and found more than 40% of Swedish and 73% of Irish respondents had engaged in external teaching with industry in the previous 5 years. Some university CPD courses are important mechanisms that allow individual

employees to gain or maintain membership of professional or regulatory bodies or to keep up with the latest methods (doctors or lawyers for example). However, CPD courses may also be used to meet the specific needs for firms, so employees working on projects can be upskilled together over short periods at a location suitable to the company. As a result, many universities offer a portfolio of services which are able to meet the needs of small, medium and large businesses (HEFCE, 2015). Income from academic engagement in CPD activities has risen steadily over the past five years increasing from £653 million in 2013 to £698 million by 2018, an increase in total income of almost 7% (Figure 7).

Figure 7. Continuous Professional Development Income



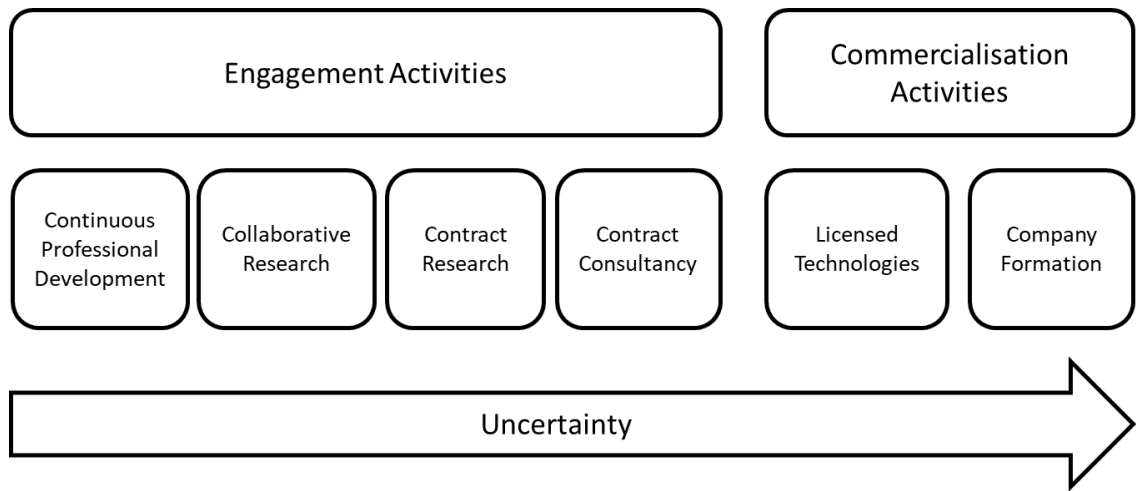
Source: HE-BIC surveys 2013-18

2.7 Spectrum of Activities

Participating in commercialisation and engagement activities have the potential to bridge funding gaps, or provide income for the individual, department or university

meaning academics are competing in the marketplace to maximise revenues from participating in these entrepreneurial activities. The differences between knowledge-based engagement activities, with more certain outcomes, and commercialisation activities where outcomes are inherently uncertain, are presented in the following spectrum of academic entrepreneurial activities (Figure 8).

Figure 8. Academic Entrepreneurship Spectrum



Source: (Johnson, et al., 2017 p.183)

Academic engagement activities undertaken via assisting non-academic organisations with either the implementation of, or improvement to products, process, or services are considered to be more aligned with long-standing traditional academic outputs (Klofsten and Jones-Evans, 2000; Philpott, Dooley, O'Reilly, and Lupton, 2011). While these activities still carry an element of risk (particularly reputational risk), formal contractual agreements can be put in place which clearly outline the financial return to the academic and/or their institution. The skills required are typically more familiar to them, with expected time frames and the income to be received agreed upon before the project commences, so any level of uncertainty is substantially reduced. Commercialisation activities on the other hand are much more entrepreneurial in nature

with investments in academic's time and financial returns being highly uncertain, and the skills required to be successful are often unfamiliar to many academics (Philpott et al., 2011). In order to understand if academic participation in commercialisation activities is driven by similar individual and contextual factors as academic engagement activities, or whether it represents a completely different type of phenomenon, the following section will explore a number of individual, organisational and institutional determinants or factors. These determinants have been identified in the academic entrepreneurship literature as motivating factors as to why academics participating in different engagement and commercialisation activities.

2.8 The Importance of Context in Entrepreneurship Research

In the wider entrepreneurship literature context has found to be “important for understanding when, how, and why entrepreneurship happens and who becomes involved” (Welter 2011, p.166). The term context originated from the Latin “to knit together or to make a connection” (Rousseau & Fried, 2001 p.1). Cappelli and Sherer (1991 p. 56) depict context as “the surroundings associated with phenomena which help to illuminate that phenomena”. In management research, context has typically referred to the circumstances, conditions, situations, or environments that are external to a particular phenomenon which in turn, exert some direct or indirect influence on it (Whetten, 2009).

Gartner (1993, p.234) discussed that researchers should recognise the context in which entrepreneurship takes place, as researchers “have a tendency to underestimate the influence of external factors and overestimate the influence of internal or personal factors when making judgements about the behaviour of other individuals”. As a result, Brannback & Carsrud, (2016) believe that context is essential in allowing individuals to make sense of what they encounter but that context has often been ignored in research conducted in the field of entrepreneurial cognitions with authors assuming that context is equal for everyone and is commonly dealt with by using a few control variables. This

has led Brannback & Carsrud (2016) to declare that researchers need to conduct more research into the impact of context on entrepreneurial cognitions rather than assuming that context is irrelevant or unimportant.

Some authors (Mowday & Sutton, 1993; Johns, 2006; West, 2003) have suggested that context often operates as a cross or multi-level effect in which situational variables at one level of analysis can affect variables at other levels. Johns (2006) discussed that although some upward effects are possible, the vast majority of cross or multi-level effects of context are top-down and as a result there is a need to consider the impact of a higher level of analysis on the lower level (Johns 2006). As such, West (2003, p. 55) pointed out that, “in the domain of entrepreneurship, aspects at one level of the phenomena can have an impact and bearing on aspects of other levels.” As a result, context has the ability to exert direct and/or indirect influences (Whetten, 2009; Johns, 2006), such influences may have the potential to moderate an academic’s entrepreneurial behaviour.

Context is essential for making sense of what people encounter as it serves as a form of cognitive map which helps individuals navigate by drawing upon past experiences or from observing successes or failures within social settings. One keyway of observing context and how it is created is to examine what influences contextual meaning, through behaviours, language and symbols. This “context lens” allows researchers to frame entrepreneurship by paying attention to cross, lower and higher levels of analysis (Hackman, 2003). In other words, context at a higher level of analysis (e.g. political, institutional or organisational factors) or cross level factors (e.g. departmental or group factors) may interact with a particular phenomenon at a lower level (e.g. academic commercialisation or engagement intentions) and result in a context-specific outcome (Johns, 2006). Although contextual influences on entrepreneurial action have been acknowledged (Aldrich and Fiol, 1994; Welter, 2011), research into on entrepreneurial action has typically focused on the individual (Shane, 2003; Shane and Venkataraman, 2000) meaning that the effects of contextual influences on individuals represents a major gap in the literature (Zahra and Wright, 2011; Autio et al., 2014). As a result, researchers are now starting to call for a more contextual

approach to entrepreneurship studies and researchers should pay more attention to the context in which entrepreneurs operate as they have not been adequately observed or paid attention to (Brannback & Carsrud, 2016). As a result, Brannback & Carsrud (2016) have called for a more contextual approach to entrepreneurship studies stating that researchers should pay more attention to the context in which entrepreneurs operate as we still do not fully understand how contexts impact entrepreneurial cognition and in turn entrepreneurial behaviour.

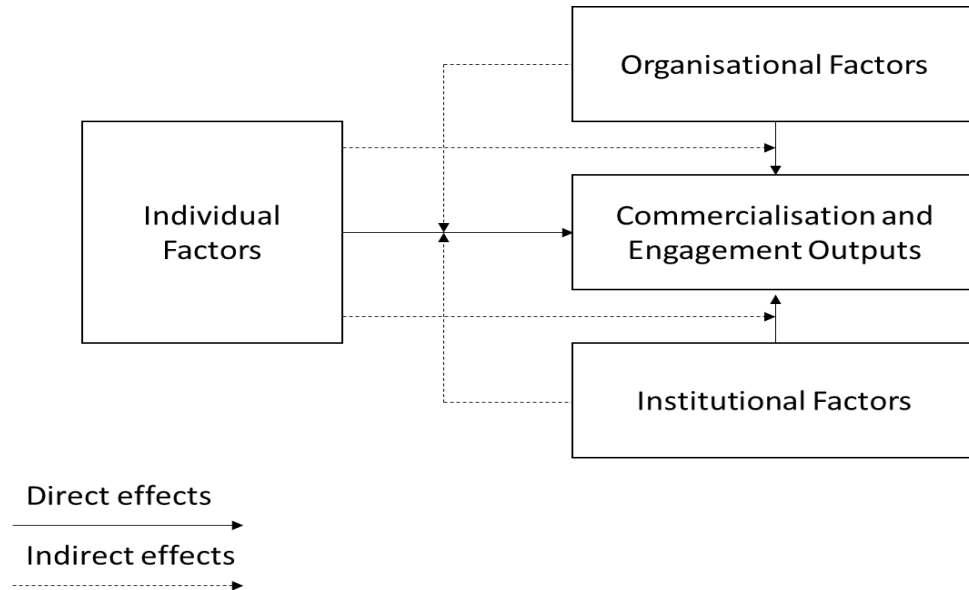
In the academic entrepreneurship field, Perkmann et al's. (2013) review of the literature on university-industry relations suggested that academic participation in commercialisation and engagement activities may be part of a multi-level phenomenon, in the sense that it may be determined by the characteristics of the individual, the organisational and institutional context in which they work.

2.9 Multi-Level Determinants

Previous research of academic entrepreneurship has identified a number of individual, organisational and institutional antecedents that can assist researchers and policy makers in making sense of what factors affect the academic entrepreneurship process (Markman et al., 2008). These factors that enable or inhibit entrepreneurial activities within universities have been the subject of a number of research articles, which have covered institutional-level factors (e.g. Grimaldi et al., 2011; Kenney & Patton, 2009), organisational-level factors (e.g. O'Shea et al., 2007; D'Este & Patel, 2007) as well as individual-level factors (e.g. Krabel & Mueller, 2009; Clarysse et al., 2011; Abreu & Grinevich, 2013). In a comprehensive review of the academic entrepreneurship literature undertaken by Perkmann et al. (2013), the authors suggest that engagement in academic entrepreneurship activities may be a multi-level phenomenon, in the sense that it may be determined by both the characteristics of individuals, as well as the organisational and institutional context in which they work. As a result of their comprehensive review, the authors identified a number of factors which may serve as determinants of academic engagement in commercialisation and

engagement activities, which may affect academic behaviour which in turn can affect their entrepreneurial outputs (Figure 9).

Figure 9. Determinants of Academic Engagement in Commercialisation and Engagement Activities



In order to understand how academic entrepreneurial behaviour emerges some researchers in the field of academic entrepreneurship have started to assert that it is necessary to consider the interactions of these multi-level factors and their interdependencies (Perkmann et al., 2013; Grimaldi et al., 2011; Bercovitz & Feldman, 2008). In the academic entrepreneurship literature Foo et al. (2016) have called for further research into understanding academic entrepreneurial outputs which incorporate the nexus of the individual and other contributing factors. In the wider entrepreneurship literature, Hmieleski and Baron (2009) discuss that to have a greater understanding of any entrepreneurial processes, the multi-level perspective needs to be better understood. Multi-level effects include the effects of individual factors on organisational outcomes (Hmieleski & Baron, 2008) or the mix of individual and organisational factors on

individual outcomes (Lee et al., 2011). Therefore, the following sections will discuss findings from the wider literature that have been identified as potential antecedents to academic entrepreneurship which include individual-level, institutional-level and organisational-level factors (Markman et al., 2008).

2.9.1 Individual Factors

Prior research has indicated that participated in both commercialisation and engagement activities tend to be individually driven and pursued on a discretionary basis (Perkmann et al., 2013) and universities therefore reliant on the independent initiative of academics to achieve their organisational goals. D'Este and Patel (2007) carried out research on UK academics and found that the personal characteristics of academics have a greater impact on determining their success than the characteristics of their academic departments or universities. These findings were also supported by Ambos et al (2008), who revealed that the personal characteristics of an academic has a greater influence on their decision making, than do other factors. Prior research has found that certain individual factors or characteristics play an important role in predicting differing types of academic entrepreneurship (Perkmann et al., 2013) and these will be discussed in the following section.

2.9.1.1 Individual Motivation

In the wider entrepreneurship literature, Shane et al. (2003) discuss that entrepreneurial action is underpinned by how individuals evaluate entrepreneurial opportunities. In turn, this leads to individuals having to positively evaluate opportunities and then to pursue resources in order to be able to exploit these opportunities, with this ultimately being dependent on the willingness of people to engage in the game. As a result the authors argue that it is human motivations that influence exploitation decisions, which in turn leads to variances across individuals in

these motivations, which researchers can use to help determine who actually pursues the entrepreneurial opportunities identified (Shane et al., 2003). As human motivation has been identified as an important factor in understanding who engages in entrepreneurial activities from those who do not, there has been increased interest by researchers to understand academics motivations towards pursuing entrepreneurial activities. As a result of this research, the motivation of academics towards pursuing differing entrepreneurial activities within academia, has also been identified as a motivating factor as to when or which type of academic entrepreneurial activity may be undertaken (Lam, 2011; Hayter, 2011; D'Este & Perkmann, 2010).

A review of the wider literature reveals that academics are driven to participate in different commercialisation activities by a range of motives. Lam (2011) surveyed 735 scientists from five UK research universities and found that there is a diverse range of motivations for academics participating in commercialisation activities, and that many academics do so for reputational and intrinsic reasons. The results of her research found that those academics who believe that science and commerce should be kept separate are extrinsically motivated where they participate in commercialisation activities as a means to obtain resources to support their quest for new knowledge. In contrast, she found that those academics who more closely identified with entrepreneurial norms were more intrinsically motivated by autonomy and the stimulation involved in applied commercial research. Lam (2011) also found that whilst academics were motivated by money, personal financial reward played a relatively small part in their motivation to participate in commercialisation activities. Similarly, Krabel & Mueller (2009) surveyed 2604 scientists working at the Max Planck Society in Germany where they found that those scientists who believe that science is a public good were much less likely to participate in commercialisation activities. D'Este & Perkmann (2010) surveyed UK physical sciences and engineering faculty and also found that participation in a number of engagement activities was generally driven by research considerations (i.e. learning, access to resource and funding), but on the other hand they found that academic participation in commercialisation activities was motivated by monetary incentives.

Baldini et al. (2007) surveyed 208 Italian faculty members on their motivation to get involved in university patenting activities and although universities use a share of royalties as an incentive to motivate academics to participate in these activities, the authors found that increasing personal income was again not the main factor affecting respondents' propensity to file university-owned patents, but rather it was intangible rewards such as increased reputation, new stimuli for research and often a strong desire to obtain additional research funds. Jones-Evans (1998) identified that when academics are motivated to earn additional income, they were more likely to participate in consultancy activities rather than endure the difficulties of starting a new business.

Hayter (2011) who conducted an interview-based study of 74 nascent US academic entrepreneurs identified a number of motivational factors and found that the primary motivational factor for academics to participate in commercialisation activities was that they were driven to get their research out of the university and into the market place. The author also found that nascent academic entrepreneurs were often highly motivated to commercialise their research outputs in order to gain access to resources that were not available within their universities. Like many of the other studies, many respondents identified personal financial gain as a potential result of their work, but a large number of respondents viewed academic entrepreneurship as an important part of their faculty responsibilities, which they believed was closely linked to the public service mission of their university.

D'Este and Patel (2007) argued that it is the combination of traditional academic outputs and participation in entrepreneurial activities which will be able to best provide academics with the ability to satisfy the different motives identified above, such as the need to access additional resources, or to learn from industrial problems, and to earn an additional income. The authors further elaborate this point by stating that by participating in engagement activities, such as consultancy or research with industry, this can provide academics with the opportunity to earn an additional income or to provide them with access to industrial resources and skills they require.

2.9.1.2 Gender

Abreu & Grinevich (2013) in their study of UK academics found that female academics were less likely to be involved in entrepreneurial activities than their male colleagues, with the gender gap being larger for engagement activities (Tartari & Salter, 2015). Abreu and Grinevich (2017) found that male academics' participation in certain engagement activities such as consulting and contract research was nearly double the level of female academics. These findings are consistent with other researchers who have found that male academics are significantly more likely to participate in commercialisation activities than females (Boardman, 2009; Giuliani et al., 2010; Goktepe-Hulten, 2010; Link, Siegel, & Bozeman, 2007). It has also been identified that female academics are less likely to disclose their inventions (Thursby & Thursby, 2007), hold patents (Stuart & Ding, 2006) or create a company based on their research outputs. Research undertaken by Jones-Evans and Klofsten (2000) found that male academics also have a greater tendency to participate in a wider variety of commercialisation and engagement activities than their female colleagues (Jones-Evans and Klofsten, 2000, Thursby & Thursby, 2005; Ding et al., 2006; Haeussler & Colyvas, 2011; Lawson et al., 2019). Researchers have suggested that some of the reasons that female academics are less likely to participate in commercialisation and engagement activities is that they are more risk averse, lack the experience or do not have the external networks required to effectively participate in these activities (Ding et al., 2006; Murray and Graham, 2007). Abreu and Grinevich (2017) identified that women also tend to hold more junior positions in academia comparative to their male counterparts, work in the health sciences, social sciences, humanities and education disciplines and are less likely to have prior experience of running a business. Murray and Graham (2007) suggest that these factors identified above have led to many women being excluded from academic entrepreneurship which has left them with fewer opportunities in the commercial marketplace and has, as a result, weakened their skills in commercial science.

2.9.1.3 Age

It is unclear what effect age has as to whether an academic participates in commercialisation and/or engagement activities. A number of studies have found that there is a positive relationship (Abreu and Grinevich, 2013; Haeussler & Colyvas, 2011; Link et al., 2007) and others a negative relationship (Bekkers, Maria & Freitas, 2009; D'Este & Patel, 2007), while some studies have found that there was no relationship at all (Boardman and Ponomariov, 2009; Gulbrandsen and Smeby, 2005). Bercovitz and Feldman (2008) suggest that the negative relationship found in some studies could be as a result of training effects. They propose that older academics have established their scientific norms by working in universities where participation in commercialisation and engagement activities is less relevant or perhaps even discouraged. A more recent study undertaken by Lawson et al. (2019) examined the international engagement activity of over 14,000 UK academic which focused on three age groups <40; 40-49 and >50 the authors found a higher level of engagement in the 40-49 category compared to the other two groups.

2.9.1.4 Academic Rank

Researchers have found that an academic's status has a positive impact on the level of industry interactions. This suggests that the more senior an academic the more likely they are to participate in commercialisation and engagement activities (D'Este and Patel, 2007; Link, Siegel and Bozeman, 2007; Haeussler and Colyvas, 2011; Lawson et al., 2019) and seniority is often positively related to collaboration (Boardman, 2009; Boardman and Corley, 2008; Bozeman and Gaughan, 2007; D'Este and Perkmann, 2011; Haeussler and Colyvas, 2011; Link et al., 2007; Ponomariov, 2008). Given that participation in these activities is often seeded by personal contacts, more experienced researchers are likely to have larger networks, and hence more social capital, this in turn provides them with a great number of potential partners in the private sector to work with (Giuliani et al., 2010; Haeussler and Colyvas, 2011; Landry et al., 2006).

2.9.1.5 Employment Status

Researchers have found that having greater perceived security in one's job through obtaining tenure as opposed to fixed-term contract work, is an indicator of increased participation in entrepreneurial activities (Stuart & Ding, 2006; Bercovitz & Feldman, 2008). Link et al. (2007) find that tenured faculty members are more likely to participate in engagement activities than non-tenured faculty members. They go on to discuss that one of the main goals of an academic is recognition within their academic discipline which results in non-tenured academics focusing on publishing in top rated journals, presenting research findings at conferences and applying for research grants. As a result, untenured academics have strong incentives to pursue such goals because they are often the requirements for promotion and tenure within universities.

2.9.1.6 Prior Entrepreneurial Experience

The wider entrepreneurship literature discusses that prior entrepreneurial experience increases the probability of the identification and exploitation of opportunities (Shane & Venkataraman, 2000; Shane, 2000). The entrepreneurship literature has shown that an important determinant of entrepreneurship is previous experience, such as having started a business in the past, or having an immediate family member who owns or has owned or started a small business (Klofsten & Jones-Evans, 2000; Shane and Khurana, 2003, Foo et al., 2016). Within the academic entrepreneurship literature Mosey and Wright (2007) have found that less experienced entrepreneurs often find it difficult to identify opportunities to commercialise their research or knowledge and find it more difficult to bridge the gap between scientific research and commercialisation activities. On the other hand, Clarysse et al. (2011) found that academics with prior entrepreneurial experience increases the likelihood of them being involved in a new venture.

2.9.1.7 Undertaking Applied vs Basic Research

Within the literature it has been found that academics who are engaged in applied research are more likely to be involved in commercialisation and engagement activities. Prior research has found that academics who concentrate on applied research rather than basic blue-sky research have an increased likelihood of entrepreneurial action (Bekkers & Bodas Freitas, 2008; Bozeman & Gaughan, 2007). As a result, applied fields of research make academic participation in both commercialisation and engagement activities much more likely (Bekkers & Bodas Freitas, 2008; Boardman, 2008, 2009; Ponomariov, 2008).

2.9.1.8 Academic Tensions

It has also been identified that there are fundamental differences between traditional 'for profit' business models and the remit of universities as disseminators of research knowledge (Bok, 2003), and it has been found that such differences can create tensions within universities (Ambos et al., 2008). Participating in commercialisation and engagement activities often requires a skill-set that may be viewed as contradictory with the skills required to undertake core activities such as teaching, grant writing and publishing journal articles (D'Este & Patel, 2007). In order to establish a successful career, academics are often required to devote a significant proportion of attention to teaching, publishing their findings and gaining recognition in their field, leaving little time or incentive to undertake commercial activities (Perkmann & Walsh, 2008). In addition, there may be reluctance on the part of senior academics to alter a system that has provided the basis for their own recognition and success (Markides, 2007). Work undertaken by Arvanitis, Kubli, & Woerter (2008) found that departments not involved in entrepreneurial endeavours were seriously impeded from doing so by a series of single obstacles. These obstacles primarily reflected the fears of academics in neglecting their main tasks of teaching and research, believing that the quality of their work would diminish if they were to participate in entrepreneurial activities.

Researchers have also found that many academics are already just balancing the requirements of teaching and research commitments (Markman et al., 2008; Liberman & Idson, 1999) and some academics are worried that by concentrating on the exploitation of knowledge and research outputs will eventually lead towards more entrepreneurial university departments, ‘in which commercial outputs become the norm rather than an optional side activity’ (Ambos et al., 2008 p.1425). This suggests that participation in entrepreneurial action requires an academic to exercise judgment as to what academic activities are most valued. This can lead to variations across academics in their perceptions of risk which can influence the entrepreneurial decision making process (Shane & Venkataraman, 2000), and as a result, academics are likely to vary in how they feel about risking their limited resources. It has been identified that when individuals experience feelings in relation to perceptions of risk, ambiguity or uncertainty this creates a sense of doubt, which in turn can “produce hesitancy by interrupting routine behaviour; promotes indecision by perpetuating continued competition among alternatives and encourages procrastination by making prospective options less appealing” (McMullen & Shepherd, 2006 p.135).

An alternative line of research in the entrepreneurship literature has discussed that it may not be the fact that some individuals are risk averse when it comes to commercialising their research or knowledge, but instead doubts arise as a result of limited attentional capacity (Gifford, 2010). As one’s attentional capacity is a scarce resource, it needs to be allocated amongst competing uses. Thus, at any point in time attention can only be allocated to a number of currently known objectives. Gifford (2010, p. 1) uses the following analogy to describe the challenge that individuals face in the allocation of their limited attention amongst a number of competing alternatives:

Imagine a juggler on the ‘Ed Sullivan Show’ who is rewarded according to the number of plates she can spin on the tips of long sticks on a table. The plates are the targets of attention and the juggler allocates limited attention between re-spinning old plates and setting up new plates. Assume that there is an unlimited supply of plates and sticks (and table top). As soon as one plate is spinning, she can set up another one.

However, as she continues to set up additional spinning plates, the first one starts to wobble, threatening to fall. The choice the juggler faces is to either continue to set up new plates.

This suggests that it may be that as a result of limited attention it is why academics vary significantly in their motivation to take entrepreneurial action (D'Este & Patel, 2007), when this is considered in the context of the academic entrepreneurship spectrum outlined in figure 8 above, any doubts experienced by academics may induce hesitancy when they consider the potential disruption towards their core academic activities or promote indecision as to what activities academics should allocate their attention towards when they are being faced with an increasing number of choices.

2.9.2 Institutional Factors

Within this section two key aspects of the institutional context in which academics operate will be considered. Firstly, the scientific discipline of the academic and secondly, the effect of specific national regulations and policies. Both factors have the potential to inform the level of academic participation in entrepreneurial activities as they have the possibility to shape the norms and rules for academics (Perkmann et al., 2013).

2.9.2.1 Academic Discipline

Academic discipline has been found to be an important variable when considering academic entrepreneurship, as opportunities to participate in commercialisation and engagement activities vary across disciplines (Wright et al., 2004; Hughes & Kitson, 2012). Laukkanen (2003) identified that opportunities to behave entrepreneurially in STEM related disciplines are higher when compared to other disciplines. Fini et al. (2010), for example, find that spinouts based on patents are more likely to occur in biosciences. However, in a more recent study the founding of spinouts

is now becoming relatively common in the non-STEM related disciplines of business, media and the creative arts “reflecting the intensely entrepreneurial nature of academia in these disciplines” (Abreu & Grinevich, 2013 p.415).

Abreu & Grinevich (2013) found that academic participation in engagement activities are also much more widespread than commercialisation activities across all disciplines. However, there are also variations in the level of participation in specific activities across disciplines. The authors also discovered that in the health and social sciences disciplines, academics were much more likely to be involved in engagement activities, as these are activities in keeping with the resources and the nature of the demand in the public sector (Abreu & Grinevich, 2013). This was reflected in the high numbers of academics in these disciplines who have started their own consultancy business based on their research or knowledge.

2.9.2.2 Scottish Government Policy

To date, few studies have investigated the policy instruments available for governments which aim to improve entrepreneurial outputs from universities (Hossinger et al., 2019). It has been identified that it is possible that government policies have the potential to shape the entrepreneurial intentions of academics by providing necessary the necessary resources and regulations (Rasmussen, 2008). In Scotland, the Scottish Funding Council (SFC) (2012) who are a non-departmental body of the Scottish government and responsible for funding research within Scotland have recently changed their terminology from knowledge-transfer which they describe as “get innovations out of the laboratory and into the work place”, to using the terminology ‘knowledge exchange’ which is viewed as a two way process, which they believe has the capacity “to lever innovation and value form the Scottish research base to achieve an effective, demand driven exchange of knowledge and expertise with business, public and third sector organisations, which enhances competitiveness and promotes economic growth”.

This change in terminology also coincided with a shift in policy in relation to how knowledge is transferred or exchanged from universities to benefit the wider

economy. In 2012 the Scottish Government, through the SFC, introduced outcome agreements, so that Scottish universities could demonstrate their contribution towards the Scottish Government's policy priorities as set out in their economic strategy for Scotland (Scottish Government, 2011). The aim of an outcome agreement is to provide a mechanism so that universities can demonstrate in relation to the measurable outputs the value of the public investment in them. Outcome agreements are therefore the mechanism through which specific goals for individual universities to meet government policy goals are set. The focus of each outcome agreement is the contribution that each university makes towards improving the life chances of individuals, supporting world-class research and creating sustainable economic growth for Scotland, through the transfer of university knowledge into business and industry in order to exploit the Scottish research base. Outcome agreements therefore set out what a particular university needs to deliver over a given period, against a number of strategic goals, in return for funding from the SFC (Scottish Funding Council, 2013).

The outcome agreements cover a wide range of knowledge-transfer channels which include; expanding the number and quality of Continuous Professional Development (CPD) opportunities for business and industry; increasing licensing income from intellectual property (through Easy Access IP and traditional mechanisms); growth in spin-out companies and a significant improvement in the level of university participation with business and industry (e.g. consultancy, contract research and collaborative research), in particularly Scottish SMEs, with the goal of creating a more prosperous and successful country (Scottish Funding Council, 2013). To arrive at an agreed set of outcomes in their outcome agreement, negotiations take place between the SFC and each university. These negotiations could include the level of income generated from engaging with business through some the channels set out above, or the number of companies started/or licenses granted. The actual outcomes are then assessed against the pre-agreed outcomes, which in turn determines the funding the university receives from the SFC in the future.

At the time of writing this literature review, it is currently unclear how the introduction of outcome agreements will affect Scottish universities strategies towards

entrepreneurial activities and in turn what implications this shift in policy may have for individual academics who currently do, or do not, participate in commercialisation and engagement activities. It must be remembered that individual universities are organisations and the following section of the study will provide an overview of the organisational factors identified in the wider literature.

2.9.3 Organisational Factors

Organisation factors can be examined in the wider context such as university type or level of resources available for innovation. They can also be examined against the local context in which an academic works and aspects relating to both wider context and local context will be explored in the following sections.

2.9.3.1 University Type

A key organisational-level determinant for academic participation in entrepreneurial activities has been found to be the academic quality of research output from the academics' university. Previous studies have suggested that commercialisation activities tend to be concentrated amongst the top-ranked universities, while engagement activities are more prevalent in less research intensive universities (D'Este & Patel, 2007; Di Gregorio & Shane, 2003; Ponomariov, 2007). It has been suggested that this may be because universities with lower ranked research outputs may find it more difficult to compete with higher ranked institutions for research grants, as a result this may motivate academics to participate in commercialisation and/or engagement activities as a means of acquiring research funds (Perkmann et al., 2013). However, more recent studies have shown that both commercialisation and engagement activities are becoming part of the everyday activities of all universities (Hughes, et al., 2016; Hughes & Kitson, 2012; Abreu & Grinevich, 2013; Markman et al., 2008)

2.9.3.2 Resources for Innovation

The availability of resources for academic entrepreneurship suggest that this could be an important determinant. Abreu & Grinevich, (2013) discuss that academic entrepreneurship requires increased innovation when compared to academic's core duties and the level of organisational resources for innovation could determine an academic's level of participation in commercialisation and engagement activities. In the wider organisational literature Scott & Bruce (1994) studied the antecedents of innovation and discuss that adequate supplies of resources such as funding and allocating sufficient time are critical elements in innovation, and the supply of such resources is a manifestation of any particular organisations support for innovation.

2.9.3.3 Local Context

In the wider entrepreneurship literature it has been identified that entrepreneurial action can be influenced by local contextual factors. For example, Nanda & Sørensen (2010) examined data from the Danish Integrated Database for Labour Market Research from 1990 to 1997 (which is collected and maintained by the Danish Government) in order to understand more about work place peers and whether these co-workers increase the likelihood that an individual will perceive entrepreneurial opportunities as well as increase their motivation to pursue those opportunities. The authors found that an individual is more likely to become an entrepreneur if his or her co-workers have been entrepreneurs before and that these peer influences are greatest for those individuals who have had less exposure to entrepreneurship in other areas of their lives. While Roach & Sauermann (2015) examined both founders and "joiners"(start-up employees who are attracted to entrepreneurship, but who do not want to be founders themselves) entrepreneurial activity. The authors found that contextual factors such as norms and role models exhibit different relationships with founder and joiners. Their results suggest that entrepreneurial preferences and context interrelate in unique ways to shape different

entrepreneurial interests with contextual factors do little to shape a founder's interest. On the other hand, an individual who is interested in being becoming a "joiner", is associated with that particular preference and contextual factors, and this relationship is strongest for individuals who have preferences towards this form of entrepreneurship.

In the academic entrepreneurship literature, very few studies have sought to understand how the local context helps shape why academics participate or not in commercialisation and engagement activities (e.g. Louis et al., 1989; Stuart & Ding, 2006; Haeussler & Colyvas, 2011; Tartari et al., 2014). Perkmann et al. (2013, p.432) have identified that there is a current lack of understanding in relation to "how individuals respond to local norms, such as those prevailing in their immediate, departmental work contexts and how these relate to different academic disciplines". The following sections address areas relating to the academic's local context.

2.9.3.3.1 Management Responsibility

One characteristic that has received little attention in the wider literature is whether an academic has management responsibilities. Grimpe & Fier (2009) found that having responsibility for subordinates (through leading a department or research group) mattered for participation in technology commercialisation and consulting but not for publication outputs. They reasoned that individuals with management responsibilities have a higher incentive to acquire money in order to finance their subordinates. This suggests that having management responsibilities, where individuals are responsible for subordinates, may act as an incentive to participate in commercialisation and engagement activities in order to generate income to help finance their group or department.

2.9.3.3.2 Leadership

Bercovitz and Feldman (2008) tracked 1,780 faculty members, examining their backgrounds and work environments. They suggested that although individual attributes are important, an academic's commercialisation motives are sometimes conditioned by their local work environment. In their research they found that if the department chair (the leader) had disclosed any inventions to the TTO in the past five years, then the probability that a faculty member will also disclose, increased by 4%.

In the wider management literature, it has been identified that leaders play important motivational roles in all organisations (Johnson et al., 2010) by dictating the feasibility (as the allocator of resources) and desirability (influencer of attitudes and values) of entrepreneurial outputs. As leadership is concerned with the ability to engage others in the pursuit of common cause, levels of commercialisation engagement within groups may be dependent upon the leadership styles displayed. In the wider literature two key leadership styles have been identified that can influence subordinates; transformational and transactional, leadership (Bass & Avolio, 1994). Transformational leadership, has been described as resulting in the transformation of organisations or individual followers and has been associated with the encouragement of innovation in organisations (Bass & Avolio, 1994; Howell & Higgins, 1990). Furthermore, evidence suggests that behaviours, such as openness to change, creativity, risk-taking, increased confidence and proactive behaviour, such as taking action and being less likely to support status quo, are associated with transformational leadership (Avolio, Bass & Jung, 1999; Bass, 1985; Epitropaki & Martin, 2005; Jung, 2001). Bass & Avolio, (1994) describe transformational leadership behaviour as comprising four components, inspirational motivation, idealised influence, individualised consideration, and intellectual stimulation. Inspirational motivation encompasses the ability to inspire and motivate employees and to display optimism and enthusiasm. When the leader proves to be an aspirational role model by practicing what they preach, then this is idealised influence. Individualised consideration comprises support provision, encouragement and coaching. When the leader strives to promote innovative, creative and problem-solving

behaviours, this is intellectual stimulation. Employee behaviours and subsequent performance and outputs are therefore likely to be linked to the effectiveness of their leader.

The emergence of transactional leadership is more likely in environments where conformity and tradition are present. Transactional leadership is often described as rewarding compliance, or by motivating to avoid penalty. Transactional leaders serve to clarify role and task requirements in employees. The aim of transactional leadership is to enhance the compliance of followers to the leader, by way an exchange process between the leader and followers, and in turn obedience of the departmental rules (Bass & Avolio, 1994). Research suggests that behaviours such as preference stability and the status quo, non-creative, risk-aversion, being reactive as opposed to proactive, are associated with transactional leadership (Bass, 1985; Epitropaki & Martin, 2005; Jung, 2001). Leaders who maintain tight control by emphasising compliance with historic rules and procedures, by taking greater control of the progress and quality of the work and by regulating the entrepreneurial activities of individuals within the departmental unit, would rate high for transactional behaviours. This type of behaviour is aimed at controlling others for the purpose of preserving the status quo, or supporting incremental change as required for the purposes of efficiency. Eyal & Kark (2004), found that transactional leadership is related to moderate to low levels of leaders' entrepreneurial behaviour.

2.9.3.3.3 Group Norms

In a US study, Owen-Smith and Powell (2001) drew upon 68 semi-structured interviews in an attempt to begin unraveling the effects of the institutional environment on the decision of faculty to patent. They found that faculty considerations of the costs and benefits of disclosure are largely determined by institutional environments that are either supportive or oppositional to the simultaneous pursuit of academic and commercial endeavours. Some researchers have found that an academics motives to participate in commercialisation activities can also be affected by the organisational or

group-level norms. Louis et al. (1989) who surveyed 778 academics from 40 US universities found that the local norms were more powerful predictors of various types of participation in commercialisation activities than individual characteristics, although importantly they found that the majority of academic groups in universities were not able to develop the norms that encourage different forms of academic entrepreneurship. Kenney & Goe (2004) who surveyed faculty within the electrical engineering and computer science departments at Berkley and Stanford universities, found that individuals who are working in an academic department with a supportive entrepreneurial culture can help to counteract the disincentives created by a university environment that does not strongly supportive of these activities. Exploring a sample of life scientists based in the United States, Stuart and Ding (2006) found that the greater the involvement of university and department colleagues, the more likely an academic will become an entrepreneur, which they defined as a scientist founding a biotechnology company, or when they join the scientific advisory board of a new biotechnology firm. Rasmussen, Mosey and Wright (2014) followed four unsuccessful and four successful attempts at venture creation within academia. They found that small differences in departmental support from both the management and senior academics towards gaining commercialisation experience and exploring the opportunity were seen to have a positive impact upon subsequent exploitation outcomes. Entrepreneurial ventures that were supported gained momentum as the department helped develop entrepreneurial competencies. On the other hand, a lack of departmental support for entrepreneurship severely constrained the evolution of spin-offs regardless of any university level policies and practices implying that the department plays an important role in the entrepreneurial process. Haeussler and Colyvas (2011) study of 2200 German and UK life scientists found that the need to maintain one's reputation and subsequent motivation was generally linked to group-level norms, where they discuss that if an academic's peers value patents and awards, then other academics in the group were more likely to participate in commercialisation activities, whilst they found the opposite was true if their colleagues value scientific outputs which in turn shaped the entrepreneurial climate of the group.

2.9.3.3.4 Peers

Other researchers have identified that an academic's motives to participate in commercialisation activities can be affected by certain peers. In a study of 1370 UK scientists, Tartari et al. (2014, p.1190) argue that "the influence of the local environment on academic scientists is in the form of peer effects, manifested by emulation of the behaviours of colleagues of the same rank". They found that senior faculty members tend to compare themselves with others whom they consider as having similar attitudes or abilities, and that this peer group of similar ranked individuals acts an important reference group within the wider social context. They go on to discuss that because peer group members are likely to have similar achievement records, they can be legitimately used as a yardstick for the individual's self-evaluation. Aschhoff and Grimpe (2014) in their study of 355 German biotechnology scientists which examined a scientist's career age and the influence of workplace peers and personal collaborators and whether these factors moderated a scientist's involvement with industry. The researchers found evidence of departmental peer effects, in addition to personal peer effects (co-authors) and that a scientist's involvement with industry increased based on their departments orientation toward industry. They found that these factors are in turn moderated by the scientist's career age, and that localised peer effects decrease with age and finally turns negative senior scientists. Drawing on a sample of 437 research scientists from Swedish and German universities Huyghe and Knockaert (2015) looked at the impact of university culture and climate on an academics entrepreneurial intentions, including intentions to spin off a company, patent or licensing and to interact with industry through contract research or consulting. The researchers found that the presence of university role models positively affects research scientists' propensity to engage in entrepreneurial activities, both directly and indirectly through entrepreneurial self-efficacy. Wright et al. (2004) discuss that successful commercialisation by academics, not only demonstrates the feasibility of acting entrepreneurially to other faculty members but they can also act as role models. Hayter (2011) whose study was focused on the establishment of spin-off companies also identified that some respondents had

been influenced by entrepreneurial peers, but these peers were often out with the university or those who were actually working within their university were often viewed as rebels by the wider university community. The author also discussed that several respondents in his study viewed some of their peers negatively, and they were instead identified as an obstacle in their efforts to commercialise their research outputs.

2.10 Theoretical Perspective

The studies reviewed above have used a variety of theoretical lenses through which to examine the areas of interest. Theories used include theory of planned behaviour, identity, self-determination, self-efficacy. It would however appear from the literature, that when looking at multi-level determinants one promising theory is Regulatory Focus Theory (Wu et al., 2008; McMullen & Zahra, 2009) as it enables the researcher to take into account both individual and situational factors. The following section of the literature review will therefore provide an overview of Regulatory Focus Theory. This will be the theory used in this study to explore how local contextual factors can impact an academic's intentions to participate in entrepreneurial activities.

2.10.1 Regulatory Focus Theory

According to Regulatory Focus Theory, our motivational style is defined by the different strategies we employ towards our goals (Higgins, 1997, 1998). The idea that under status quo conditions, individuals will attempt to seek pleasure and avoid pain is the underlying principle of the socio-cognitive concept of self-regulation. As individuals are motivated to make decisions which produce positive outcomes (Freitas et al., 2002), an individual's self-regulatory process defines how individuals have approach or avoidance orientations, dependent on the situation they find themselves in (Förster, Higgins, & Idson, 1998). Self-regulatory processes describe why individuals act the way they do, have more confidence in achieving goals than others and why individuals set different goals or implement differing strategies to achieve their goals (Higgins, 1997;

Higgins, 1998). One of the most influential theories of self-regulation is regulatory focus theory (Higgins, 1998) which posits the existence of two distinct modes as to how people regulate their behaviour.

Regulatory focus theory (Higgins, 1997) suggests that decision making and motivational behaviour is largely determined by how individuals allocate their attention (Higgins, 1997; McMullen & Zahra, 2009) and that there are two chronic systems that individuals use to regulate their behaviour which are promotion or prevention focus (Higgins, 1997). These two foci describe two distinct socio-cognitive styles that differ along several dimensions namely “the underlying motives that individuals are trying to satisfy, the nature of the goals or standards they are trying to attain the types of outcomes that are salient to individuals” (Brockner et al. 2004, p.208) and the means to achieve these goals and outcomes (Higgins, 2000). As an individual’s chronic regulatory focus is an established personality trait (Higgins, 1997), regulatory focus theory offers the opportunity to explain why some individuals have more confidence in achieving goals than others and why individuals set different goals or adopt differing strategies to achieve their goals (Higgins, 1997 & 1998). As a result, each regulatory focus has different outcomes linked to individual perceptions, decision making, which in turn affects their behaviour and performance (Higgins, 1997, 1998).

When individuals adopt a promotion focus, they are concerned with the presence or absence of positive outcomes. Individuals experiencing a promotion focus are interested in maximal goals (Higgins et al., 2001) and would attempt to maximise the return in risk-return decisions. Individuals in a promotion orientation adopt strategies of goal pursuit which promote desired outcomes (Crowe & Higgins, 1997), recall information relevant to success (Higgins & Friedman, 2001), ensure hits and attempt to ensure against misses (Higgins, 1998) and are more prone to emotions along the cheerfulness–dejection dimension (Brockner & Higgins, 2001). Individuals with a promotion focus are more concerned with advancement, growth and achievement, with the normal strategy being eagerness means approach with individual striving to achieve the ideal ‘self’ (Higgins, 1998). Individuals experiencing such a focus will look for hits or means of advancement and attempt to safeguard against errors of omission. An

individual considering goal pursuit in a promotion orientation would have a disproportionate focus of attention towards “the benefits that are expected if one chooses to act and is successful in that endeavour” (Wu et al., 2008 p.589).

In contrast when individuals adopt a prevention focus, they are concerned with the presence or absence of negative outcomes and meeting the standards of an ‘ought’ self. A prevention focus elicited by potential loss scenarios emphasizes minimal goals (Higgins et al., 2001), for example attempting to minimise the risk in risk-return decisions. Individuals adopt vigilant strategies of goal pursuit which are oriented towards preventing negative outcomes, are sensitive to information regarding the presence or absence of loss, are more prone to emotions along the quiescence–agitation dimension and are more likely to recall information related to the avoidance of failure (Higgins, 1997; Higgins, 2002). As prevention focus is concerned with security, safety, obligation and the presence and absence of negative outcomes, the natural strategy adopted would be a vigilant means approach (Förster et al., 1998). With goals being seen as the duties and responsibilities that an individual feels they ‘ought’ to be attaining (Higgins, 1998). Individuals experiencing a prevention focus tend to be more cautious, attempt to make correct rejections and try to safeguard against errors of commission (Förster, Higgins & Bianco, 2003; Higgins et al., 2001). An individual considering goal pursuit in a prevention focus would have a disproportionate focus of attention towards, “the costs that are expected to be incurred if one chooses to act and is unsuccessful in that endeavour” (Wu et al., 2008, p.590).

Therefore, as opposed to being two extremes of a continuum, prevention and promotion foci are distinct and different (Figure 8). The underlying motivations are conflicting, one being for advancement, growth and accomplishment, the other being to ascertain responsibility, safety and security. Therefore, prevention focused individuals may be more likely to maintain the status quo, whereas promotion focused individuals are more likely to seek achievement, advancement and welcome change (Shah et al. 1998). The presence of these different foci has been confirmed by asymmetry in frontal cortical activity, demonstrated using electroencephalography (EEG) testing. Promotion focus was found to be related to an increase in activity in the left frontal cortex and

prevention focus related to an increase in activity in the right frontal cortex (Amodio et al., 2004). These findings indicate that individuals focusing either on promotion or prevention self-regulation, impact an individual's perceptions, decision making processes and ultimately their means of goal attainment (Crowe & Higgins, 1997; Higgins, 1998).

Figure 10. Dimensions of Regulatory Focus Theory: Promotion vs. Prevention focus.

	Promotion focus	Prevention focus
Underlying motives	Advancement, growth, and accomplishment	Security, safety and responsibility
Goals or standards	Maximal goals: hopes and ideals	Minimal goals: duties and obligations
Salient outcomes	Attaining hits and avoiding misses	Attaining correct rejections and avoiding false alarms
Means (Strategy)	Eagerness means	Vigilance means

2.10.1.1 Situational Regulatory Focus

Although one's regulatory focus is typically considered a chronic disposition (a personality trait), certain environmental factors may alter an individual's chronic regulatory focus. Antecedents to an individual's regulatory focus include needs, values, and situational framing or situational cues (Higgins, 1997). It is therefore important to understand how both situational and chronic regulatory focus can influence an individual's behaviour and actions (Förster et al., 2003). As at any one time, an individual may be regulating their behaviour with either a promotion or prevention focus (Higgins, 1998), situational factors can also influence the regulatory focus and individual adopts (Higgins, 1997), When strong situational cues are not present, an

individual's chronic tendencies will dominate and vice versa when strong situational cues are present (Wu et al., 2008), when strong situational cues are lacking, an individual's chronic regulatory focus dominates, but where situational cues are present and the possibility of gains or losses exist, this may lead to an individual eliciting an alternative regulatory focus (Keller & Bless, 2006). Evidence from regulatory focus theory research show that contextual cues can affect an individual's situational regulatory focus through an organisational rewards system or the priming of hopes or duties (Higgins, 2000). It is believed that certain individuals working in their workplace can influence others by strongly engaging various aspects of one's self-concept. Self-concept is dynamic and is therefore influenced by situation, context and external factors. The view of self can be regarded as comprising 'modular processing structures', otherwise known as 'self-schemas.' The elicitation of these schemas is context specific and each has specific cognitive, affective and behavioural outcomes. As a result, it has been suggested by Brockner and Higgins (2001), that contextual cues coming from leaders operating in the local context are often 'makers of meaning,' and may influence the regulatory focus of those they interact with via their use of language and their own behaviour and actions. The authors suggest that if a particular leaders message is one of 'ideals' then it is more likely to elicit a promotion focus, whereas if it pertains to responsibility, then it is more likely to elicit a prevention focus.

This has been demonstrated in studies where manipulation has been used to elicit a certain regulatory focus. Researchers through undertaking numerous lab studies have found that when an individual is exposed to certain stimuli (i.e. they are primed), this can manipulate their regulatory focus (Lieberman & Idson, 1999; Crowe and Higgins, 1997; Friedman and Förster, 2001). Priming is an effect in which exposure to certain stimuli influences response to a later stimulus and can be used to influence individuals in both positive and negative ways. Priming activates goals, which are often representations of desired end-states, thereby eliciting actions and behaviours in individuals which are consistent with attaining particular goals (Cesario et al., 2008). These goals are thought to reside in our memories as mental representations, often without us being aware of them with researchers demonstrating priming and mimicry

effects on goal performance (e.g. Dijksterhuis & Van Knippenberg, 1998; Lakin & Chartrand, 2003). Kirk and Mcsherry (2012) studied the effect of non-conscious goals on investment choice by priming individuals with environmental cues such as ‘luxury’ and ‘thrifty’, they found that individuals primed with luxury cues were 248 times more likely to choose a high-risk investment plan rather than the conservative low risk choice. Interestingly the researchers found that the behavioural strength of the non-conscious goal pursuit of such ‘luxury’ primes did not diminish over time. Contextual cues and priming therefore affects how individuals sub-consciously pursue goals and can also change the way individuals behave over periods of time.

2.10.1.2 Regulatory Reference

Regulatory focus theory (Higgins, 1997) suggests that decision making, and behaviour are largely determined by how individuals allocate their attention. As a result, Higgins (1997) discusses a further self-regulatory principle, which is that individuals can also use salient reference points in order to guide their behaviour. This is referred to in the cognitive psychology literature as regulatory reference (Higgins, 1997) and is independent of, but complementary to, regulatory focus. As regulatory reference views ‘approach versus avoidance; in terms of an individual’s movement in relation to given reference points. This means, if individuals view a particular reference point as having positive value, this will correspond to them experiencing attraction toward it and - they will try to approach it. If individuals experience a reference point as having negative value, this will then correspond to them experiencing repulsion from it – they will attempt to avoid (Higgins, 1997). Higgins (1997) proposed that regulatory reference research remained incomplete and suggested that regulatory focus theory be used in combination with the reference point to explain why individuals adopt different strategies when choosing amongst alternatives.

2.10.1.3 Regulatory Focus and Values

The independence of promotion and prevention focus has also been found to be consistent with Schwartz's (1992) values theory, which organises ten basic values into two orthogonal axes, "one varying from promotion values (self-direction and stimulation) to prevention values (conformity, security and tradition) and the other from collectivistic (universalism and benevolence) to individualistic values (achievement and power)" (Johnson et al. 2010, p.232). Schwartz (1992) outlines that values are beliefs or conscious concepts about what are desirable behaviours or end states that guide the evaluation or selection of behaviours. Leikas and Lönnqvist (2009) studied the effect of prevention and promotion foci on personal values. Their results indicate that regulatory foci are associated with certain values which increase motivation in promotion versus prevention situations. In their study, they found that a chronic promotion focus was positively associated with achievement and negatively with tradition values, whereas a chronic prevention focus was positively associated with security and conformity and negatively with self-direction and stimulation values. As values serve as strong regulatory guides, they are also likely to play a key role in an individual's motivational and cognitive processes. Value congruence refers to the similarity between an individual's values and the cultural value system within an organisation, department or group (Kristof, 1996). Value congruence may affect academics attitudes and behaviours towards exploiting their research because individuals are more attracted and trusting of others who are similar to them (Cable & Edwards, 2004).

2.10.2 Regulatory Focus and Entrepreneurship

Journal articles using regulatory focus theory as a theoretical lens are extremely rare in studies of academic entrepreneurship (other than Foo et al., 2016 and Johnson, 2017) and the researcher is not aware of any other studies using regulatory focus theory at this time). This section will therefore draw upon evidence from the wider literature, in an attempt to provide a greater perspective and understanding of how different

regulatory orientations and situational and contextual cues may affect an academic's entrepreneurial behaviour. The wider entrepreneurship literature suggests that certain individual factors distinguish those who act more entrepreneurially, from those who do not. At any particular point in time, an academic who is considering entrepreneurial action, may find themselves confronted with a number of factors that have been identified towards taking entrepreneurial action. While these factors are varied, this section of the literature review focuses on those factors for which evidence supporting regulatory focus theory and entrepreneurial outcomes are strongest, namely; creativity (Wu et al., 2008), opportunity recognition (Shane, 2000), tolerance for risk and uncertainty (Sitkin & Pablo, 1992), entrepreneurial self-efficacy (Chen & Greene, 1998), and an individual's intention to take entrepreneurial action (Krueger & Carsrud, 1993).

2.10.2.1 Regulatory Focus and Creativity

The introduction of new products, services and process that national and regional economies rely on to stimulate growth, are often the result of entrepreneurial actions. Within this context, it is therefore important academics be open to participating in commercialisation and engagement opportunities. Amabile, Conti, & Coon, (1996 p. 1155) have described creativity as “the production of novel and useful ideas in any domain”, these often form the seeds of new innovations and cognitive perceptions and are likely to impact an individual's motivation to implement new ideas. As individual creativity is also the foundation for organisational or department creativity (Amabile et al., 1996; Amabile, 1997), factors affecting academics creativity and their subsequent entrepreneurial actions are likely to be important factors to understand (Bharadwaj & Menon, 2000). Within the university environment, levels of creativity are likely to vary. Universities may expect academics to undertake novel research that could yield not only publications but also have the ability to generate income streams from commercialisation activities (Bercovitz & Feldman, 2008). The environmental demand for new knowledge, products, processes and services from university departments may affect academics in differing ways, leading them to produce either incremental research

outputs or to develop disruptive and radical new breakthrough technologies, processes and services.

Brockner, Higgins, & Low, (2004) discuss that chronic promotion focused individuals show greater creativity than chronic prevention focused individuals. Promotion focused individuals have shown that they are more creative, but they are also more willing to consider new ideas and are more inclined to 'think outside the box' compared with prevention focused individuals (Friedman & Förster, 2001). In addition to the individual's chronic regulatory focus it has been found that actors working within the individual's local environment can also moderate the situational regulatory focus of subordinates' creativity. Wu et al. (2008) surveyed 191 leaders and employees from a Chinese firm and they found that the promotion focused behaviours and actions displayed by their leader were found to be significantly related to an employees' subsequent creativity. These results suggest that a leader demonstrating promotion focused behaviour is more likely to elicit a promotion focus in their employees, resulting in increased levels of creativity. In the same study, they also discovered that a leader eliciting prevention focused behavior had no significant effect on employee creativity. This suggests that despite an individual's chronic regulatory focus, the behavior and actions of peers working in an academic's local context may elicit a situational promotion focus. This in turn should lead to those academics generating a greater number of novel research ideas and in turn more heterogeneous departments. An academic with a primed situational promotion-focus should consider more novel research alternatives, increasing the number of potential avenues for future entrepreneurial action. Covin & Slevin (1989) demonstrated that active and heterogeneous environments fostered increased entrepreneurial behaviours. This suggests that peers, who provide situational cues that can prime academics with a promotion focus, will enhance their creativity leading to more novel behaviours and potentially more disruptive and innovative research outputs. Peers priming academics with a prevention focus are more likely to induce status quo conditions, motivating academics to generate ideas in existing areas of strength and therefore more incremental and less disruptive research outputs.

2.10.2.2 Regulatory Focus and Opportunity recognition

Opportunity recognition is viewed ‘as a key step in the entrepreneurial process, one from which in many cases all else follows’ (Baron, 2006, p. 104). Shane (2000), discovered that individuals from different backgrounds and experiences who assessed the same innovation recognised and then subsequently developed different business opportunities. Shane’s study provides some evidence that contrasting personal experience and backgrounds, combined with the spectrum of entrepreneurial channels, may impact an individual’s ability to recognise and exploit opportunities within the academic environment. Regulatory focus theory has been used to explore how the focus that an individual is currently experiencing, may impact on their ability to recognise opportunities (Bryant, 2007). Individuals experiencing a promotion focus, being concerned with achieving gains, are more likely to proactively look for opportunities than those with a prevention focus. A more cautious approach would be demonstrated by individuals experiencing a prevention focus, as they are concerned with error avoidance (Baron, 2004). The conclusion being that promotion focused individuals should be more likely to recognise greater number opportunities than those with a prevention focus. Tumasjan & Braun, (2011) empirically tested whether regulatory focus is associated with opportunity recognition and their research demonstrated a significant relationship between promotion focus and opportunity recognition whereas prevention focus was not found to be significantly related to opportunity recognition.

Individual differences in their adeptness of being able to identify high from low potential opportunities, are therefore likely to play an important role in the academic entrepreneurial process. Therefore, chronic promotion focused academics (or academics with a situationally induced promotion focus) are more likely to set lower thresholds as to whether an opportunity to participate in academic entrepreneurial activities exists (attaining hits) and will therefore be more inclined to identify a greater number of perceived opportunities (Baron, 2004), across the academic entrepreneurial spectrum. On the other hand, chronic prevention focused individuals (or academics with a situationally induced prevention focus), should therefore set higher thresholds as to

whether an opportunity to participate in academic entrepreneurial activities exists. As they seek to avoid losses, they will be more cautious when assessing opportunities and identify fewer perceived opportunities (attaining correct rejections) limiting the choice of activities across the entrepreneurial spectrum.

2.10.2.3 Regulatory Focus and Risk, Ambiguity and Uncertainty

Research undertaken by Sarasvathy, Simon, and Lave, (1998) showed that individual factors have an important role, as individuals differ in how they consider and process information. Risk perception varies because individuals access different 'cognitive spaces', when trying to find solutions to problems. Their study, which observed bankers and entrepreneurs across a range of situations, reported that although entrepreneurs believe that risk is inevitable, they look to control and take responsibility for the outcomes. The bankers concentrated on risk control whilst avoiding options that encompassed increased individual responsibility. Friedman and Förster (2001), while studying creative thought, found promotion cues produced a risky response bias compared to prevention cues, where a risk-averse response bias was found. Crowe & Higgins, (1997) found that individuals who were engaged in signal detection tasks, the outcome being to decide if a signal was present, found that those individuals in a promotion focus had a risky response bias and answered 'yes' when they detected a signal even if they were not sure; whereas individuals in a prevention focus were more conservative and took more time to respond and answered 'no' when they were not sure.

Tolerance for ambiguity has been described as the tendency to view situations, without clear outcomes, as attractive (Budner, 1962). Studying the role of regulatory focus in ambiguity aversion, Liu (2010) established that prevention focused individuals were less likely to select ambiguous opportunities than promotion focused individuals, when choosing between investment alternatives. Individuals in a promotion focus anticipated a higher likelihood of success from ambiguous options, than those with a prevention focus. An interest in 'hits' even when the probability of success may be low

(Higgins, 2000), means that individuals with a promotion focus may be more open to entrepreneurial activities where the outcomes are uncertain (Hmieleski & Baron, 2008).

The success of the entrepreneurial university is likely to be closely tied to the way that academics and their leader perceive and manage risk and uncertainty. Since the academic entrepreneurship spectrum ranges from inherently uncertain activities (e.g. Spin-off and licensing), where a lack of information exacerbates uncertainties and increases the chances of failure, to a perceived high certainty (e.g. CPD) of a successful outcome, it is likely that the attitude of peers in the local context towards commercialisation and engagement activities may ultimately influence the risk and ambiguity perceptions of academics. Tversky and Kahneman (1991) provide evidence that an individual's attitude to risk depends on the status quo and on whether perceived outcomes are gains or losses in relation to that particular benchmark. Baron (1998, p.280) states, "when individuals imagine being better off than they currently are, they experience intense dissatisfaction with their current state of affairs. When they imagine being even worse off, however, they feel much more satisfied with the status quo". This logic suggests that as the level of risk and uncertainty decreases, an academic should have a much clearer understanding when the possibility of taking action exists, greater knowledge of what to do, and a better understanding of any risks and benefits associated with any decision.

2.10.2.4 Regulatory Focus and Self-efficacy

Self-efficacy is the belief that an individual is able to perform certain activities, or to effectively undertake certain actions to successfully accomplish particular goals (Bandura, 1977). Research has shown that high self-efficacy is an important determinant of successful entrepreneurial behaviours. Chen & Greene (1998), showed that self-efficacy is able to differentiate between non-entrepreneurs and entrepreneurs. As self-efficacy has a positive effect on entrepreneurial behaviours, it may similarly impact an academic's entrepreneurial activities. For example, individual's high in self-efficacy

should not only prefer the more challenging entrepreneurial activities but should also be more determined in those activities.

Leaders and their subsequent motivation of colleagues are likely to play an important role, as vicarious experience is an important factor in self-efficacy (Bandura, 1977). Seeing another colleague complete an entrepreneurial task without incident, will increase the belief in a person's capabilities. If they see somebody fail, they themselves become hesitant and this will either strengthen or weaken their perceived self-efficacy. Prodan and Drnovsek, (2010) examined academics intentions to 'spin out a technology' and found that entrepreneurial self-efficacy was the key predictor of entrepreneurial intent. This implies those academics who are high in self-efficacy should be more likely to considering entrepreneurial action. Bandura, (2001, p. 2) describes those high in self-efficacy as individuals who "make things happen." Individuals lower in self-efficacy tend to stay away from tasks which are perceived to be difficult and are likely to display lower aspiration and commitment levels. Tumasjan and Braun, (2011 p.632) empirically tested the relationship between regulatory focus theory and self-efficacy, where their results imply that entrepreneurs low in creative and entrepreneurial self-efficacy, significantly benefit from adopting a promotion focus. Strauss, Griffin, & Rafferty (2009), also found role based self-efficacy to be an important motivational construct. When leaders expressed encouraging messages to subordinates, this was positively related to individuals' confidence in their ability to undertake a range of tasks. This suggests that certain peers working in the local context, through the priming of a promotion focus or situational cues, may increase the range across the spectrum of entrepreneurial channels that academics believe they are capable of doing. Therefore, this might indicate that academics low in self-efficacy may significantly benefit from the adoption of a situational promotion focus.

The following table (Table 2) sets out the entrepreneurial dimensions of regulatory focus that have been found in prior entrepreneurship research.

Table 2. Entrepreneurial Dimensions of Regulatory Focus Theory: Promotion vs. Prevention focus.

Entrepreneurial behaviour	Promotion focus	Prevention focus
Creativity	Higher levels of creativity	Lower levels of creativity
Opportunity recognition	Sets low thresholds: Identify a greater number of exploitation opportunities	Sets high thresholds: Identify a lower number of exploitation opportunities
Risk, uncertainty and ambiguity	Risk seeking, increased tolerance of uncertainty and ambiguity	Risk avoidance, increased intolerance of uncertainty and ambiguity
Self-efficacy	Higher-self efficacy	Lower-self efficacy

2.10.2.5 Regulatory Focus and Entrepreneurial Intentions

No opportunity is exploited without entrepreneurial action (Bird, Schjoedt, & Baum, 2012). An individual’s motivation to undertake entrepreneurial behaviours has normally been examined in respect of their entrepreneurial intentions (Krueger & Carsrud, 1993; Krueger, Reilly, & Carsrud, 2000). The greater the intention, the stronger one’s motivation to take entrepreneurial action (Carsrud & Brännback, 2011; Locke, 1968). Sheppard et al. (1988) conducted a meta-analysis review of empirical studies and found that intentions were found to successfully predict behaviour. It is believed that intentions “capture the motivational factors that influence a behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert in order to perform the behavior. As a general rule, “the stronger the intention to engage in a behavior, the more likely should be its performance” (Ajzen, 1991 p.191).

McMullen and Shepherd (2002) examined the effects of regulatory focus and how individuals identify and evaluate opportunities on 142 US students who were about

to graduate. Their results showed that increased entrepreneurial intent, stemmed from increases in the perceived gains related to taking entrepreneurial action and that the effect was greater for promotion focused individuals than for prevention focused individuals. They found that ‘lucrative’ opportunities, which were opportunities that were presented to individuals that had perceived high benefits and low costs, caused individuals primed to elicit a promotion focus to display heightened entrepreneurial intentions.

In the academic setting, Foo et al., (2016) investigated the interaction between their promotion focus and an academic’s work and family environments, in an attempt to predict the entrepreneurial intent of 208 Norwegian research scientists. The results of their study found that a promotion focus did not by itself predict the research scientist’s entrepreneurial intentions but instead it was the relationship between an individual’s entrepreneurial intentions and environmental factors. Interestingly, they found that joint individual and environmental factors, not either factor alone, predicted entrepreneurial action especially when a scientists’ parents have owned a business or when they work in laboratories with are financed more by industry research. Importantly, the authors did not report how these environmental factors affected prevention focused individual’s entrepreneurial intentions as they only used promotion focus as a measure in their article.

2.11 Conclusion

The purpose of this chapter was to review the literature associated with academic entrepreneurship accounting for the background, development and current debate surrounding the concept. For the purposes of this study the entrepreneurial activities of academics are defined as activities that occur “beyond the traditional academic roles of teaching and/or research, is innovative, carries an element of risk, and leads to financial rewards for the individual academic or his/her institution” (Abreu & Grinevich, 2013, p.408). As a result of this definition, a spectrum of entrepreneurial activities (figure 8), which sets out the commercialisation and engagement activities that will be analysed in

this study, has been created. The spectrum of entrepreneurial activities of academics in this study include interactions with businesses, the public sector and the third sector via engagement (CPD, collaborative research, contract research and consulting) and commercialisation (licensing and company creation) activities. The participation of academics in these commercialisation and engagement activities consistently generate significant revenues for universities and will lead to academics taking on various levels of risk and uncertainty when they participate in these activities.

It was also identified from the review of the literature, that prior research has often tended to focus on both commercialisation activities and on the academics, who work in STEM related disciplines. However, more recent research has found that academics are participating not only more frequently in engagement activities (compared to commercialisation), but many academics who are actively participating in entrepreneurial activities are working in non-STEM disciplines. As a result, this thesis will include in its analysis not only the intentions of academics to participate in both commercialisation and/or engagement activities but will also examine academics who work in STEM and non-STEM disciplines.

Turning to contextual factors, Perkmann et al. (2013, p.432) have identified that there is a current lack of understanding in relation to “studying how individuals respond to local norms, such as those prevailing in their immediate, departmental work contexts and how these relate to different academic disciplines”. Through gaining a greater understanding of how the academic’s context shapes their entrepreneurial intentions this may provide useful ideas for institutional strategies which are aimed at supporting academic participation in commercialisation and engagement activities or mitigating any adverse factors identified. From the review of the small body of literature, a number of local contextual factors were identified which include, the department chair, peers of the same rank, peers working outside the university, group norms and institutional norms as having the potential to influence academic behaviour and engagement in commercialisation and engagement activities.

A second key contextual factor that has the potential to affect academic participation in commercialisation and engagement activities was identified from the

literature review. This is the shift in Scottish government policy where outcome agreements have been introduced, so that Scottish universities are required to demonstrate their contribution towards the Scottish Government's economic strategy. The outcome agreements, cover outputs from a wide range of commercialisation and engagement activities, and as a result, universities can be held accountable against the level of income they generate from participating in engagement activities, or the number of companies started/or licenses granted against the pre-agreed outcomes, which will determine a university's future funding from the SFC.

As a theoretical anchor, this thesis will draw upon regulatory focus theory which, at a theoretical level, and as fundamental motivational and attentional theory which perhaps offers the potential to understand both how individual motives and contextual cues may shape an academic's motivation to participation in commercialisation and/or engagement activities. The review of regulatory focus theory above gives this thesis a starting point to enable a theoretical model to be developed in order to answer the research aim.

To further explore the issues identified in this chapter, the following chapter will discuss the most appropriate research design that can meet the needs of the research gap identified, in order to understand how both the introduction of the SFC outcome agreements and which local contextual factors are most likely to affect academic entrepreneurial intentions in Scottish universities.

Chapter 3 Research Philosophy and Design

3.1 Introduction

In the previous chapter, it was identified that the recent introduction of outcome agreements between Scottish universities and the SFC (institutional context) may impact how universities consider their academics participate in commercialisation and engagement activities. Secondly, the academics' local context is a less well understood area with multiple peers, social norms and institutional norms being identified as potentially affecting an academics motivation to participate in entrepreneurial activities (Louis et al., 1989; Bercovitz & Feldman, 2008; Stuart & Ding, 2006; Tartari et al., 2014; Perkmann et al., 2013). Therefore, in order to gain a richer understanding of this underexplored context the initial step is to explore these factors within Scottish universities.

In the section that follows, the broad research aim and objectives will be re-stated and considerations relating to data collection will be examined. Then a discussion focusing on three philosophical paradigms, post-positivism, constructivism and pragmatism will be presented with a justification for the ultimate selection of a pragmatist approach. The approach described above supported a mixed methods approach, leading to a sequential-exploratory research design (Creswell, 2014) being adopted in this thesis. Finally, the different stages of the research are outlined, and methods of analysis are presented.

3.2 Aims and Objectives

The aim of the research is:

To investigate the individual and contextual factors that encourage or discourage academics in Scotland to participate in commercialisation and/or engagement activities.

This broad aim was designed to explore not only an academic's intention to participate in commercialisation (i.e. more uncertain outcomes; spin-offs / licensing) and/or engagement (i.e. more certain outcomes; contracting/collaboration/professional development) activities within the Scottish university context, but also to explore if certain factors in their organisational and local contexts affect their motivation and subsequent intentions. This would first require the identification of the key factors, before their impact could be studied. The unexplored issues surrounding how contextual factors shape an academic's entrepreneurial intentions motivated this research aim. This in turn, led to the first research objective:

To consider the individual and contextual factors that influence academic participation in entrepreneurial activities.

The first objective was initially explored using a qualitative research study, presented in chapter 4. The results of this qualitative stage led to a conceptual model which was then tested in the other empirical chapters within this thesis. As outlined in chapter two, participating in academic entrepreneurship implies that there are interactions between academics and certain contextual factors which may in turn shape their entrepreneurial intentions, the second and third objectives investigated how these factors might affect academics participating in commercialisation and engagement activities. Research objective two is:

To evaluate the identified individual and contextual factors that affect academic participation in commercialisation and engagement activities in Scottish universities.

This second objective was explored through a quantitative study, presented in chapter 5. This analysis was designed to test whether academic participation in commercialisation and engagement activities is driven by similar individual and contextual factors, or whether they are different types of phenomena that need to be treated separately by researchers and policy-makers. The final research objective is:

To explore if contextual factors impact the intentions of academics to participate in commercialisation and engagement activities differently, between STEM and non-STEM academics.

In order to accomplish this objective, the responses from academics working in the STEM and non-STEM disciplines were analysed and presented in chapters 6 and 7.

The range of methods outlined reflects the requirement for a mixed methods approach. An outline of the sequential exploratory design adopted, is presented in this chapter. In this project the quantitative data collection stage is designed to build on and explore the results of the qualitative research stage (Creswell, 2009; Teddlie & Tashakkori, 2009; Plano Clark & Ivankova, 2016). The philosophical underpinnings of the current research endeavour and their translation into the design of this research (Saunders et al., 2012; Plano Clark & Ivankova, 2016) are presented in the following section.

3.3 Research Philosophy

The undertaking of any research project will be influenced by philosophical ideas and these should be made explicit within any research plan (Creswell and Creswell, 2018). As such, it is considered unwise to commence a research project without acknowledging underlying philosophical issues. While the relationship between theory and data is hotly debated any “failure to think through philosophical issues, while not necessarily fatal, can seriously affect the quality of management research and are central to the notion of research design” (Easterby-Smith, Thorpe & Lowe, 2002, p. 27).

The purpose of this section is to explore the philosophical issues pertinent to this particular area of research. As has been demonstrated in the literature review, the research area is diverse but historically has leant itself to empirical studies. The critique of the corpus of knowledge is that it cannot be applied to all disciplines, includes consideration of numerous, multi-level factors and seeks to quantify outcomes. Easterby-Smith, Thorpe and Lowe (2002) propose that there are three main issues for consideration which are relevant to this piece of research. Firstly, particular approaches

are typically related to certain research designs which can help identify appropriate research methods. Secondly, understanding the philosophy should identify which research designs may work well and which may not, by demonstrating the limitations of particular approaches. Finally, a knowledge of philosophy can aid the researcher by identifying or creating suitable research approaches and designs which may otherwise have been outside the researcher's prior experience. Therefore, by acknowledging the philosophical underpinnings, researchers can provide a justifiable rationale for their decisions. This procedure of deciding a philosophical position requires both an appraisal of the differences between different positions, and a thorough evaluation of the researcher's beliefs about how knowledge is achieved (Creswell & Plano Clark, 2011).

Differing philosophical positions can be thought of as a 'set of beliefs' that guide one's actions and encompass paradigms, epistemologies, ontologies, methodologies and worldviews (Creswell & Creswell, 2018). Creswell and Creswell (2018) uses the term worldview to describe the philosophical orientation that a researcher brings to a study. Importantly, Creswell also describes that worldviews are shaped through, "discipline orientations, students' advisors/mentors inclinations and past research experiences" (Creswell & Creswell, 2018 p. 5). A researcher's beliefs will lead to them adopting a qualitative, quantitative or mixed method approach to their research. It is important to note that "research problems often require compromise designs, which draw from more than one tradition" (Easterby-Smith, Thorpe & Lowe, 2002 p. 27). The reasoning for the choices that influence the design of this research are discussed within this chapter.

Four of the principle worldviews are post-positivist, constructivist, transformative and pragmatic (Mertens, 2019) and these worldviews are described in terms of a research continuum. Branches of philosophy including ontology, epistemology, and methodology can be used to compare worldviews. These concepts are outlined in Table 3 (Easterby-Smith, Thorpe & Lowe, 2002 p. 31).

Table 3. Ontology, Epistemology and Methodology

Philosophical Term	Explanation
<i>Ontology</i>	Assumptions about the nature of reality
<i>Epistemology</i>	General set of assumptions about the best ways of inquiring into the nature of the world.
<i>Methodology</i>	Combination of techniques used to enquire into a specific situation.

Morgan (2007 p.58) characterised these three core concepts as the ‘metaphysical paradigm,’ defining metaphysics as consisting of “issues related to the nature of reality and truth.” Morgan (2007) discusses the perceived incompatibilities between ontological, and as result, epistemological and methodological perspectives. This has previously been described as an ‘incommensurability between paradigms’ (Kuhn, 1996) and it has been thought that researchers who decide to “operate within one set of metaphysical assumptions inherently rejected the principles that guided researchers who operated within other paradigms” (Morgan, 2007 p. 58). Morgan’s worldview offered an alternative to the popular positivist paradigm, by affording researchers a variety of ontological, epistemological and methodological perspectives and these are now commonly employed in business and social science research (e.g. Easterby-Smith, Thorpe & Lowe, 2002; Gill & Johnson, 2010). The worldviews commonly employed within business research are the post-positivist and constructivist paradigms. These will therefore be explored further in the following section.

3.3.1 Post-positivism and Constructivism

Post-positivism represents the traditional form of research and is strongly aligned to quantitative rather than qualitative research (Creswell & Creswell, 2018). For academic entrepreneurship research, it has proved useful for trying to quantify particular antecedents of academic entrepreneurship in large scale studies such as D’Este and Patel (2008) and Abreu and Grinevich’s (2013) studies of UK academics. Post-positivist thinking developed from positivism, and it challenges the concept of absolute truth of

knowledge. Post-positivist thinking recognises that “we cannot be absolutely positive about our claims of knowledge when studying the behaviour and actions of humans” (Creswell & Creswell, 2018 p. 6). However, the reliance on quantitative methods is retained (Teddlie & Tashakkori, 2009). For post-positivists, reality is observable, measurably and therefore objective in nature. Measuring observations numerically and studies of behaviour takes precedence in postpositive research (Creswell & Creswell, 2018). Post-positivists therefore typically take hypothetical approaches to research. The researchers utilise theory in order to develop hypotheses around a research question or objectives and then test them through statistical analysis, to allow the researcher to support or refute the theory (Creswell & Creswell, 2018; Creswell & Plano-Clark, 2011). Human behaviour can be observed and is therefore measurable if the behaviour is well-defined. However, cognitive processes are not observable and are therefore more difficult to measure. Measurements tend to be based on subjective experience and self-report (e.g. Toure-Tillery & Fishbach 2014).

In the last 50 years or so, the wide employment of positivism within the social sciences, has resulted in experiments producing results that did not fit into existing theories and therefore an alternative worldview has emerged (Easterby-Smith, Thorpe & Lowe, 2002). This alternative worldview is often associated with, or termed as, interpretivism and is known as constructivism or social constructionism (Creswell, 2014; Teddlie & Tashakkori, 2009). As a result, the constructionist worldview has evolved as a viable, and extensively used, alternative to positivistic research (Easterby-Smith, Thorpe & Lowe, 2002; Teddlie & Tashakkori, 2009).

Constructivists believe that individuals should attempt gain knowledge by subjective understanding around their experiences (Creswell & Creswell, 2018). In contrast with the reductionist or hypothetical approach, constructivists attempt to seek many viewpoints and often rely as much as possible on the participants’ views on the situation under exploration, so they can construct meaning (Creswell & Creswell, 2018). As a result, within constructivist research, subjective meaning is “not simply imprinted on individuals but are formed through interaction with others (hence social-constructivism) and through historical and cultural norms that operate in individuals’ lives” (Creswell &

Creswell, 2018 p. 8). Research employs inductive methods to develop theories or patterns of meaning (Creswell & Creswell, 2018). Methods used in constructivist research typically involve gathering, analysing and interpreting narrative data by the use of thematic analysis (Teddlie & Tashakkori, 2009). Qualitative research has typically been less used than quantitative methods within academic entrepreneurship research. Researchers have used it to build theory or gain a richer understanding of a particular phenomenon, examples include (e.g. Jain, George & Maltarich, 2009; Philpott et al., 2011 & Rasmussen, Mosey & Wright, 2014). The main differences between the Post-positivistic and Constructionist philosophies are summarised in Table 4:

Table 4. Comparison of Post-positivistic and Constructionist Philosophies

Research Assumption(s)	Post-Positivism	Constructivism
Ontology	Reality is tangible and observable by the researcher	Reality is subjective and is interpreted by the researcher
Epistemology	The researched and the researcher are independent.	The researcher is part of what is being researched
Human Interest	Should be irrelevant	A main driver
Intention	The intention is to establish causality	The intention is to increase understanding of the situation
Research Process	Hypotheses and deduction	Ideas are induced from gathering rich data
Concepts/Ideas	Need to be expressed in terms of the operation, to allow for measurement	Should incorporate the perspectives of the key stakeholders
Units of analysis	Should be reduced to the simplest form	May include the complexity of 'whole situations'
Generalisation	Statistical probability	Theoretical abstraction
Sampling	Requires a large number, which are randomly selected	Requires a small number of specifically chosen cases

Sources: Easterby-Smith, Thorpe and Lowe, 2002; Hussey and Hussey, 1997; Teddlie and Tashakkori, 2009)

Historically, because of the basic differences between the paradigms, mixing quantitative and qualitative research has been considered to be inappropriate. Paradigm incompatibility asserts that “the conflict between qualitative and quantitative research is so fundamental that it is impossible to combine them” (Morgan, 2007 p.52). This paradigm incompatibility derives from the fact that certain research methods are allied with certain research paradigms and incompatibility between the different paradigms does not allow for these methods to be combined (Teddlie & Tashakkori, 2010). However, over the past couple of decades it has been recognised that as opposed to being incompatible, these approaches can be complementary (Bergman, 2008; Creswell & Creswell, 2018; Creswell & Plano-Clark, 2011). Advocates of mixed methods research (i.e. Creswell & Creswell, 2018; Morgan, 2007; Teddlie & Tashakkori, 2009) employ the compatibility thesis (Brewer & Hunter, 2006). Brewer and Hunter (2006, p.55) state “the pragmatism of employing multiple research methods to study the same general problem by posing different specific questions has some pragmatic implications for social theory. Rather than being wedded to a particular theoretical style...and it’s most compatible method, one might instead combine methods that would encourage or even require integration of different theoretical perspectives to interpret the data.”

The incompatibility argument was countered at a philosophical level, by developing the alternative perspective of Pragmatism (Creswell & Plano Clark, 2011; Teddlie & Tashakkori, 2009; Mertens, 2019). This approach would seem to be appropriate when exploring questions relating to both cognitive processes and behaviours. As the aim of this thesis is to explore both the individual and the main contextual factors that may impact academic participation in commercialisation and/or engagement activities, it would appear that pragmatism is the best philosophical fit. An overview of pragmatism, in relation to this particular research, is discussed in the following section.

3.3.2 Pragmatism

Pragmatism is a philosophy attributed to the American philosopher Charles Sanders Peirce (Johnson & Onwuegbuzie, 2004). Peirce supported the idea that “beliefs are habits of acting rather than representations of reality” (Mautner, 1997 p. 441). Pragmatism became a notion whereby an individual should “consider what effects, that might conceivably have practical bearings, we conceive the object of our conception to have. Then our conception of these effects is the whole of our conception of the object” (Peirce, 1905 p.171). Building on Peirce’s work, William James developed the concept of true beliefs, where individuals should think of a true belief “as one which led to successful action, to a theory of truth as ‘what works’ ” (Mautner, 1997 p. 485). Expanding on the works of Peirce and James, John Dewey adopted a Darwinian, naturalistic view suggesting there is no such thing as the disinterested pursuit of truth and there can be no clear separation between theoretical enquiry and practical deliberation (Mautner, 1997). Ultimately, they were interested in examining empirical findings, in order to understand the importance of philosophical positions. The aim being to help determine which action(s) should be taken in order to better understand the real-world. Pragmatism is therefore associated with practicality, which can be translated to “what works out most effectively in practice” and that this can be used as a standard for the determination of truth (Honderich, 2005 p. 747).

Pragmatism therefore offers an alternative to the dominant positivist and interpretivist research traditions which are mostly concerned with “getting things right, where it is important that they follow antecedent phenomena when reporting past experiences” (Cherryholmes, 1992 p.13). Pragmatism differs, as the approach strives to clarify meanings, consequences values, human action, and interaction which precede searches for descriptions, theories, explanations, and narratives (Cherryholmes, 1992). All of which are important features when considering academic entrepreneurship at the individual level.

Pragmatic choices relating to research are conditioned by the researcher’s ultimate goal. As a result, research findings from the wider literature are important as

they highlight practical consequences as well as being “the basis for organizing future observations and experiences” (Cherryholmes, 1992 p.14). Pragmatism is a philosophy that stresses the relationship between theory and action (Audi, 1999) and can be explored through thinking, experiential learning or by experiment (Johnson & Onwuegbuzie, 2004).

Pragmatism rejects either/or choices, advocates for the use of mixed methods and acknowledges that the values of the researcher may influence the interpretation of results (Teddlie & Takahashi, 2009). Pragmatism can therefore integrate both quantitative and qualitative research designs. Creswell (2009, p. 10) states that pragmatism “arises out of actions, situations, and consequences rather than antecedent conditions as in post-positivism”. Morgan (2007 p.71) believes that during the “actual design, collection, and analysis of data, however it is impossible to operate in either an exclusively theory – or data-driven fashion”. Researchers consider the research question and use all approaches available to answer the question. As a philosophical underpinning for mixed methods studies, pragmatism conveys the importance of focusing attention of the research problem and then using a pluralistic approach to derive knowledge about that problem. As discussed in the literature review, academic entrepreneurship is a multi-faceted area for research and it is therefore reasonable to consider all approaches. When it comes to connecting theory and data using a pragmatic approach, there is a need to rely on abductive reasoning. Abductive reasoning alternates between inductive and deductive methods, by translating observation to theory and then evaluating the results (Morgan, 2007). An overview of the traditional quantitative, qualitative and pragmatic approaches to research is presented in table 5 (Morgan, 2007 p.71).

Table 5. Approaches to Research Methodology

	Qualitative	Quantitative	Pragmatic
Linking of theory and data	Induction	Deduction	Abduction
Connection to the research process	Subjectivity	Objectivity	Intersubjectivity
Interpretation of data	Context	Generality	Transferability

Academic entrepreneurship can be explored on different levels, including the individual, the organisational and the institutional. There is a wealth of both quantitative and qualitative data that can be derived from exploring these areas and a pragmatic approach allows for the use of both numerical and narrative data (Teddlie & Tashakkori, 2009). This approach to data collection allows the researcher to employ the most appropriate approaches answer the research question (Creswell & Creswell, 2018; Morgan, 2007; Teddlie & Tashakkori, 2009; Mertens, 2019).

When undertaking pragmatic research, there is no assertion made as to whether the research being conducted is bound by context or more generalisable. As stated by Morgan (2007, p.72) “we need to investigate the factors that affect whether the knowledge we gain can be transferred to other settings”. This is an important consideration when limiting the study to institutions in Scotland. Johnson and Onwuegbuzie (2004, p.17) believe that pragmatism offers researchers “*an immediate and useful middle position, philosophically and methodologically; it offers a practical and outcome-oriented method of inquiry that is based on action and leads, iteratively, to further action and the elimination of doubt; and it offers a method for selecting methodological mixes that can help researchers better answer many of their research questions.*”

3.4 Research Design

The following section discusses the research design that has been developed from a pragmatist perspective and is to be used to answer the research aims and objectives.

3.4.1 Mixed Methods

This thesis reflects a pragmatic, philosophical approach and implements a mixed methods research methodology. Mixed methods research has been termed the “third methodological movement” (Creswell & Plano Clark, 2011 p. 1) or the “third research

paradigm” (Johnson & Onwuegbuzie, 2004, p. 15) and the beginnings of mixed methods research can be dated back to the late 1980’s. It was at this time where several researchers from different countries and disciplines had the same idea at approximately the same time, with the concept of using mixed methods research in their publications (Creswell & Plano Clark, 2011). These common ideas were slowly combined and research designs and classifications were eventually developed which led to Johnson et al. (2007) studying how mixed methods was being defined across different disciplines leading them to develop the following definition:

“Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative viewpoints and quantitative viewpoints, data collection, analysis inference techniques) for the broad purposes of breadth and depth of understanding.”

Mixed methods research emerged in the mid-20th century, where researchers such as Campbell and Fisk (1959) supported the use of multiple quantitative methods in their study of psychological traits. The authors argued that exclusive use of one method, prevented researchers from distinguishing “trait variance from unwanted method variance” (Campbell & Fisk, 1959, p. 102). Jick (1979) recognised the strength and weakness inherent in single measure designs and discussed that “qualitative and quantitative methods should be viewed as complementary rather than as rival camps” (p. 602) and began to look at the potential for triangulating qualitative and quantitative data. An important element in this new way of thinking increased incorporation of qualitative research in the research process to act as a “counterpoint to quantitative research” (Jick, 1979 p 609). As a result, mixed methods approaches have evolved over the years beyond simple triangulation. Integration and mixing of both quantitative and qualitative methods within the same study is now acceptable and journal articles and books that specifically focus on this approach to conduct research have been published (Creswell, 2014; Creswell & Plano Clark, 2011; Johnson, et al., 2007; Morgan, 2007; Teddlie & Tashakkori, 2009; Mertens, 2019). Creswell (2009, p. 4) discusses that mixed methods research has now evolved to become “more than simply collecting and analysing both kinds of data. It also involves the use of both approaches in tandem so that the overall

strength of a study is greater than either qualitative or quantitative research”. As Creswell (2014) has identified that mixing qualitative and quantitative methods can be performed sequentially, as separate studies within one research study, it will be the approach to be adopted within this thesis. The mixed methods approach to research, has also started to gain traction in order to investigate phenomena within the academic entrepreneurship literature. Studies such as Hayter’s (2016) research into the importance of social networks amongst early-stage academic entrepreneurs and de Silva et al.’s (2012) study of academic entrepreneurship in resource constrained environments are but two examples.

Creswell and Plano Clark (2011) charted the evolution and history of mixed methods research and identified five different stages of development since Campbell and Fisk (1959) to the present, by analysing key authors and their contributions towards mixed methods research. A summary of these five stages of development are set out in table 6 (Creswell & Plano Clark, 2011 pp. 23-25).

Table 6. The Evolution and Development Stages of Mixed Methods Research

Development Stage	Epoch	Contribution
Formative Period	1959 - 1979	Establishes the use of different sources within the same study and triangulating qualitative and quantitative data
Paradigm Debate Period	1985 - 1997	Addresses the debate between the established paradigms and attempts to reconcile approaches and move beyond the paradigm debate
Procedural Development Period	1988 - 2000	Identification and development of procedure for mixed methods research
Advocacy and Expansion Period	2003 - onwards	Establishes mixed methods research as an acceptable research design.

Reflective Period	2003 - onwards	Critical analysis and interrogation of issues identified in the mixed methods research field
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As with all research approaches, mixed methods research has strengths and weaknesses. It is important to highlight these areas, to establish the justification for the approach adopted within the thesis, before the research design of this study is set out. The principle strengths and weaknesses are outlined within table 7 (Johnson & Onwuegbuzie, 2004 p. 21).

Table 7. Strengths and Weaknesses of Mixed Methods Research

<p>Strengths</p> <ul style="list-style-type: none"> • Mixed methods research can provide insight that might be missed when a single method is employed. • Mixed methods produce more complete knowledge, that is required to inform theory and practice. The strengths of one method can be used to overcome the weaknesses in another method by the use of both within a research study. • Specific mixed research designs have their own particular strengths and weaknesses (e.g., in a two-stage sequential design, the Stage 1 results can be used to develop and inform the purpose and design of Stage 2). • Mixed methods research can answer a broader range of questions because the researcher is not limited to a single method or approach. • Mixed methods research can provide stronger evidence through triangulation of findings.
<p>Weaknesses</p> <ul style="list-style-type: none"> • More time consuming. • May be problematic for an individual researcher to undertake both qualitative and quantitative research, particularly if doing so concurrently. • The researcher has to learn about multiple methods and understand how to integrate them appropriately. • Methodological purists attest that research should be undertaken solely within either a qualitative or a quantitative paradigm, due to fundamental incompatibility.

From a pragmatic perspective, adopting a mixed methods approach when undertaking doctoral research has a number of factors in its favour. As this thesis was

conducted over a period of years, weaknesses of the approach, as identified above, are largely nullified. This is because a researcher often has the time to allow them to become familiar with the approaches required for qualitative and quantitative data collection and analysis. As the research aim within his thesis is to investigate the individual and contextual factors that encourage or discourage academics in Scotland to participate in commercialisation and/or engagement activities, each stage of data collection and analysis will be designed to inform the research aim (by completing the research objectives) in an incremental manner.

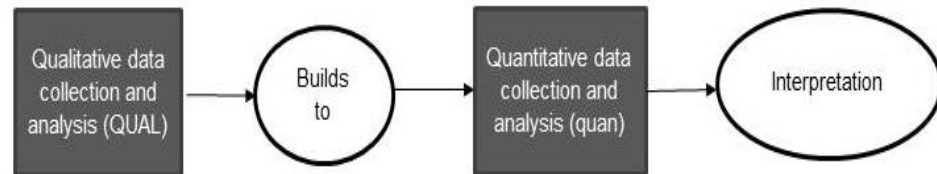
The following section of this chapter introduces the research design which is being implemented within this thesis. Creswell and Creswell (2018) identified two main types of mixed methods designs, which are classified as sequential or concurrent. In a concurrent design, the researcher undertakes research activities at the same time. In a sequential design, the researcher commences with one method of data collection and then after undertaking analysis, moves forward to complete another; concurrent designs on the other hand lead to researchers undertaking research activities simultaneously. Given the exploratory nature of objective one, an initial exploratory phase of qualitative research was devised to create a testable, conceptual model and to select an appropriate theory. This was designed to better understand to what extent individual and contextual factors affect academic participation in commercialisation and engagement activities, in Scottish universities. In order to answer objectives 2 and 3, the qualitative phase will be followed by a quantitative research phase, where the conceptual framework is tested firstly across the whole academic population, then amongst STEM and non-STEM academics. In the following section a sequential exploratory design is discussed as it appears to best fulfil the requirements of this particular research.

3.4.2 Selected Research Design

Exploratory, sequential mixed method designs have a number of uses within mixed methods approaches. The focus is to investigate a phenomenon but it is also used

to aid in the interpretation of qualitative data and can allow for the generalisation of findings (Creswell, 2014).

Figure 11. Exploratory Sequential Mixed Method Design



As set out in figure 11 (Creswell & Creswell, 2018 p. 218), an exploratory sequential method typically involves a first phase of qualitative data collection and analysis. This is subsequently followed by the second phase which encompasses quantitative data collection (Creswell & Plano Clark, 2011). Normally, researchers using exploratory sequential designs (ESD) use the qualitative data from small samples in the first phase and then they apply the findings to a larger sample during the second phase with the aim of the first phase being to inform and develop phase two (Creswell & Plano Clark, 2011). Creswell & Plano Clark (2011, p. 87) outline that an ESD approach is typically used when:

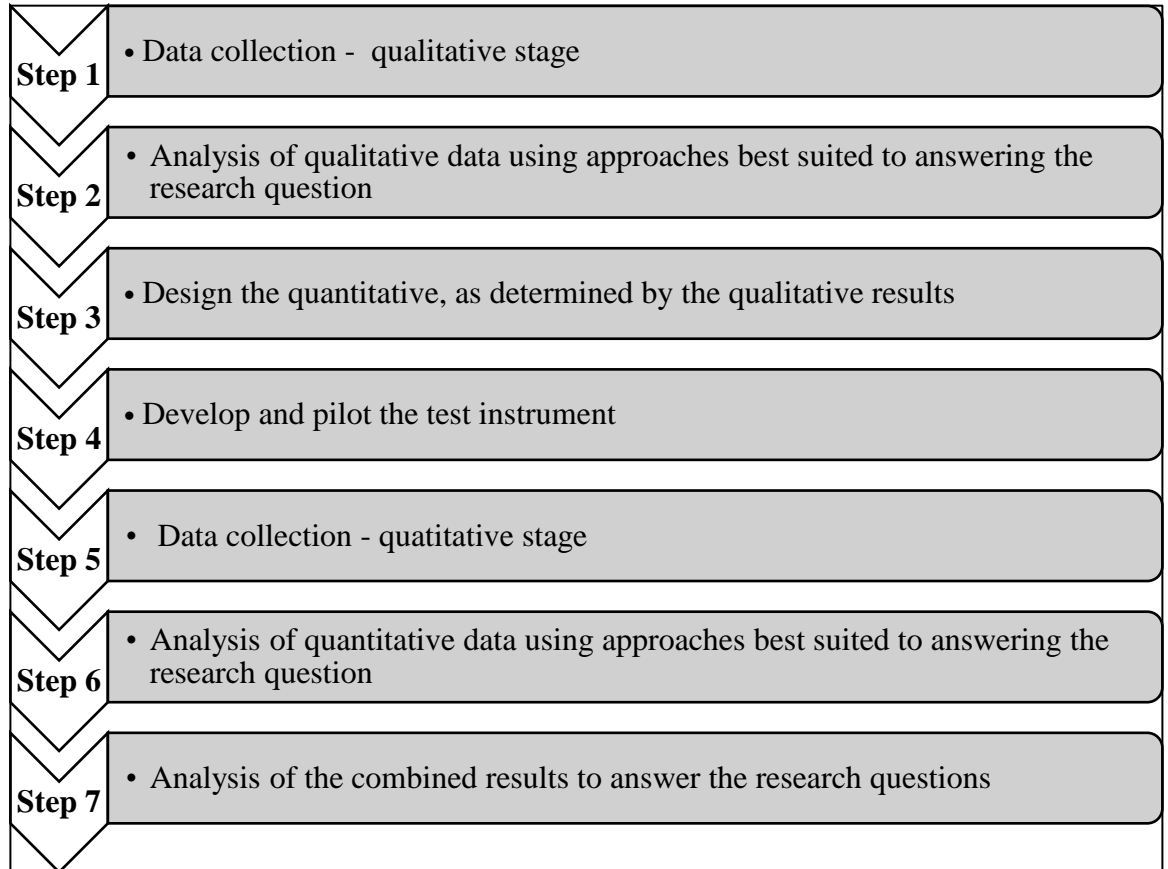
- The researcher does not know what constructs are important
- The researcher has sufficient time to conduct multi-stage research
- The researcher is resource poor and requires a research design where only one type of data is being collected and analysed, at any given time
- Additional questions emerge from the qualitative data that cannot be answered by using the qualitative data alone.

Variants of ESD put different emphasis on the qualitative or quantitative elements. There are both advantages and disadvantages to this approach. The advantages are that the process is uncomplicated in terms of implementation, description and reporting. It

allows researchers to identify which constructs, particularly when a number of possibilities exist, are the most important to study. It is also a particularly useful method for researchers who wish to explore a particular phenomenon which they wish to test beyond the initial qualitative findings (Creswell & Creswell, 2018). One of the main disadvantages identified is that ESD's require considerable time to complete, but as this is a PhD study there is sufficient time available to complete each of the phases.

The analysis of the data collected in mixed methods research should not differ from that used for single methods approaches, as each of the phases should be analysed independently using established procedures (Teddlie & Tashakkori, 2009). It may be that the analysis of a particular phase is dependent on the previous phase and may subsequently include the hypotheses development, as a result of the findings of the qualitative research. This approach can be described as *validatory*, as the quantitative phase allows for confirmation of the themes that emerged from the qualitative phase (Teddlie & Tashakkori, 2009). In order to undertake the research in a chronological manner Creswell and Plano Clark (2011, p. 219) identified a number of steps for collection and analysis of ESD research, these are set out in the diagram below (Figure 12).

Figure 12. Steps in the ESD Process



Within this chapter the traditional worldviews, of post-positivism and constructionism that have typically been used in mainstream research have been discussed and compared with the pragmatic worldview. The design that has been selected for this research, an exploratory sequential design, has been outlined and justified. The chapters of the thesis that follow are therefore based upon the exploratory sequential model as shown in Figure 11.

The following chapter (chapter 4), will cover the exploratory phase of the thesis and will consist of three parts. The first part outlines the sample and the framework used for the qualitative data collection phase, the second and third parts relate to semi-structured interviews conducted with a range of academics working in three Scottish universities. The second and third parts of this section will seek to address objective 1,

which is to explore to what extent do individual and contextual factors affect academic participation in commercialisation and engagement activities. The second part will specifically look at the effects on university policies in relation to the introduction of outcome agreements by the SFC and how these may affect academic entrepreneurship in their respective institutions. The third part of this chapter looks firstly at the individual academic and then which peers working in their local context may shape their entrepreneurial intent. After this phase has been completed, hypotheses based on the qualitative research will be proposed and a conceptual model will be created, and appropriate survey questions identified.

Subsequent chapters then address the remaining research objectives by testing the hypotheses in the conceptual model using quantitative techniques. Chapter five includes a survey of the wider Scottish academic population, in order to address objective two. This objective was designed to investigate the impacts of contextual factors on academic intentions to participate in commercialisation and engagement activities across the Scottish academic population. Next, chapters six and seven will address objective three, by investigating whether contextual factors affect the intention of academics working in STEM and non-STEM disciplines to participate in commercialisation and engagement activities in different ways. Chapter eight will then provide an overarching discussion of the three individual studies and will not only compare the results but also explore the implications of these results for our understanding of how individual and contextual factors affect academic participation in commercialisation and engagement activities, within the context of the research objectives.

Chapter 4 Exploring Individual Motives, Contexts and Conditions

4.1 Introduction

The results of the initial qualitative stage which seeks to address the first objective, are presented in this chapter:

To consider the individual motives and the contextual factors that may affect academic participation in commercialisation and/or engagement activities.

This chapter consists of analysis of interviews that were conducted with academics working in three Scottish universities; the methodology and the results of this qualitative stage are also presented, with the goal of creating hypotheses. The chapter concludes with a final conceptual model drawing upon regulatory focus theory. This model can be used to test the main individual and contextual factors identified, in order to understand the factors that affect an academic's intention to participate in commercialisation and engagement activities.

The objective outlined above meant an initial qualitative exploratory study was required in order to better understand the role of context in academic entrepreneurship. As a result, it was necessary to consider if the shift in Scottish government policy, where outcome agreements have been introduced, may have affected individuals and their organisations relating to participation in commercialisation and engagement activities. In addition, a number of contextual factors were identified in chapter 2 as having the potential to influence academic behaviour and participation in both commercialisation and engagement activities. As there is limited research which seeks to understand how contextual factors can affect academic participation in entrepreneurial activities (Tartari et al., 2014; Bercovitz & Feldman, 2008; Johnson et al., 2017) and given the relative infancy of the SFC's outcome agreements, a greater understanding of how context may shape academics motivations to participate in entrepreneurial activities was explored. This was achieved through understanding the wider organisational context, the

individual academics motivations and finally how the contextual factors may affect their participation in entrepreneurial activities.

4.2 Interviews

Interviews can allow researchers to develop a greater depth of understanding of any particular phenomenon (Easterby-Smith et al., 2002). The interview process provides a way of gathering empirical data about a phenomenon from multiple perspectives, which in turn can lead to a richer and deeper understanding of that particular phenomenon. This means that not only can richer data be gathered, but also contextual implications may be discovered which, combined with individual motives, can contribute to a more realistic interpretation of phenomena (Hussey & Hussey, 1997).

The three main techniques for gathering data from interviews take the form of structured, semi-structured, and unstructured interviews. Unstructured approaches typically provide the interviewee with the greatest opportunity to express their own opinions but ultimately may not enable comparisons to be made between each of the interviewee's responses. With structured approaches, the questions are typically asked in a predetermined order and the interviewer will not probe beyond the replies given. This ultimately reduces the flexibility of the interviewer to investigate interesting responses in more detail. Since the initial interview phase was exploratory and the objective required some level of uniformity in the data collected to allow comparison between the participants to be made, it was most appropriate that the interviews should be structured to some extent. Therefore, a semi-structured approach was used (see appendix 2 for interview guides), this is because semi-structured approaches allow for an element of discovery associated with unstructured approaches, while the structured element allows an analysis in terms of commonalities between the interviews.

4.3 Sampling

Sampling involves “selecting units of analysis in a manner that maximizes the researcher’s ability to answer research questions set in a study” (Teddlie & Tashakkori, 2009 p.169). Sampling is typically divided into probability and non-probability sampling (often referred to as purposive sampling) (Teddlie & Tashakkori, 2009). The selection of these forms of sampling is dependent on the nature of the research project, the types of participants required, and the data being collected (Jankowicz, 2005). Non-probability sampling is associated with gathering data from a variety of personal viewpoints, which represent a variety of perspectives on a particular subject (Jankowicz, 2005). Non-probability or purposive sampling approaches are most commonly associated with sequential mixed methods designs and are used so the researcher can select particular people who can provide information that may not be readily available from other sources. Some typical approaches to non-probability sampling have been summarised in Table 8 (Teddlie & Tashakkori, 2009).

Table 8. Non-Probability Sampling Methods

Description	Approach
Purposive sampling	Selecting individuals whose views are relevant to particular issues. Includes reputational case sampling where the opinions of key informants are sought and snowball sampling
Convenience sampling	Selecting individuals for the study on the basis of convenience only
Stratified sampling	Subgroups (strata) within a population are identified and individuals or groups within the strata are targeted
Quota sampling	Selecting respondents who are representative of diversity within a population

For the exploratory qualitative component of this thesis, a purposive sampling approach was used in order to recruit academics whose experiences were likely to provide some insight into the research objective. In an attempt to gain a richer

understanding of the research objective, the sample population included academics working in Russell group, pre-1992 and post-1992 universities. The three universities were selected firstly, as they were actively participating in commercialisation activities and had all formed at least one spin-off company and secondly, for reasons of practicality they were located within an accessible traveling distance of the researcher.

The first aim was to interview three senior academics who oversee academic entrepreneurship within their respective universities, in an attempt to understand if the introduction of outcome agreements had an effect on the organisational context. The second aim was to interview around 20 academics working in the three universities, as this has been identified as being an acceptable number to be able to get the appropriate level of data (Creswell, 2014). Initially, academics interviewed were identified based on the 'knowledge exchange' outputs they listed on their university staff web pages. These academics were then emailed directly to ask if they would agree to an interview. As it proved difficult to get participants to respond to interview requests via direct email, a snowball sampling strategy was undertaken where participants and informants were able to recommend potential interviewees suitable for the study. As a result, it should be noted that there is some bias in this sample as academics working in one institution made up the majority of interviewees.

Ultimately an additional 21 interviewees working within a range of academic disciplines across three universities were interviewed. The final sample of the 24 interviews are set out in Table 9, which includes the coding for each interviewee used in the analysis and qualitative results sections.

Table 9. Interviewee Details and Codes Used During Analysis

Institution	Academic Rank/Position	Discipline	Code for Analysis
Institution 1	Senior Management Team	-	SM/INS 1
Institution 2	Senior Management Team	-	SM/INS 2
Institution 3	Senior Management Team	-	SM/INS 3
Institution 3	Professor	STEM	PROF1
Institution 3	Professor	STEM	PROF2
Institution 2	Professor	STEM	PROF3
Institution 3	Professor	Non-STEM	PROF4
Institution 3	Professor	STEM	PROF5
Institution 2	Professor	Non-STEM	PROF6
Institution 3	Professor	STEM	PROF7
Institution 2	Professor	STEM	PROF8
Institution 1	Professor	Non-STEM	PROF9
Institution 1	Reader	STEM	READ1
Institution 3	Reader	Non-STEM	READ2
Institution 3	Reader	Non-STEM	READ3
Institution 3	Senior Research Fellow	STEM	SRF1
Institution 3	Senior Lecturer	STEM	SL1
Institution 3	Senior Lecturer	Non-STEM	SL2
Institution 1	Senior Lecturer	Non-STEM	SL3
Institution 1	Lecturer	Non-STEM	L1
Institution 3	Lecturer	Non-STEM	L2
Institution 2	Lecturer	Non-STEM	L3
Institution 3	Research Associate	STEM	RA1
Institution 3	Research Associate	Non-STEM	RA2

4.4 Bias and Reflexivity

While it is widely accepted that a thorough understanding of the existing research literature is important, Easterby-Smith et al. (2002, pp. 59-60) claim that “it is rare for good research ideas to be derived directly from the literature”. It has been recognised that positivist researchers are often “not keen on self-disclosure, because the admission of personal motives and aspirations might be seen to damage the image of independence and objectivity that they are at pains to cultivate.... hence they rarely explain precisely where their ideas or questions have come” (Easterby-Smith, Thorpe & Lowe, 2002 p. 59). On the other hand, social-constructivist researchers are starting to

take a different view and there is now a “growing acceptance among social scientists of the need to be reflexive about their own work” (Easterby-Smith et al., 2002 p. 59). Reflexivity reinforces the fact that the researcher is part of the study and this can affect their understanding and analysis (Creswell, 2014). As a result, when conducting qualitative research through a pragmatic worldview, it is important that the researcher is aware of their role in relation to the research project (Creswell, 2014). Acknowledging bias in relation to their personal background, gender and experiences can shape their interpretations within a research project (Creswell, 2014). As the researcher had not previously worked in academia, there were no issues of bias in relation to the interviews and the researcher’s background or prior experience. In addition to understanding bias and reflexivity, Creswell (2014) also recommends that researchers consider any ethical issues that may arise from their study and these are discussed in the following section.

4.5 Ethical Considerations

Ethics are an important consideration when undertaking research as “ethical behaviour helps protect individuals, communities and environments” (Israel & Hay, 2006 p.2). Ethical issues are particularly important in relation to qualitative research “because of the potential freedom within the interaction for exchanging information and interpretations” (Easterby-Smith et al., 2008 p. 95). As a result, qualitative research leads to the researcher having considerable control over the information gathered, how it is recorded and how it is interpreted. Although no vulnerable individuals were involved, it is still important to protect the identity of individuals and/or organisations involved (Creswell, 2014; Easterby-Smith et al., 2008). As a result, anonymity of both the individual and their employer was given particular consideration, due to the fact that the research was being undertaken within and is about their working environment. Some interviewees expressed concern that they may be identified from their comments. All participants were assured that both they and the institution they worked for would remain anonymous and that any identifying remarks would be censored. All the recorded interviews transcripts were transcribed, and each interviewee was offered a

copy of the transcript for review and approval. Interview data was stored in compliance with the University of Strathclyde's code of conduct for researchers.

As none of the interviewees were prior acquaintances, rapport had to be built through email contact and at the start of the interview. All the interviewees in the qualitative study were provided with information about what the interview would involve as a participant and an information sheet was emailed to each interviewee ahead of each interview. All the interviewees gave their time freely and none of the interviews lasted longer than 70 minutes. The researcher held all the information collected and the University of Strathclyde's data protection protocols were followed. Interviewees were also informed that any future academic and non-academic outputs produced would also protect both the interviewees names and their institutions and that the findings would only be used for academic purposes through academic publication.

4.6 Interview Protocol

As Creswell (2014) advises, an interview protocol was developed for use in the interviews. This acts as an overall guide to the interviewer so that each interview can be structured in a similar manner (Gillham, 2005). As a result, a schedule was prepared in accordance using Gillham's (2005, p. 76) five phases of semi-structured interviewing (Table 10).

Table 10. Five Phases of Semi-Structured Interviewing

Preparation Phase	In this phase the researcher clarifies the time and place of the interview, ensures that equipment is functioning correctly and that the interview location is appropriate.
Initial Contact Phase	This phase involves the introductions (if necessary) and making sure that the interviewee is happy with the location and setting of the interview
Orientation Phase	This phase the researcher explains the purpose of the interview and guide the interviewee to how they would like them to engage, explaining how the questions will be asked.
Substantive Phase	This phase in the key part of the interview where the main questions will be asked
Closure Phase	This is the final phase of the interview where closing questions can be asked. Interviewees can also be offered a copy of the interview transcript once they have been transcribed.

Research objective one required the researcher to discover the nature of the individual motives and main contextual factors that affect academic engagement in entrepreneurial activities. The questions, therefore, needed to gauge what kind of individual and contextual factors affect academic intentions to participate in commercialisation and engagement activities. Questions based on the institutional, organisational and local context and individual motives were identified and developed and were assessed for suitability by the research supervisor. As the interviews were semi-structured, this also allowed for additional questions to be asked as the interview developed and additional interesting themes emerged. Semi-structured interviews require researchers to word questions carefully (so as to not appear too knowledgeable about each topic) and allow each respondent to provide their own views (Yin, 2003).

4.7 Data Collection

The interviews were undertaken between November 2013 and February 2014 and conducted at the convenience of the participants. The interview started with a participation information sheet, which outlined information about the study. In all cases but one the interviews were recorded at the participant's place of work. It was hoped that they would be most comfortable discussing the phenomenon in their natural workplace setting (Creswell, 2014). One interviewee was interviewed in a café, at their request, this environment proved to be slightly noisy, so notes were taken in addition. At the start of each interview the participants were introduced to the subject area, the spectrum of entrepreneurial activities and then the interviewer proceeded. Twenty-four interviews (three senior managers and twenty-one academics) were undertaken which ranged from 20 minutes to 70 minutes with an average of 30 minutes in duration. All interviews were recorded using a digital recorder, which allowed for backing up and transcribing of the data collected. A sample transcription of an interview with a senior manager can be found in appendix 3. The data collected from the interviews amounted to over 76,000 words.

4.8 Data analysis

The digital recordings were transcribed and the analysed using NVivo 10 software, which allowed the researcher to code and analyse the data collected. The method of analysis used was template analysis, which is a method of “thematically organising and analysing textual data” (King, 2004 p. 256). During such analysis of the data, collected themes emerge and are written up in a template where some themes are gathered based upon the extent literature while other themes may emerge as the analysis of the data progresses. Template analysis uses a hierarchical coding structure to arrange data into relevant themes and this worked well with NVivo's tree node structure, where relevant passages of text were coded into different branches of the tree. Key themes

were identified; these being institutional factors, organisational level factors, individual level factors and local contextual level factors. Using a limited number of themes is consistent with the approach of King (2004, p. 256), who advises against starting with “too many pre-defined codes as the initial template may blinker analysis”. Once the key themes were identified from the literature review, the final structure of analysis was agreed with the thesis supervisor. Each of the themes was analysed separately and relevant quotes were extracted. The section that follows presents the findings of the interview phase.

4.9 Qualitative Study Results

The findings are presented within themes of analysis including the institutional context, the organisational context, the individual academic and their local context. This is then followed by a broader discussion of the results, which in turn led to the development of testable hypotheses and a conceptual model.

4.9.1 Institutional Level Factors

Etzkowitz et al. (2000) described universities that decide to embrace the third mission of contributing to regional and economic development in addition to teaching and research, as entrepreneurial universities. The authors defined an entrepreneurial university as “a university where entrepreneurial activities are undertaken with the objective of improving regional or national economic performance as well as the university’s financial advantage and that of its faculty” (Etzkowitz et al., 2000 p.313). Perkmann et al. (2013) suggest that academic participation in commercialisation and engagement activities could be part of a multi-level phenomenon, which may be determined by the characteristics of the individual and the organisational and institutional context in which they work. Therefore, it is important that researchers pay greater attention to the context where entrepreneurship takes place, as researchers tend to underestimate the influence of external factors and overestimate the influence of internal

or personal factors when attempting to understand entrepreneurial behaviour (Gartner, 1993).

As previously outlined in the literature review, the Scottish Government amended their innovation and growth policy in 2011 in order to better leverage innovation and value from the Scottish research base to enhance competitiveness and promote economic growth within Scotland. In order to do so, the Scottish Government through the SFC introduced outcome agreements, so that Scottish universities could demonstrate their contribution towards the Scottish Government's policy. The aim was to provide a mechanism for universities to demonstrate the value of the public investment in relation to measurable outputs. Outcome agreements are therefore the mechanism through which specific goals for individual universities to meet government policy goals are set. The focus of each outcome agreement is on the contribution that each university makes through their research base, towards improving the life chances of individuals, supporting world-class research and creating sustainable economic growth for Scotland through the transfer of university knowledge¹ into business and industry. Outcome agreements set out what a particular university needs to deliver over a given period, against a number of strategic goals, in return for funding from the SFC (Scottish Funding Council, 2013).

The outcome agreements cover a wide range of channels including both engagement and commercialisation activities. Engagement activities can be expanding the number and quality of Continuous Professional Development (CPD) opportunities and a significant improvement in the level of university engagement with Scottish business and industry through consultancy, contract research and collaborative research. Commercialisation activities are in the form of increasing licensing income from

¹ The terminology used in the interviews by academics in relation to academic entrepreneurship activities covered a wide range of terms. Interviewees referred to academic entrepreneurial activities as knowledge exchange, knowledge transfer, commercialisation or entrepreneurship in any case where an interviewee refers to any of the terms above, they all come under the overarching umbrella term academic entrepreneurship.

intellectual property (through Easy Access IP and traditional mechanisms) and growth in spin-out companies, with the goal of creating a more prosperous and successful country (Scottish Funding Council, 2015). It is currently unclear how the introduction of outcome agreements will affect Scottish universities thinking towards entrepreneurial activities and in turn what implications this shift in policy may have for the academics who currently do, or do not, participate in commercialisation and engagement activities.

Interviewees suggest that there has been a change of focus within universities at senior management level, as a result of the introduction of outcome agreements. For example, all the interviewees at a senior management level mentioned the introduction of outcome agreements between universities and the Scottish Funding Council, which suggests they were adopting new practices to meet the entrepreneurial activities in these agreements. One university senior management member summarised the current situation in relation to academic entrepreneurship and research within Scotland universities as follows:

“There needs to be much greater alignment between what the staff on the ground are doing and what the overarching strategic plan of what the universities are doing.” (SM/INS 1)

They continued:

“That is not just at the whim of the university, this is very much driven by Scottish government through the Scottish Funding Council, through the outcome agreements. So now universities have to sign up to an outcome agreement, where a big part of it is knowledge exchange and the Scottish government through their arm, the Scottish Funding Council, is now holding universities accountable.” (SM/INS 1)

The key factor driving this re-alignment between university strategies and academic outputs appear not to be self-determined changes in strategy but are the result of changes in national policy. Scottish universities are now being expected to act more like ‘entrepreneurial universities’ in order to achieve the commercialisation goals they

have signed up to in their respective outcome agreements. The implementation of outcome agreements between the SFC and universities should result in decisions being made by senior management teams, with a view translate their research into greater commercial opportunities and to enable business to turn innovation and ideas into commercial opportunities.

Such changes may force university senior management teams to reconsider the way commercialisation and engagement activities are undertaken in their institution, which activities within the spectrum they choose to focus and support, and how they communicate this information throughout their organisations.

4.9.2 Organisational Level Factors

The findings of the interviews with members of university senior management teams, who were responsible for promoting academic entrepreneurial activities within their respective universities, are presented in the next section.

4.9.2.1 University Level

Historically, activities undertaken within the academic entrepreneurship spectrum tended to be viewed by universities as optional activities, where enthusiastic academics participated in commercialisation activities on a discretionary basis (Perkmann et al., 2013). The senior managers interviewed confirmed that prior to the introduction of the outcome agreements this had typically been the views of their respective institutions and it had been self-motivated academics who participated in the majority of commercialisation activities.

“Before, it has always been that these activities were driven by the enthusiasm of individual researchers rather than necessary institutional priorities.” (SM/INS 2)

Echoing this sentiment, another senior manager stated,

“In the past it has been about an individual’s desire, commitment and expectations as to whether they took part in these types of activities.” (SM/INS 3)

Within the institutions in the study, the managers all discussed that there has been a fundamental shift as to how commercialisation activities are viewed at the senior level within their respective institutions. The interviewees all suggested that academic participation in commercialisation and engagement activities within their institutions is expected to become the norm rather than a discretionary activity and is viewed by senior management teams as fundamental to the future success and sustainability of their universities.

“It is now hugely important for the university to have the income that comes from knowledge exchange” (SM/INS 1)

“It is now seen as very important, in fact increasingly so”. (Institution 2)

“It is now absolutely necessary. I don't think it is entrepreneurial in the sense that they should be optionally doing this. It is now, for one, expected and two fundamentally necessary.” (SM/INS 3)

Gulbrandsen and Smeby (2005) discussed that an increased level of university research being funded by companies (both for and not-for profit) across OECD regions is due to the fact that the share of research public funding for universities has been steadily decreasing. This qualitative investigation indicated that the universities were describing similar circumstances. The interviewees discussed the importance of their academics building partnerships with external non-academic organisations, aimed at leveraging engagement activities within the spectrum and how they were going to

interact in the commercialisation of their research and knowledge. Interviewees stressed the importance of academic participating in both commercialisation and engagement activities. This was seen to be an important mechanism for assisting with decreasing their reliance on government or research council funding, providing them with the ability to increase their proportion of self-generated income. At institutions 2 and 3, the Russell group and pre-1992 universities, the interviewees suggested that their initial focus was on leveraging their reputation and existing relationships their academics have with external organisations and partners to increase their share of income from commercialisation activities.

“....it has become absolutely central because of the shift in government funding” (SM/INS 3)

“For us it is about building relationships with external organisations and leveraging that....we see that we need to use our contacts to open up new funding streams” (SM/INS 2)

However, at the post-1992 institution, the senior manager discussed that there was a need to start building a reputation with external organisations so they can not only increase their income through academic participation in engagement activities, but to also help improve their research outputs. They recognised that their share of research income was likely to fall due to increased competition for research council funding.

“As a new modern university, we have to create our reputation, we have to build our credibility in a number of these areas.” (SM/INS 1)

The interviewee continued,

“It is also hugely important for the university to have the income that comes from knowledge exchange but it is also hugely important for the university to have the knowledge and ideas that come from knowledge exchange and research to feed in to the teaching.” (SM/INS 1)

The quotes above highlight that in response to the introduction of outcome agreements, an increased emphasis is being placed on knowledge exchange outputs by universities at the organisational level, in exchange for future funding from the SFC. As a result, this has led to the implementation of either completely new, or revised institutional strategies focusing on increasing academic interactions with external organisations across the spectrum of commercialisation activities. The interviewees all discussed that the introduction of these strategies had been a recent development, with one interviewee confirming,

“There is now a knowledge exchange strategy for the institution which has these channels articulated with emphasis on some more than others.”

(SM/INS 1)

Another interviewee concurred,

“Now for the first time, just in May last year, we established a knowledge exchange and impact strategy at the university which incorporates these activities [points to Academic Entrepreneurship spectrum].” (SM/INS 3)

Such changes in strategy suggest that participating in academic entrepreneurial activities is becoming an integral part of institutional strategies, which reflects the increased importance of academic participating in commercialisation and engagement activities within Scottish universities.

The universities placed varying levels of importance on the channels within the spectrum of activities. This was aligned with their wider strategic research objectives, the reputation of the university and their prior experience and has led to the institutions having different levels of motivation to support particular commercialisation activities. The two interviewees from Institutions 2 and 3 discussed how their universities strategies were oriented towards supporting academic’s exploiting their research and knowledge across the entire spectrum, recognising that they require a portfolio approach to meet their strategic objectives and to maximise future income streams. The senior

manager from institution 3, discussed that academics participating in commercialisation activities was very much focused about generating income:

“We are trying to do all of them [in relation to the academic entrepreneurship spectrum], we encourage all of these and they don't necessarily bite each other...we will be supporting all these [activities] because of the kind of university we are.” (SM/INS 3)

They continued,

“I don't think we necessarily see we are going to generate huge amounts of income from the companies we will set up and take shareholdings in. We are not doing it as a charity, but I think we recognise that the income streams that you can generate from those companies are highly uncertain and unpredictable and throughout the income streams will be variable.” (SM/INS 3)

“So, we are operating in that space because that is where we want to be, not necessarily because of the income, the bulk of these other activities [points to engagement activities] are the steady income drivers, but you need it all.” (SM/INS 3)

The senior manager at Institution 2 also discussed that their university was active across the entire spectrum and motivated to support academics in participating in these activities. However, Institution 2 differed by viewing commercialisation activities primarily as mechanisms to leverage and build relationship with external organisations. This was considered necessary to increase additional funding opportunities and allow their academics to maintain their research outputs:

“...fundamentally we want more academics getting out there building those networks building relationships with industry and creating the opportunities that arises” (SM/INS 2)

“So, we are having to think about, getting people to think a bit more creatively about where you go for funding opportunities, letting them know it is not all about research council money.” (SM/INS 2)

“That is where we are more likely to create the impact that we need but most of it is around research we get publication outcomes, so we are getting that, and we are engaging with industry which is something that the funding council wants to see us to do and it leads us into an international playing field, so it aligns with the strategic needs of the university.” (SM/INS 2)

The senior manager at Institution 1 discussed that the introduction of the outcome agreements had led to their university adopting a more focused approach as to which commercialisation activities their academics participated in. They felt that concentrating on engagement activities linked to working with Scottish SME's, was of the highest strategic importance for them.

“Many of our academics have found it difficult to access pure research money because of the competition.” (SM/INS 1)

“We have become much more focused in terms of the knowledge exchange work that we do....we are trying to do these four [engagement activities] and in particular the first three (CPD, Contact and Collaborative Research). Having said all of that we always are looking for new opportunities and if somebody comes to us and says we would like you to do some work and it is an area where we don't have any expertise we will honestly say we can't do it ” (SM/INS 1)

They continued:

“Because we are a small university a lot of the research we do is collaborative; it is collaborative because in order to access research council funding or funding from charitable organisations we have found it tactically that it is better to link with others.”

“Most of our research is policy and practice oriented, we don't do blue sky research...therefore a lot of our research is ideally placed to work with SME's. They like working with us as they see us as being close to market, we understand their needs and because we are a small university we can work quickly, SME's work to a different agenda to most research units or pools. Academics therefore like working with SME's because it helps with their academic curiosity, it fits with their practice orientation of their work.”

4.9.2.2 Commercialisation Activities

The introduction of new commercialisation strategies has potentially forced the university leadership teams to reconsider how they can maximise returns from both the resources they make available versus the perceived financial returns they expect to capture through participating in commercialisation activities. In line with their more narrowly focused strategy, the senior manager at Institution 1 commented:

“In terms of these activities [points to commercialisation activities] we do some work...we now don't necessarily push or encourage our staff down that road because we see that as quite a difficult road to go down....it is a very difficult and long process and I have to say it has coloured my judgement about supporting other people down that road, because trying to get proof of concept, trying to get investors to put money up front has not been easy at all.” (SM/INS 1)

The senior managers at the other institutions interviewed both had similar views in terms of supporting commercialisation activities. They discussed that their institutions have both been active in those areas, but their strategies had evolved over time. This has led to both institutions focusing on fewer, but higher value opportunities underpinned by university IP, whilst working in collaboration with venture capitalists who they viewed as not only bringing external investment

but also the expertise required to assist in the evaluation of potential opportunities and whether they should invest or not.

“We tend to focus our efforts into the start-up activity only on high value propositions that we go and receive external VC investment in a relatively short time frame, typically a 3 to 4 year time frame, where we can see real traction from the start. We now don't tend to just spin out lots and lots of businesses, we now focus on 2 to 3 per year. We have got a relationship with [a venture capitalist] that provides seed funding to us and to our ventures and we work very closely with them.” (SM/INS 2)

“We are not trying to nurture lots of spin out activity, it is resource intensive. It doesn't generate massive income streams. Occasionally you get nice really good income streams, but you can't account, or plan for it, the timescales are all over the place.” (SM/INS 2)

“We have got a very good track record on start-ups.....what we are going to do now is bring in experts in that area that we tend to spin out companies into and that is a way of ensuring that we are getting better insights from the industry about the commercial position of the companies that we are generating, so we can manage the risks better. It is also leading us to invest further down the line rather than just that one off investment, we might make a second larger investment or indeed, third or fourth larger investments” (SM/INS 3)

The outcome agreements are also bringing change how the institutions think about and deal with their licensed technologies. Two of the institutions discussed conflicting demands in relation to licensed technologies, in particular increased income generation, easy IP and a focus on Scottish SME's being demanded of them by the SFC.

“Licensed technologies, that is kind of a difficult one, because on the one hand the university has agreed it is going to increase the amount of licensing income that it generates. On the other hand, we are also engaged in all of

these different research agreements where we are essentially giving away the IP. The Scottish Government at the same time are requesting that we increase our licensing income and also go down the route of easy IP where they want us to give it away. So there seems to be some interesting challenges in both making money and giving it away.” (SM/INS 3)

Providing access to university IP within the Scottish SME’s sector is also seen as a priority for the SFC. One institution identified their issues with their attempts to participate in this area:

“They [SFC] are asking us to work with Scottish SME's, but actually if you look at our licensed technologies we licence very little to Scottish businesses, in fact we licence very little to the UK business sector, it is mainly international.” (SM/INS 2)

In an attempt to make access to university IP easier they discussed how they established easy access IP for Scottish SME’s in an attempt to increase their engagement:

“So, we have established easy access IP, this is something we launched in 2010 which is licensed technology which is a commercial deal, but with no royalty patent, no upfront payment, it is a very simple license with simplified terms. Everybody tells us we are overvaluing our IP and we are over negotiating, these are criticisms. So, we now have a situation where we say here you go, it is free and there is a very simple license, we still don't license any of that technology to Scottish companies.” (SM/INS 2)

In relation to academics leaving the university and running the company, both institutions 2 & 3 are now encouraging the academics whose knowledge and research underpinned by the IP in these companies, to remain within the university and take technical or advisory roles in the new business:

“If you are going to have a start-up company, then you are probably going to be somebody who is quite well established in their career and we would

typically be wanting that to occur in such a way that the academic retains their role in the university. So, if we have a research star producing IP, we don't want them going to the start-up and we've found they will probably not be the best person to lead the start up. As they are good academics and not good business people, what we try to do is to separate out those research leaders from the other people who might be working in the company. For example, the post doc goes into the company as the CTO or something like that.” (SM/INS 3)

“...they still remain as a professor at the university. In most cases they don't take a senior role in the business, they step back and take a technical or advisory role or external consultant. By and large they stay in the university and we very much encourage that.” (SM/INS 2)

Some of the senior managers discussed whilst there are commercialisation strategies in place, they are highly reliant on individual academics identifying and exploiting commercialisation and/or engagement opportunities. They discussed that the majority of academics working in their institutions struggle to understand the important role they play in universities achieving their respective outcome agreements, in relation to the income generated from them participating in commercialisation activities. Senior managers also recognised that exploiting academic research is often difficult and time consuming for academics, and the main difficulty identified was the differing demands of undertaking commercialisation and/or engagement activities alongside teaching and research:

“We have got to work harder because academics struggle to see how that is relevant to them, which is a problem. We have high level mission and vision statements and they are unable to understand, what does that mean to me as a worker? (SM/INS 2)

“They will just do what they want to do....as I say the words are all embedded in our approach, but we are not seeing great use of it yet as a community.” (SM/INS 2)

“...a lot of people will say here that frankly I want to follow up the opportunity, but it is just too much hassle.” (SM/INS 3)

“We really need to get the balance between what is a healthy teaching load, a healthy research load so each academic is expected to teach students and in balance keep a healthy KE profile.” (SM/INS 3)

These statements regarding some of the difficulties universities are having in relation to integrating participation in commercialisation and/or engagement activities into every academic life, was discussed by an academic who said such practices were generally viewed as an intrusion by his colleagues into their academic freedoms:

“Many of my colleagues don't believe that they work for an organisation, they believe they work in an organisation and they should have the academic freedom to do as they wish and management should not be telling them what to do.” (Read 1/STEM)

This comment suggests that for many academics it may take an extended period of time before participating in entrepreneurial activities, alongside their core academics duties, becomes the norm.

Another key theme to emerge from the interviews was the pivotal role that the various leaders, who manage the academics throughout universities, are now expected to play. These leaders were viewed, across all the institutions, as being instrumental in the adoption and dissemination of their institutional commercialisation strategies. It has been identified that there is a need for academic leaders to motivate other academics and help shape the culture and behaviour of academics within their groups:

“The leaders within the various departments play an important role in us reaching these objectives” (SM/INS 3)

“What we commit to in the outcome agreements has an effect on the academic leaders, but it tends not to filter down. Most people will not even know there is an outcome agreement on KE.” (SM/INS 2)

“They are essential because they set the tone and the environment that people work in, so you see your professors, leaders, line-managers, whatever you want to call them, engaging in business development activities, engaging with the outside community and encouraging it, then that rubs off on people, particularly in their early career path...if they are not solely focused on traditional outputs such as research papers and funding council income then it drives a different culture.” (SM/INS 2)

Although the various academic leaders have been identified as key actors in the implementation of their knowledge exchange strategies, university wide adoption was proving to be problematic.

“I'm not sure that the various academic leaders understand yet, is how they measure KE quality.” (SM/INS 2)

“.... this comes down to the culture of the line-managers, if they don't recognise it [participation in commercialisation and engagement activities], then it's difficult. They are now paying more attention with the focus on impact and I can talk until I'm blue in the face, but unless somebody externally says that you have to do this, for this reason. Then I can't get them to respond. They will do what they do anyway.” (SM/INS 2)

“you have to remember the head of department changes every five years and they typically don't interfere with the group leads that have successful track records of publishing....it's these group leads within the departments who play an important role in us reaching these [knowledge exchange] objectives.” (SM/INS 3)

4.9.2.3 Academic Leaders

The academic leaders (this is the individual who academics report directly to – their line manager) who were interviewed in this phase of the study implied that the culture created within work groups by the various academic leaders may be an important factor as to whether academics in their group participated in commercialisation and/or engagement activities. One academic leader who leads a large research group suggested that some academic leaders may have a very strong influence over what individual academics working in their groups do:

“The group leader has a tremendous influence over what the group does. Even though we may sit back and say don't let me interfere with your free expression” (Prof 7/STEM)

Some interviewees indicated that they had created a long-standing culture within their groups whereby their academics participation in commercialisation and engagement activities was viewed as an important and valued way of working. However, they also discussed that historically they had been frustrated that the work they carried out for external organisations and the income generated from these activities had not been particularly valued by their universities. These interviewees also indicated, that due to the introduction of the outcome agreements, this had led to universities to come around to their way of working rather than any shift of focus by these academic leaders:

“I don't want you to report me as an, I told you so. But when I set up my research group in 1987 I put this model in place straight away, I had a number of income streams and have always saw the merit in that, but my institution and other HEI's didn't like that model.” (Prof 5/STEM)

They continued:

“Nowadays it is going this way [points to academic entrepreneurship spectrum]my group have no problem, as my group have never done it any

other way, but I see the tensions in the departments as that wave of change comes through the institution”

Another academic leader described a similar experience.

“...a lot of my group’s work is very applied and in particular we were working with companies and historically that was probably rather frowned upon because it wasn’t bringing in the big EPSRC [research council] grants” (Read 2/STEM)

“Suddenly it is all change and suddenly the fact that you are engaging with industry is absolutely critically important to the university, so if anything, the university has come around to my way of thinking rather than me to them.” (Read 2/STEM)

Other academic leaders interviewed suggested that although they may be willing to allow some of their academics to participate in a limited number of engagement activities, they had focused on creating a culture within their groups whereby they wanted their academics to have a greater focus on grant writing, paper writing and teaching and that they were going to continue to primarily focus on these areas.

“So we do a lot of academic work in our day job, that’s writing the grants, writing the papers, training the students etc. and that is the main function of the job.....the core skills and outputs I look for in my guys are grant writing, paper writing and teaching.” (Prof 3/STEM)

“I have said to management that I don’t work for them they work for me. I’m the academic, I have my team, my colleagues, and it is a worldwide discipline that is who we work for. I’ve told them, our job is to do further research, apply for grants and to train students.” (Prof 9/non-STEM)

The responses from the academic leaders who were interviewed suggest that even though universities may have introduced new strategies in an attempt to increase commercialisation income, it is the local context in which the academic leaders and

individuals work that may affect an individual academic's motivation to participate in commercialisation and engagement activities or not, as opposed to the wider organisational context. This in turn may lead to tensions between the traditional perceptions of the academic role (research & teaching) and university expectations that increased levels of participation in entrepreneurial activities is required. The section that follows firstly looks at the individual level factors that affect an academic's motivation to participate in entrepreneurial activities. This is then followed by the key local contextual factors that were identified as having the potential to affect an academics motivation to participate in entrepreneurial activities.

4.9.2.4 Local contextual factors

The first local contextual or situational factor, that some interviewees identified as a potential motivational factor, were the actions and behaviour of their academic leaders. To date there has been little research that has sought to understand how academic leaders affect their subordinates (Bercovitz & Feldman 2008).

4.9.2.4.1 Leaders (Line-Managers)

Some of the academics interviewed identified the behaviour and actions of their academic leader as being an important source of motivation as to their willingness to participate in commercialisation and/or engagement activities. This was achieved through directly or indirectly observing their leader role modelling commercialisation activities to them and their colleagues:

“He’s now very focused on these [points to commercialisation activities in spectrum], licensing more so than starting up companies, but he has started up a company too and is working just now on getting another up and running, I have watched him and he has also shown me how to do things, such as who to talk to and really how to avoid mistakes and also with advising with funding to allow me to get to this point.” (RA 1/STEM)

He discussed that he was now going to attempt to start his own company and because of this influence he now had the confidence to deal with and talk to other business people.

“I think I have a broad understanding now of how things work in terms of starting up a company and I suppose that has given me confidence to talk and deal with business people.”

Other academics discussed the significant impact that witnessing his academic leader successfully participating in a range of commercialisation and engagement activities and their actions and behaviour has had on their attitude towards participating in commercialisation activities:

“We here are relatively lucky in the sense we have had role modelled to us virtually all of this spectrum so it allows us to understand what might be possible in terms of things to do, so it allows us to pick examples or try and copy examples that seem appropriate to the situation. So, I think that is, I think without that I would probably be sitting somewhere down here (points to collaborative research) without that influence” (SRF 1/STEM)

They continued

“He is a less risk averse individual than I am, he’s a good a role model and I’ve been encouraged along this kind of spectrum in a way”

More cautionary tales were also discussed regarding the fact that the actions and behaviour of their leaders were leading them to direct their attention towards more measurable traditional academic outputs. This suggests that individuals may afford less of their attention capacity to commercialisation or engagement activities. Some academics felt that their line managers did not have the time, skill or knowledge to enable them to be a good role model:

“They do not have the skills or knowledge to do these things [points to spectrum]. They don't have the vision in terms of knowledge exchange, they

don't know, it, it's just amateurish, they just don't have the time, knowledge or skills.” (Read 1/non-STEM)

A number of interviewees discussed that their leader's goals were clearly articulated to them, suggesting that the academics attention should be focused on the traditional academic outputs:

“What you get judged on and still get judged on by your line-manager is research publications and big grant income and that shapes your thinking.” (Read 2/STEM)

Another academic who works in a business school indicated that although there were a large number of opportunities to participate in engagement activities within their department, there was in fact very little participation in engagement activities. They attributed this to be a result of the actions and behaviour of their leader, who suggested that their attention should be fully focused towards achieving their publication targets for the REF otherwise there could be serious consequences:

“There are good lines of communication here in terms of expectations....we all know what our line manager's expectations are here, we know that we are to get at least 12 points in terms of publications and people that have not achieved it, well everyone did in the end, but people were worried about their jobs” (Prof 4/non-STEM)

A health sciences academic who wanted to participate in commercialising their research, discussed that the various academic leaders in their university played a significant role as to whether academics were encouraged to participate in commercialisation activities or not.

“The message from the top of the university is do knowledge exchange, do impact and there are people at the bottom who want to do it and then there are the blockers in the middle. It is mostly the line managers or sometimes

the heads of school that is where it blocks, and you get some people saying yes, yes, and other people saying no, no.” (L3/non-STEM)

They also discussed that the priorities of their academic leader led to their colleagues focusing their attention towards those activities too.

“You know there is some strategic document somewhere that he is accountable for, the REF primarily, or some other thing, like internationalisation or whatever the top strategic thing happens to be this year, they all focus on this. Everyone in my group who is successful, they are all adhering to the strategic things our line-manager thinks are the top priorities.” (L3/non-STEM)

When asked why this is so, they suggested that participating in commercialisation and engagement activities produces the least reward when compared to competing academic activities:

“There are too many things for them to focus on and knowledge exchange is bumping around the bottom. It would be naive of me to see that they don't care, but it gets you the least reward and it is the ball that they choose to drop.” (L3/ non-STEM)

Another academic who is currently at the early stages of launching a spinning out discussed that opportunities were being missed across the academic entrepreneurial spectrum due to the focus of their leader:

“I think there are opportunities missed all the time and I think that is because there is a mindset where department heads are concentrating on research, teaching and publishing, there is no reason why anybody from my department can't do some of this (points towards engagement activities).” (RA 2/non-STEM)

4.9.2.4.2 Work Group Colleagues (Peers)

The second local contextual factor that interviewees identified as a potential motivational factor in what they chose to focus their attention on, were the actions and behaviour of their work group colleagues in relation to academic entrepreneurship. Some interviewees suggested that it was not their leader that was the motivating factor as to whether academics participate in commercialisation activities or not. Instead they identified that other colleagues in their workgroup were perhaps used as a reference point to determine what academic activities they should focus their attention on. Some academics discussed that group norms were a negative factor in relation to the level of participation in commercialisation and engagement activities within their work group and that the group members were paying greater attention to what their colleagues were doing, rather than the message of their leader:

“My academic colleagues are stubbornly refusing to interact with industry in any way. So, they are not really following the ideas of leadership, they all still want to meet the EPSRC goals.” (Read 2/STEM)

They continued:

“There are two reasons, they have to move out of their comfort zone if they engage with a company, so they don't know what they are letting themselves in for and they are also trying to read the signs from the university about which is more important engaging with industry or EPSRC grants generating publications.... they tend to stick together as a group, where they pretty much do what everyone else does.”

Echoing this sentiment, another academic discussed there were also similar situational factors at play within their work group:

“I have heard conversations where my colleagues say you can tell us what you like about knowledge exchange but we are too busy doing research and publications. I have heard people in my group meetings tutting and sighing

when it comes to the knowledge exchange bit. You know, as a group they are too busy doing the research and writing papers and of course getting work published is where you enhance your reputation the most, so they all want to maintain their reputation within the group and they view it as somebody else's job to do that [points to academic entrepreneurship spectrum] and there is quite a lot of animosity and negativity towards people doing knowledge exchange in my group.” (L3/non-STEM)

Other interviewees suggested that the group norms in their work group were an enabling factor in relation to the level of engagement commercialisation within their work group, leading to group members being more motivated to pay greater attention towards commercialisation and/or engagement activities. One interviewee discussed that they had observed that the level of colleague participation in the spectrum of activities in their group had a significant effect on the motivation of other members of staff to participate in those activities:

“....they are responsive to this and feel the pressure to contribute more, particularly when a number of the other academic staff in the department are already doing these things [points to spectrum]” (SL1 / STEM)

Another academic discussed that, as the level of colleague participation in certain engagement activities within her workgroup was quite high, they felt that they had a responsibility or a duty to also participate in engagement activities. This was in order to assist their colleagues and to remain a valued group member, even though they would rather have been spending time with their children:

“I have two young children and you have to remember that a lot of CPD that companies pay for is delivered in the evenings or at weekends and of course that means that I don't get to see my children that evening or for most of that weekend, but I do it because I feel I should be doing it as my colleagues are doing it too, I do it to help the department and because I like the people I work with and feel I should help” (L1/non-STEM)

The data from the interviews above have provided some preliminary evidence, which suggests that actors working in their local context may also influence individual academics to pay more or less attention to identifying and exploiting commercialisation and engagement activities. The interviews above suggest that either the behaviour and actions of academic leaders, or the level of work group colleague participation in commercialisation and/or engagement activities has the potential to shape an individual academic's intentions to participate in entrepreneurial activities. The findings from this section suggest that there may be multi-level factors at work which need to be understood in more detail in relation to how these factors affect an academic's intentions to participate in commercialisation and/or engagement activities.

4.9.3 Individual Level Factors

It has been acknowledged by researchers that there has been a paucity of research seeking to understand the level of academic involvement in different commercialisation activities across different academic disciplines (Abreu & Grinevich 2013; Perkmann et al. 2013). Many of the academics interviewed had varying levels of involvement in different forms of commercialisation activities, especially when viewed in the context of different academic disciplines. In line with prior research (Laukkanen 2003), a number of interviewees in STEM related disciplines indicated that they were regularly participating in either commercialisation and/or engagement activities. A small number of the interviewees highlighted they have been involved in all the activities across the academic entrepreneurial spectrum as set out in figure 8. This suggests that there are greater opportunities for STEM academics to participate in a wider range of entrepreneurial activities. Similar to the findings of Grimaldi et al. (2011), the results of the interviews also suggest that academics participating in commercialisation activities, is also becoming more common in Non-STEM disciplines. Interviewees working in Health, Social Sciences, and Arts & Humanities disciplines indicated that they were either in the process of starting up a company or were actively exploring using digital technologies in order to start businesses based on their research.

The academics interviewed identified a range of benefits of participating in commercialisation and engagement activities, which were broadly in line with the motives identified in the extant literature (e.g. Lam 2011; Hayter 2011). The main motivation for the majority of academics interviewed who had participated in commercialisation and/or engagement activities, was to fulfil personal values or goals related to self-direction (autonomy) and stimulation:

“For me, the motivation is, first of all, I think it is rather sterile to do just research and the output of that is a publication and a few PhD students. Another big driver is seeing the research being utilised, to see what you do making a difference, and certain things that you do in research you feel that this could influence things outside of academia” (Prof 7/STEM)

*“I cannot focus on something with publications being the only output, I need to be working at the applied end that is what I find interesting.”
(RA1/STEM)*

*“I get excited by research and I want to see how that can be used in the world rather than keeping it in a closed domain...I just actually want to get out there to see how it can be applied and to work together with people.”
(RA 2/ non-STEM)*

“....being involved in problem solving for industry, being involved in real problems that mater.” (SL 1/STEM)

Other interviewees suggested that their primary motivation to participate in commercialisation activities was around generating the financial resources they needed in order to reduce their reliance on traditional research funding, and to also provide them with the self-direction or the autonomy to research in areas that they were personally interested in:

“you need funding to do good research and therefore you take funding from wherever it comes... so this is a good way of doing that and I also see it as a way of generating more income for research.” (Read 1/non-STEM)

“I have always operated across this spectrum to make that difference because that is the only way I know of to make sure that you have independence from those who might give you money or might not give you money.” (Prof 5/STEM)

Personal financial gain was mentioned infrequently by the interviewees. The few respondents who discussed money had already achieved financial returns as a result of their commercialisation efforts and whilst they suggested that while money was important, it was a lower ranked motive and was perhaps viewed more as a measure of their success.

“Personal remuneration, it is not the actual big driver, but it was nice, it is more a measure of your success, but you want to make sure that it is positive.” (Prof 1/STEM)

“I do make money out of it, I'm not going to shy away from that and the money is always nice to have, but it is not my main motivation. I'm doing ok as things stand, at least financially, but the key driver is to see your technology being used on patients that is the key driver and recognition that your technology is an improvement in what is currently out there, that is the key driver.” (Prof 7/STEM)

A common theme raised by the academics interviewed, was that they had to allocate a significant level of their limited attentional capacity when participating commercialisation and/or engagement activities. A number of the interviewees who participated in commercialisation and engagement activities mentioned the costs or risks of allocating a significant level of their limited attentional capacity when participating in commercialisation and/or engagement activities. These interviewees primarily discussed the risks that allocating a greater level of attention towards commercialisation and engagement activities, instead of the traditional academic activities, had on their publication records and careers. For example, interviewees who regularly participated in commercialisation and engagement activities discussed that this often had a detrimental

effect. This was mentioned particularly in relation to their outputs, or number of quality publications. It was felt that this was the most commonly used benchmark to measure academic performance and to also reward academics:

“One of the problems with working with industry is that the density of publications drops and limits you. Certainly, the case study we have got, where we saved the company 25% in their production costs, huge saving for them, but we get one paper out of it, so in terms of your traditional academic career trajectory, it isn’t good” (Read 2/STEM)

“The REF [Research Excellence Framework] and commercial sources of funding, they are not compatible, so my academic CV has suffered as a result” (SL 1/STEM)

Other interviewees suggested that they had allocated a significant level of their limited attentional capacity towards commercialisation activities over an extended period and that this had resulted in them neglecting publication outputs which had negative effects on the careers in terms of promotion:

“If it distracts you from doing your normal academic work which is the teaching, research and writing and getting your publications out, as it did with me, then it can have a bad effect on your career...you are no longer valued for your research output and impact in that area and I did suffer for that” (Read 1/non-STEM)

“The risk has always been I guess is not being promoted for spending time on things that I think is important and for me it is quite easy, I just did the stuff that I personally thought was important and just lost out on promotion” (L3/non-STEM)

The interviewees who were not currently participating in commercialisation activities discussed their main concerns as to the reasons why. They suggested that they were having to commit a significant level of attention towards successfully achieving their core academic activities and objectives, or they had concerns about what they

perceived as a fundamentally different skill set that is required to participate in commercialisation and/or engagement activities:

“The reality is I work much more than my contracted hours, there are all the evenings and weekends I put in, in fact if I added all them all up, I guess, I guess it probably works out at about an extra day a week and that, and that just covers the teaching, the admin, going to meetings and trying to get work published. I spend a lot of time trying to get work published.” (Prof 4/ non-STEM)

“I think it's important to recognise that research and commercialisation are very different activities that require different skills and a different focus. It is almost impossible to be involved in teaching, administration, research and commercialisation at the same time and still do a good job I would prefer to be unsuccessful at commercialisation and successful at doing other things.” (Prof 9/non-STEM)

The data from the interviews above have provided some preliminary evidence suggesting how academics may be motivated to allocate more or less of their limited attentional capacity towards commercialisation and engagement activities. It is clear from the interviews, that academics within both STEM and Non-STEM disciplines were actively involved in both commercialisation and/or engagement activities. This reinforces that there is a need for a greater understanding of the antecedents of participating in both commercialisation and engagement activities in both the STEM and Non-STEM disciplines.

4.10 Hypotheses Development

The interviews have provided an initial insight as to how the institutional, organisational and local context may affect academic participation in commercialisation and engagement activities. The data from the interviews suggest that while the individual academic is the key cog in the academic entrepreneurial wheel, the

academic's local context, in particular the affects that peers, their line manager (leader) and the work group colleagues have, may also affect their academic entrepreneurial intentions. As the interviews suggested, there could be multi-level factors at play that could either directly or indirectly affect an academics intention to participate in differing forms of academic entrepreneurship. The following discussion will attempt to integrate the appropriate evidence from extant regulatory focus theory literature, which offers the potential for multi-level analysis and theory building, along with appropriate academic entrepreneurship literature and the findings from the interviews to generate testable hypothesis.

4.10.1 Institutional Level Factors

Perkmann et al. (2013) outlined that institutional factors include shifts in government policy. This section attempts to shed more light on the impact of the introduction of the outcome agreements between the Scottish government (through the SFC) and Scottish universities. There was evidence from the interviews that the Scottish government's push is resulting in university senior management teams placing much greater emphasis on their academics participating in entrepreneurship activities with a view to generating measurable outputs. Klein and Sorra (1996) describe the creation and implementation of new strategies within organisations as being the process of gaining employees' appropriate and committed use of a new strategy. The data from the interviews suggests that the implementation of outcome agreements is leading to universities moving from perhaps a laissez-faire attitude towards academic entrepreneurship to senior management teams creating strategies in an attempt to increase returns from their respective institutions.

4.10.2 Organisational Level Factors

Within their respective institutions, all the interviewees highlighted that there was now a need for increased levels of participation in commercialisation and engagement activities whilst they recognised both the research, teaching and economic benefits that can be derived from increased levels of academic participation. All the senior managers identified that a greater level of university research funding was coming from commercialisation activities and that the ability to win research council funding has become increasingly more difficult which is in line with findings by Gulbrandsen and Smeby (2005). The interviews also suggest that the senior management teams within universities are considering how to best allocate scarce resources across a range of entrepreneurial activities. The data indicates that the more mature universities (pre-1992) were committed to supporting academic participation in entrepreneurial activities right across the entire spectrum, in order to maximise their returns and fulfil their obligations in the outcome agreements. By comparison, members of the ‘younger’ institution (post-1992) discussed that their attempts at participating in commercialisation activities was to help (in part) increase their reputation and that they were focusing their attention towards a more focused portfolio of engagement activities. Whilst the ‘younger university’ had spun out a company before, they had found the process to be a difficult task and there had been little return on the investment. What previously may have been an obvious choice if considered in isolation (i.e. spin-out a company in an attempt to increase future revenue streams), may not now be as salient and obvious when this is considered across a spectrum of academic entrepreneurship activities and the outcome agreement targets they have to achieve. This suggests that senior management within some universities may have a greater focus towards academic participation in engagement activities because a greater number of academics are comfortable with these activities (D’Este & Patel, 2008).

Another theme to emerge from the data was that the two institutions who were focusing on commercialisation activities discussed that their strategies had evolved, with both institutions now focusing on fewer, but higher value opportunities.

Both universities described that they were working in collaboration with venture capitalists who have the expertise to evaluate commercialisation opportunities and to also provide additional investment. This has led to the number of companies being spun-out of these universities, falling over the past few years. The interviewees also discussed that they are now encouraging the academic's whose knowledge and research underpinned the IP, to remain within the university and take technical or advisory roles in the new business. It was felt that they are often not the best people to run the businesses.

It was recognised by senior managers that exploiting academic research is often difficult and time consuming for academics, and the main difficulty identified was the differing demands of undertaking commercialisation and/or engagement activities alongside teaching and research, which led to tensions. These findings are in line with the extant literature suggesting that considerable tensions still exist between balancing instructions. Senior managers still need to find a way to balance academic entrepreneurship and traditional academic activities (Ambos et al., 2008; Philpott et al., 2011).

The interviewees also discussed that while the universities had strategies and mission and vision statements in relation to academic entrepreneurship, the majority of academics struggle to see how it is relevant to them. The interviewees suggest that their message in relation to academic entrepreneurship tends to not filter down to the academic's local context. This can be a problem as many academics are unaware of the content of the key policy measures, in this case outcome agreements. One key actor all the interviewees identified was the importance that the various academic leaders play in the integration and execution of their new strategies. Academic leaders were viewed as important, because they set the tone and create the environment where the academics work. The responses from the academic leaders who were interviewed, suggest that even though universities may have introduced new strategies to increase commercialisation income, it is the local context where the academics work which may be the biggest factor an individual academic's motivation to participate in commercialisation activities or not, as opposed to the wider organisational context. The section that follows will use

regulatory focus theory in addressing individual motives and the main local contextual factors, in order to develop testable hypotheses.

4.10.3 Individual Level Factors

As prior research has indicated that both commercialisation and engagement activities tend to be individually driven and pursued on a discretionary basis (Perkmann et al., 2013) and universities are reliant on the independent initiative of academics to achieve their organisational goals, then it is justified that this section begin with a focus on the individual academic. There was some evidence from that interviews that despite the risks involved, certain academics are prepared to allocate a significant level of their attention to commercialisation activities. This occurs even though there may be many other demands upon on their attention and thus their motivation to participate in these activities. This suggests that participating in commercialisation activities requires, at the individual level, the academic to exercise judgment as to the risks involved and what activities are most likely to be valued and rewarded. All individuals have limited attentional capacity (Gifford, 2010; Simon, 1947) and when academics consider involvement in commercialisation and engagement activities, any personal doubts they experienced about participating in these activities may induce hesitancy.

Returning to Gifford's (2010, p. 1) analogy from chapter 2 where she outlines the choices faced by individuals as to how they allocate their limited attentional capacity:

“Imagine a juggler on the ‘Ed Sullivan Show’ who is rewarded according to the number of plates she can spin on the tips of long sticks on a table. The plates are the targets of attention and the juggler allocates limited attention between re-spinning old plates and setting up new plates. Assume that there is an unlimited supply of plates and sticks (and table top). As soon as one plate is spinning, she can set up another one. However, as she continues to set up additional spinning plates, the first one starts to wobble, threatening to fall. The choice the juggler faces is to either continue to set up new plates or to go back and try to re-spin old plates.”

This analogy is useful in helping explain the choices academics described in relation to how they might choose to allocate their limited attention across an increasing number of academic activities. When considered in the academic context identified in the interviews, it suggests that the level of attention that an academic allocates to commercialisation and/or engagement activities is likely to be consistent with the level of cognitive effort that they allocate to the continued consideration (spinning) of commercialisation and/or engagement activities (academic entrepreneurship plates). This occurs alongside the continued spinning of other plates (e.g. teaching, administration, research, grant writing and writing publications).

One could expect that a significant level of an academic's limited attentional capacity would be allocated towards maintaining high standards in their core activities of teaching and administration (plates which must be kept spinning). However, from the interviews some academics suggested that either participating in commercialisation activities or working with industry, where positive results are expected, can lead to a considerable amount of their attention being constantly allocated to participating in commercialisation and/or engagement opportunities (entrepreneurial plates are kept spinning). If these entrepreneurial efforts are kept under a sustained focus over a long time period, it is likely to be at the expense of some other academic tasks (e.g. the publication plate falls). However, if an academic allocates minimal or no attention to entrepreneurial activities, then there is the risk that commercialisation and/or engagement activities may disappear from academics' thoughts altogether, as they choose to focus their attention on activities, which potentially offer greater rewards (they let the entrepreneurial plates fall). This suggests that at the level of the individual, taking entrepreneurial action in academia requires the academic to exercise judgment as to which activities are likely to be most valued and rewarded, as the rules of the game and potential outcomes may be unclear (Alvarez & Barney, 2005).

4.10.4 Regulatory Focus Theory and Hypotheses Development

The findings above suggest that regulatory focus theory, where one's motivation and subsequent behaviour is largely determined by how individuals allocate their attention (Higgins, 1997; McMullen & Zahra, 2009) may help explain, at the cognitive level, why academics are more or less motivated to exploit their research or knowledge through different commercialisation activities. McMullen and Shepherd (2006) suggest that when individuals experience feelings in relation to perceptions of risk or uncertainty and this creates a sense of doubt. This suggests that as a result of this sense of doubt, academics may vary significantly in their motivation to take entrepreneurial action, as has been found in prior research (D'Este & Patel, 2007; Hayter, 2011; Lam, 2011; Perkmann et al., 2013).

Regulatory focus theory posits that when one's self-regulation is focused on prevention, individuals are concerned with the presence or absence of negative outcomes, and when one's self-regulation is focused on promotion, individuals are concerned with the absence or presence of positive outcomes. A prevention focus elicited by potential loss scenarios emphasises minimal goals (Higgins et al., 2001), for example minimising the risk in any risk-return decisions. Individuals experiencing a promotion focus are interested in maximal goals (Higgins et al., 2001) and maximising the return in any risk-return decisions (McMullen et al., 2009). Prior research has found that academics vary significantly in their motivation to take entrepreneurial action (D'Este & Patel, 2007), so regulatory focus theory may be appropriate to help explain why academics are more or less motivated to participate in commercialisation, in the different ways described above.

As prevention and promotion foci are distinct, they should result in differing motivational levels and in turn, different levels of entrepreneurial intent. If the prior research findings in relation to regulatory focus and entrepreneurship (e.g. risk taking, self-efficacy, creativity, etc.) hold true within an academic setting, an academic who is highly promotion focused is likely to be aligned to the promotion focused characteristics as previously described in the literature review, thereby increasing their intent to

participate in commercialisation activities. In contrast, an academic who is highly prevention focused is likely to be aligned to the prevention focused characteristics as previously described, thereby decreasing their intent to participate in commercialisation activities, leading to the following hypotheses:

Hypothesis 1a: *The stronger an academic's promotion focus, the greater their intention to participate in commercialisation activities.*

Hypothesis 1b: *The stronger an academic's promotion focus, the greater their intention to participate in engagement activities.*

Hypothesis 2a: *The stronger an academic's prevention focus, the weaker their intention to participate in commercialisation activities.*

Hypothesis 2b: *The stronger an academic's prevention focus, the weaker their intention to participate in engagement activities.*

4.10.4.1 Local Contextual Factors

Within the entrepreneurship literature, context has been identified as being important for understanding “when, how, and why entrepreneurship happens and who becomes involved” (Welter, 2011 p.166). The results of the interviews suggest that the line manager (academic leader) and work group colleagues, working in an academic's local context, may have a significant impact on an academic's commercialisation and/or engagement intentions. The following section will therefore discuss the findings of the interviews in relation to regulatory focus theory, the behaviour of academic leaders and work group colleagues. This will lead to testable hypotheses being developed.

4.10.4.2 Situational Regulatory Focus

In order to develop hypotheses, it is important to recall the difference between situational and chronic regulatory focus, as both influence an individual's regulatory orientation (Förster et al., 2003). An individual's chronic regulatory focus is an

established personality trait (Higgins, 1997) and when strong situational cues are lacking, an individual's chronic regulatory focus will dominate (Wu et al., 2008). However, situational factors, where the possibility of gains or losses exist, may lead to alternative regulatory foci being elicited (Keller & Bless, 2006). This has been demonstrated in studies where manipulation has been used to elicit a certain regulatory focus. When an individual is primed to be concerned with ideal attainment and maximising gains, then a promotion focus is exhibited. When they have been primed to be concerned with duty, safety and minimising loss, then a prevention focus is elicited (Förster et al., 1998) and this affects how individuals sub-consciously pursue goals and can change behaviour over longer periods of time.

4.10.4.3 Regulatory Focus and Academic Leaders

Theories of leadership imply that differing leadership styles will result in different outcomes in terms of orientations towards change, entrepreneurial thinking, risk taking and innovation (Avolio et al., 1999; Bass & Avolio, 1994). If academic leaders create meaning, then their behaviour and actions is likely to influence the regulatory focus of those academics they interact with (Brockner & Higgins, 2001). Thus, through priming academics and encouraging them to allocate increased or decreased attention towards entrepreneurial activities, leaders and the behaviours they exhibit, are likely to be a key factor in influencing others. This then sets the basic conditions for increasing or decreasing academic entrepreneurial intentions.

Some of the interviewees discussed that the actions and behaviour of academic leaders, may actually influence their intentions to participate (or not) in commercialisation or engagement activities, by signalling to academics what is valued and expected (Jain et al., 2009). Drawing on Gifford's analogy, as outlined above, academic leaders are effectively signalling or role modelling to their subordinates which plates should be kept spinning and which ones should be allowed to fall. Brockner and Higgins (2001) suggest that leaders, through their differing behaviours, may elicit greater levels of promotion or prevention focus in their subordinates as leaders play a

major role in priming self-concepts. This occurs as a result of how they interact with their subordinates (Lockwood et al., 2002). Specifically, leaders and the behaviour and actions they adopt, are able to direct individuals by projecting their vision and the subsequent benefits for both parties.

The senior managers interviewed also suggested that the various academic leaders played important motivational roles in their organisations by dictating the feasibility (as the allocator of resources) and desirability (directors of attention) of which entrepreneurial outputs, if any, they value. The data from the academic leaders interviewed, suggest that their strategies are often concerned with excelling in their core academic activities whilst attempting to bridge the funding gap. This may be either through winning grant applications, or via entrepreneurial endeavours, resulting in leaders having differing motivations. As a result, leaders within academia are likely to experience the self-regulatory states of eagerness or vigilance (Higgins, 2002) in differing intensities. This is likely to result in them eliciting different behaviours, when they are considering participating in commercialisation and/or engagement activities.

4.10.4.4 Regulatory Focus and Leader Role Modelling

Based on the evidence from the interviews and from the wider leadership literature, leaders play an important role in achieving organisational or group outcomes with the behaviours and attitudes they adopt leading to differing outcomes towards change, entrepreneurial thinking, risk taking and innovation (Avolio et al., 1999; Bass & Avolio, 1994). Ambos et al. (2008) found that contradictory demands create doubts for academics, making it difficult for clear priorities to be set to guide behaviour (Ambos et al. 2008). It is therefore reasonable to consider that a leader's behaviour will moderate an academic's intention to participate in entrepreneurial action. Prior research undertaken by Bercovitz and Feldman (2008) discovered some evidence of this, in as much as that academic leaders (the chair) and their entrepreneurial actions, have the potential to influence others through role modelling. Thus, via role-modelling, academic

leaders should theoretically impact an academic's regulatory focus, regardless of their chronic regulatory focus (Kark & Van Dijk, 2007).

Within the academic entrepreneurial process, the results from the interviews suggest that the group leader has the potential to play a major role in priming academic self-concepts based on how they interact with their subordinates (Lockwood et al., 2002). Specifically, the results from the interviews suggest that, academic leaders and the behaviours they are adopting towards academic entrepreneurship, should be able to direct an academics attention towards or away from commercialisation or engagement activities by outlining their goals, vision and the subsequent benefits for both parties. Brockner and Higgins (2001) suggest that leaders and their differing behaviours, should elicit greater levels of promotion or prevention focus in their subordinates, which in turn should affect their motivation to participate in commercialisation and engagement activities and lead to them paying increased attention towards keeping their commercialisation plates spinning.

Consequently, academic leaders are likely to induce a state of regulatory focus in their subordinates. Because academics may share the same goals as their leaders (i.e. due to prospects of advancement in their group), they are likely to perceive the leader's authority, behaviour and actions as evidence of what they should value (Brockner & Higgins, 2001; Schein, 1992), irrespective of their own beliefs. Thus, to eliminate uncertainty, academics may be looking towards their leader for cues regarding behavioural expectations and the potential rewards or consequences of participating in commercialisation and engagement activities. As a result, a leader's pattern of behaviour communicates their endorsement of promotion-focused or prevention-focused behaviour (Brockner et al., 2004).

For example, if the academic leader continually seeks to participate in commercialisation activities alongside their core activities and demonstrates success from participating in commercialisation and engagement activities, then a pattern of behaviour emerges that others begin to attribute (consciously or unconsciously) to promotion focus. In contrast, if the academic leader emphasises focussing on the traditional academic activities and not on commercialisation activities then a pattern of

prevention-focused behaviour is communicated, in which avoiding risk seeking behaviour will become the norm. As a result, when a leader engages significantly in promotion-focused behaviours, it becomes increasingly likely that employees will experience a heightened state of promotion focus observable through increased commercialisation intentions. Therefore, regardless of an academic's chronic regulatory focus, an academic leader with whom the employee interacts – their line manager, for example – and whose behaviour is perceived as highly promotion-focused is likely to elicit a congruent psychological state in the employee. This promotion-focused state of eagerness then increases the likelihood of participation in commercialisation and engagement activities. In contrast, an academic leader whose behaviour is perceived as highly prevention-focused is likely to elicit a prevention-focused state of vigilance from the academic, making them less likely to participate in commercialisation and engagement activities. Accordingly, the following direct effect hypotheses are offered:

Hypothesis 3a: *The more promotion-focused a leader's behaviour is perceived to be, the more positive an academic's intention to participate in commercialisation activities.*

Hypothesis 4a: *The more prevention-focused a leader's behaviour is perceived to be, the more negative an academic's intention to participate in commercialisation activities.*

Hypothesis 3b: *The more promotion-focused a leader's behaviour is perceived to be, the more positive an academic's intention to participate in engagement activities.*

Hypothesis 4b: *The more prevention-focused a leader's behaviour is perceived to be, the more negative an academic's intention to participate in engagement activities.*

4.10.4.5 Individual Chronic Regulatory Focus and Leader Interactions

According to regulatory focus theory, the motivational levels of academics to participate in engagement and commercialisation activities may also be affected by an interaction between chronic and situational factors (Shah et al., 1998). As chronic and situational regulatory foci can interact to affect an individual's behaviour (Brockner & Higgins, 2001; Shah et al., 1998) and Kark and Van Dijk (2007) suggest that a leader's

regulatory focus should interact with an individual's chronic regulatory focus to moderate the follower's behaviour. Individuals with congruent situation and chronic promotion foci should be more likely to develop increased motivations to take entrepreneurial action. When incongruence occurs, the moderating effect of situational and chronic regulatory foci as a motivational factor is likely to be weakened (Van-Dijk & Kluger, 2004). Thus, via role-modelling, academic leaders should moderate an academic's regulatory focus, regardless of their chronic regulatory focus (Kark & Van Dijk, 2007).

Based on the evidence from the interviews and from the wider regulatory focus theory literature, it appears reasonable to consider that the leader's behaviour and attitude towards commercialisation or engagement activities will moderate an academic's regulatory orientation and in turn their motivation to participate in commercialisation. An academic leader, whose behaviour is perceived as being highly promotion focused, is likely to interact with their subordinates' chronic regulatory focus to produce increased motivation in their subordinates thereby increasing their intention to participate in commercialisation and/or engagement activities. In contrast, a leader whose behaviour is perceived as highly prevention focused is likely to interact with their subordinates' chronic regulatory focus reducing their motivation and thereby lowering their intent making them less likely to participate in commercialisation and/or engagement activities. Therefore, the following hypotheses are offered:

Hypothesis 5a: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.*

Hypothesis 6a: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in commercial activities.*

Hypothesis 7a: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.*

Hypothesis 8a: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities.*

Hypothesis 5b: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.*

Hypothesis 6b: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.*

Hypothesis 7b: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.*

Hypothesis 8b: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.*

4.10.4.6 Regulatory Focus and the Influence of Work-Group Colleagues

The interviews suggested the more general work environment can also provide situational cues. Some researchers have found that academics are also motivated to participate in commercialisation activities through being exposed to the group norms (Bercovitz & Feldman, 2011; Louis et al., 1989; Rasmussen, Mosey & Wright, 2014; Kenney & Goe, 2004) and by peers working within their local environment (Tartari et al., 2014). The results of the interviews suggest that the level of colleague participation in commercialisation and/or engagement activities within their group, may also be an important motivational factor. Drawing on Gifford's analogy, this suggests that academics observing colleagues spinning commercialisation plates alongside their core academic plates reinforces the legitimacy of participating in engagement and engagement activities. As has been found in the literature that when an academic's colleagues value patents and awards, then that academic is more likely to participate,

whilst the opposite is true if colleagues value traditional academic activities (Haeussler & Colyvas, 2011). Therefore, the following hypothesis are offered:

Hypothesis 9a: *The greater the level of colleague commercialisation participation, the more positive an academics intention to participate in commercialisation activities.*

Hypothesis 10a: *The greater the level of colleague participation in engagement activities within their work group, the more positive an academics intention to participate in engagement activities*

Hypothesis 9b: *The greater the level of colleague commercialisation participation, the more positive an academics intention to participate in commercialisation activities.*

Hypothesis 10b: *The greater the level of colleague participation in engagement activities within their work group, the more positive an academics intention to participate in engagement activities*

4.10.4.7 Regulatory Focus Theory and Work-Group Colleagues Interactions

Higgins (1997) discusses a further self-regulatory principal, which is that individuals can also use salient reference points in order to guide their behaviour. This is referred to in the cognitive psychology literature as regulatory reference (Higgins, 1997) and is independent of, but complementary to regulatory focus. As such, if individuals view a particular reference point as having positive value, this will correspond to them experiencing attraction toward it. Experiencing something as having negative value will correspond to them experiencing repulsion from it (Higgins, 1997). Higgins (1997) proposed that regulatory reference research remained incomplete and suggested that regulatory focus theory be used in combination with the reference point to explain why individuals adopt different strategies.

The data from the interviews suggested that group norms were important. As group norms are also considered to be a motivating factor in academics commercialising their research (Kenney & Goe, 2004; Haeussler & Colyvas, 2011; Hayter, 2011; Louis et al., 1989, Rasmussen, Mosey & Wright, 2014), this implies that the level of

commercialisation and engagement activities (two key reference points) of colleagues within their work group may also affect the intensity of promotion or prevention focus an academic will experience (Higgins, 1997), in turn affecting their commercialisation intent. In groups where the level of colleague participation in commercialisation and/or engagement activities is high, this reference point, in combination with an individual's chronic promotion focus should lead to academics viewing commercialisation and/or engagement activities as a 'desired end state'. In terms of commercialisation activities, the reverse should be true for prevention focused academics. As they will be motivated to avoid failure or losses by participating in commercialisation activities, this will be viewed as undesirable and will result in a lower intent to participate. On the other hand, engagement activities can be perceived as a lower risk commercialisation option and as something academics perhaps 'ought' to be doing (Higgins, 1998). As a result, in groups where the level of colleague participation in engagement activities is high, this reference point should moderate a chronic prevention focused individual's behaviour. As prevention-focused individuals have values aligned with security and responsibility, they should in turn be motivated to match the level of participation in engagement activities of their colleagues, in order to maintain their "group membership". Therefore, the following interaction hypotheses are offered:

Hypothesis 11a: *The greater the level of colleague participation in commercialisation activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.*

In groups where the level of colleague participation in commercialisation activities is greater, this reference point, when combined with an individual's chronic prevention focus, should lead to academics being repelled away from participating in commercialisation activities. As prevention-focused individuals they are unable to bear high levels of uncertainty and desire safety and security. This will be viewed as an undesired reference point, leading to lower intent to participation in commercialisation. Therefore, the following interaction hypothesis are offered:

Hypothesis 11b: *The greater the level of colleague participation in commercialisation activities, the more negative the relationship between the individual's chronic prevention focus and their intention to participation in commercialisation activities.*

In groups where the level of colleague participation in engagement activities is high, this reference point, combined with an individual's chronic promotion focus should lead to academics viewing participating in engagement activities as having a positive value, thereby matching the social norms or underlying standard and in turn increasing their intention to engage in engagement activities. Therefore, the following hypothesis is offered:

Hypothesis 12a: *The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.*

In groups where the level of colleague participation in engagement activities is high, this reference point will moderate chronic prevention focused individual's behaviour motivating them to increase entrepreneurial intent in order to maintain their "group membership". Viewing group membership as a positive value should lead to prevention focused academics experiencing a strong attraction towards it (i.e. they will try to close any perceived gap). Although this may seem counterintuitive for highly prevention focused individuals to display increased entrepreneurial intent based on the prior hypothesis. Prevention focused individuals should view knowledge-based engagement activities as something they 'ought' to be doing. As they have motives aligned with responsibility and security (Higgins, 1998), the perception of not maintain their 'group membership', an undesired end state, will lead prevention focus academics having increased intentions to participate in "less uncertain" engagement activities. This occurs in order to match the level of colleague participation in engagement activities

within their group, allowing them to maintain group membership. Therefore, we offer the following interaction hypothesis:

Hypothesis 12b: *The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.*

4.10.4.8 Situational Regulatory Focus and Academic Leader Influence on Entrepreneurial Norms

The development of the hypotheses above along with some of the interviewees suggests that the behaviour and actions of academic leaders assists in the creation of entrepreneurial norms for a group. The hypotheses developed above led to one further question; does a leader's perceived situational regulatory focus determine the level of commercialisation and/or engagement participation within their group, or do academics generally remain self-motivated and participate in entrepreneurial activities on a discretionary basis. In order to understand this in more detail the following hypotheses are offered:

Hypothesis 13a: *The more promotion focused the leader's behaviour is perceived to be, the higher the level of colleague commercialisation participation in their work group.*

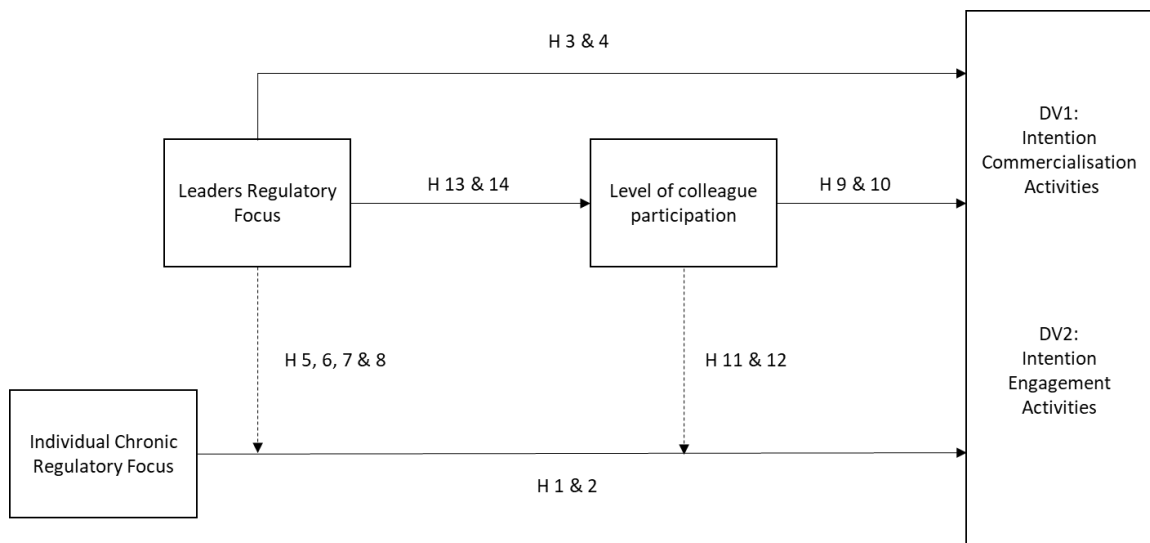
Hypothesis 13b: *The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague commercialisation participation in their work group.*

Hypothesis 14a: *The more promotion focused the leader's behaviour is perceived to be, the higher the level of colleague participation in engagement activities in their work group.*

Hypothesis 14b: *The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague participation in engagement activities in their work group.*

Taken as a whole, Figure 13 summarises this thesis' conceptual model, which outlines the hypotheses in relation to the individual, leader and colleagues' direct effect and interactions on an academic's commercialisation and engagement intentions. A summary of the hypotheses developed above is also provided below.

Figure 13. Conceptual Model



4.11 Summary of Hypotheses:

Hypothesis 1a: *The stronger an academic's chronic promotion focus, the stronger their intention to participate in commercial activities.*

Hypothesis 2b: *The stronger an academic's chronic prevention focus, the weaker their intention to participate in commercial activities.*

Hypothesis 1a: *The stronger an academic's chronic promotion focus, the stronger their intention to participate in engagement activities.*

Hypothesis 2b: *The stronger an academic's chronic prevention focus, the weaker their intention to participate in engagement activities.*

4.11.1 Leader Direct Effect Hypotheses

Hypothesis 3a: *The more promotion-focused a leader's behaviour is perceived to be, the more positive an academics intention to participate in commercialisation activities.*

Hypothesis 4a: *The more prevention-focused a leader's behaviour is perceived to be, the more negative an academics intention to participate in commercialisation activities.*

Hypothesis 3b: *The more promotion-focused a leader's behaviour is perceived to be, the more positive an academics intention to participate in engagement activities.*

Hypothesis 4b: *The more prevention-focused a leader's behaviour is perceived to be, the more negative an academics intention to participate in engagement activities.*

4.11.2 Leader Interaction Hypotheses

Hypothesis 5a: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.*

Hypothesis 6a: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in commercial activities.*

Hypothesis 7a: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.*

Hypothesis 8a: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities.*

Hypothesis 5b: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.*

Hypothesis 6b: *The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.*

Hypothesis 7b: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.*

Hypothesis 8b: *The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.*

4.11.3 Colleague Direct Effects Hypotheses

Hypothesis 9a: *The greater the level of colleague participation in commercialisation activities, the more positive an academics intention to participate in commercialisation activities.*

Hypothesis 10a: *The greater the level of colleague participation in engagement activities within their work group, the more positive an academics intention to participate in commercialisation activities*

Hypothesis 9b: *The greater the level of colleague participation in commercialisation activities within their work group, the more positive an academics intention to participate in engagement activities.*

Hypothesis 10b: *The greater the level of colleague participation in engagement within their work group, the more positive an academics intention to participate in engagement activities*

4.11.4 Colleague Interaction Hypotheses

Hypothesis 11a: *The greater the level of colleague participation in commercialisation activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.*

Hypothesis 12a: *The greater the level of colleague participation in commercialisation activities, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities.*

Hypothesis 11b: *The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.*

Hypothesis 12b: *The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.*

4.11.5 Leader Direct Effects on Entrepreneurial Norms Hypotheses

Hypothesis 13a: *The more promotion focused the leader's behaviour is perceived to be, the higher the level of colleague commercialisation participation in their work group.*

Hypothesis 13b: *The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague commercialisation participation in their work group.*

Hypothesis 14a: *The more promotion focused the leader's behaviour is perceived to be, the higher the level of colleague participation in engagement activities in their work group.*

Hypothesis 14b: *The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague participation in engagement activities in their work group.*

Now that hypotheses have been developed based on the literature review and qualitative elements of the study, the following chapter presents a quantitative analysis

of the different components identified. The rationale for the methodological approach taken is outlined and the data collection and analysis of the data collected on an academic population, is based on the conceptual model developed above.

Chapter 5 Scottish Academic Population

5.1 Introduction

This section of the chapter commences with a brief discussion of Multi-Level Analysis which is the methodological approach for the quantitative element of the study. The second section outlines the justification and reasons behind a particular Multiple Regression technique, Hierarchical Regression Analysis, and discusses how this fits within a multi-level framework. The collection of data, the variables used in the study and analysis of this data is then outlined and finally the main findings of the quantitative study are set out based upon the framework in the conceptual model (Figure 13).

5.2 Multi-Level Analysis

The level of analysis a researcher decides upon has been discussed as being an increasingly important element in entrepreneurship research (Gartner, 2001). Low and MacMillan (1988) suggest that entrepreneurship occurs across different levels of analysis, such as the individual, group, organisation, industry, and society. The reasons for studying entrepreneurship on multiple levels of analysis lie in the characteristics of the entrepreneurial phenomenon itself.

Ultimately, it is individuals who engage in entrepreneurial action, but these entrepreneurial actions often take place in organisational contexts (Shane & Venkataraman, 2000). As a result, Gartner (2001) suggests that important insights about any entrepreneurial process can be gained by researchers conducting studies that are multi-level in nature. This sentiment has been echoed more recently by other scholars (e.g. Johnson et al., 2017; Lee et al., 2011), who have also called for more multi-level research to be conducted in order to better understand entrepreneurial motivations and contextual factors. Several of the interviewees suggested that either their leader and/or colleagues played an important factor as to why they did or did not participate in

commercialisation and/or engagement. It is considered that adopting a multi-level perspective, in order to better understand how both individual and contextual factors affect one another, may help provide a deeper understanding of individual motives to participate in academic entrepreneurship in Scottish universities. Supporters of multilevel research within the entrepreneurship domain (e.g. Davidsson & Wiklund, 2001) suggest that to better understand an individual's intentions, researchers should take into account both contextual and individual factors. While a limited number of studies in the wider academic entrepreneurship literature have also indicated that contextual factors can influence why some academics may or may not participate in entrepreneurial activities (e.g. Bercovitz & Feldman, 2008; Tartari et al., 2014), such studies offer little in the way of explaining why these contextual factors affect some individuals more than others.

5.3 Multiple Regression Analysis

Multiple regression analysis (MRA) is a flexible data analytic system and may be used whenever a researcher wishes to study a dependent variable as a function of, or in relation to, other independent variables (Cohen et al., 2003). The origins of MRA can be found in the biological and behavioural sciences towards the end of the 19th century. Studies undertaken by Francis Galton, who was researching the relationship between the heights of fathers and sons and the analysis of agricultural data, led to him coining the term 'regression' (Cohen et al., 2003). One of the principal benefits of MRA is its capacity to represent, with little distortion, the types and the complexity of relationships that exist within behavioural and social science studies (Cohen et al., 2003). As such, any relationship observed between independent variables and a dependent variable in a study, can now be examined in terms of the strength of this relationship or its effect size. This technique can be used to predict the value of a dependent variable from the value of either a single independent variable or multiple independent variables and when two or more independent variables are included in an equation the analysis, is then referred to as multiple regression analysis. As a result, we can understand how much of the total

variation in the dependent variable is produced by or associated with the independent variables in the study. A key element of MRA is the provision of regression coefficients, proportion of variance explained and correlation measures which are all effect size measurements (Cohen et al., 2003). Whilst a number of differing multiple regression techniques exist, within this study, hierarchical regression analysis has been selected as the appropriate method to measure the effects that independent variables may have on the dependent variable. In the following section the justification as to why hierarchical regression has been chosen in order to analyse the data is discussed.

5.3.1 Hierarchical Regression

This thesis draws upon multiple strands of Regulatory Focus Theory, in an attempt to bring a deeper understanding of how contextual factors may affect an academic's commercialisation and engagement intentions. As at any point in time, both promotion and prevention focus exists, and one will dominate the other because of either situational triggers (i.e. leaders and colleagues) (Crowe and Higgins, 1997) or their chronic tendencies (individual personality traits) when strong situational triggers are lacking. As promotion and prevention foci are independent dimensions (Higgins, 1997, 1998) it is necessary to assess promotion and prevention foci independently. As a result, Hierarchical Regression Analysis has been selected as an appropriate technique to perform the analysis of the conceptual framework. Hierarchical regression analysis is useful in examining the relationships between variables, specifically, researchers are able to understand how and why independent variables affect the dependent variable. As such, hierarchical regression analysis allows the researcher to enter variables based upon theory, for example, as per the hypotheses in the conceptual model. As a result, this method of analysis allows the researcher to build successive linear regression models, whereby each model adds another level of theory.

Cohen et al., (2003) recommend that the first step in undertaking any hierarchical regression analysis is that the dependent variable should always retain its 'raw score' but the independent variables should be centred (i.e. have a mean of zero) but should not be

standardised. In order to start building a model it is common to start by adding only control variables as a first step. In the subsequent models, the researcher is then able to add the variables of interest based on theory (or their model), in order to see which variables are able to significantly predict the dependent variable, above and beyond the effects of the previously entered variables. As a result, for each step of the hierarchical regression analysis, a new model is created whereby the next higher order variables are added, and then significant variables can be identified and incremental R^2 and F tests of statistical significance are evaluated. As the researcher is able to build separate but related models in each step, this method allows each of the independent variables (whether a main effect or interaction) to be assessed. Each independent variable can firstly be assessed if it is significant as to what it can add to the model in terms of R^2 after all the previously entered variables are controlled for (Pallant, 2007), showing how each model or strand of regulatory focus theory explains or predicts the dependent variable.

This method is particularly useful for understanding interaction effects. This is because, as all the previously entered variables are controlled for and any significant interaction effect identified only exists if the interaction term also delivers a significant R^2 contribution over and above all the previously entered independent variables (Cohen et al., 2003). As the conceptual model suggests that some contextual variables may moderate an individual's commercialisation or engagement intentions, the hierarchical regression should be an appropriate method of analysis to interpret multiplicative or interaction terms in regression analysis (Cohen et al., 2003). The validity of this procedure has been shown mathematically by Cohen et al., (2003) and has also been the method of choice when used to explore direct and interaction effects in prior entrepreneurship research (e.g. Wu et al., 2008; Lee et al., 2011).

5.3.2 Simple Slope Analysis

Once the hierarchical regression analysis has been completed, Cohen et al., (2003) advise that as a robustness check any significant interaction effects found in the hierarchical regression analysis should also be assessed through simple slope analysis. This is an important procedure to undertake, as researchers have expressed concerns that interactions may remain undetected during regression analysis due to lack of statistical significance (Aguinis, 1995; Saemundsson & Candi, 2014). For example, Saemundsson & Candi (2014) found that interactions could remain undetected in regression analysis due to lack of statistical significance and Aguinis (1995) found that even within larger sample sizes of 120, moderating effects can remain undetected. As the test for interaction using regression analysis is regarded as a conservative test and thus increases the likelihood of not detecting an interaction when one may exist, simple slopes should be used to check for undetected moderating effects on all the interactions.

A simple slope can be understood as the regression of the outcome y (dependent variable) on the predictor x at a specific value of the moderator z (Aiken and West, 1991). For example, using example variables from this study this would allow us to graph the gradient of the dependent variable commercialisation intentions (y) on the predictor variable individual chronic promotion focus (x), which is in turn moderated by specific values of leader prevention focus (z). Typically, assessment of how significant interactions moderate the dependent variable is completed by inputting specific values of the interaction items from the regression analysis and then plotting them against the dependent variable at plus and minus one standard deviation above and below the mean to represent high and low moderation points (Cohen et al., 2003). In order to create the simple slopes diagrams in this study and to test and interpret the interactions excel worksheets from Jeremy Dawson's website [www.jeremydawson.co.uk] were used to input the data, interpret the results and create the simple slope diagrams. As simple slope analysis is useful in testing two-way interactions when the relationship between an independent and dependent variable is moderated by a third variable, simple slope analysis can also be used to understand the range of values for which relationships

remain statistically significant. Simple slopes are also able to visually show the relationship between the two simple slope lines and can converge from left to right to form a point, can cross like an “x” or can diverge from left to right to form an opening angle.

5.4 Survey Sample

For an effective assessment of academics working in Scottish universities intentions to participate in commercialisation or engagement activities and of the direct and/or moderating effects, it was necessary to pay careful attention to existing studies that have been affected by incoherence in the populations studied, which have led researchers to raise questions over the external and internal validity of the results. Historically many studies have focused on specific disciplines whilst others have attempted to address populations of academics at selected universities, which increases the possibility of skewing results. It has been recommended by researchers in the field that ideally, sampling procedures should ensure population representativeness and attempt to avoid sampling bias. In order to try to avoid these pitfalls, the research sample was selected in an attempt to ensure it was as close as possible in representativeness of the Scottish academic population as a whole, and to limit selection bias.

A key challenge for any researcher in attempting to address some of the issues identified above is their ability to access a large list of contact details that are reflective of the population studied. As no central database of Scottish academics exists, it was decided to use a census sampling approach (whole academic population) and to manually create a directory of the academics listed on their respective university web sites across differing departments and faculties within their institutions. It was intended that this approach would lead to no bias being afforded towards any particular discipline or type of university. A main stumbling block of this approach was its resource intensiveness; collecting academic email addresses from websites was made increasingly difficult due to anti-spam filters and many academics having their own individual web

page meaning they had to be accessed individually in order to collect their details. One university, the University of the Highlands and Islands did not provide the details of their staff members at that time and after discussing the situation with the PhD supervisors, it was decided that the omission of one of Scotland's smaller universities would not materially affect the results.

In terms of distributing the survey to large numbers of academics, a self-administered e-mail survey approach was deemed to be the most suitable for this research project. This method has a number of strengths, namely, respondents input their own data, can reply anonymously, it is low cost, the data is automatically stored electronically and respondents can save their responses and return to the survey at a later time (Dilman, 2000). Qualtrics survey software was thus used to administer the survey. The survey software provided a hyperlink in the email and all respondents were required to do was to click on the link to access the survey. A pilot study was also conducted to test the wording of the questionnaire. The pilot questionnaire was sent to the interview participants and an additional number of academics working at Strathclyde University, in an attempt to ensure validity of the scales and that the survey software was working correctly. After the pilot study was conducted, the full survey was sent out to Scottish academics. The link for the web-based questionnaire was originally e-mailed to 7065 academics working in fourteen Scottish universities. The survey involved an initial email along with two follow-up email prompts sent one and two weeks later. A copy of the survey invite can be found in appendix 4. The first wave of the survey began in May 2014 and the final wave was completed in June 2014. The survey was sent out to academics internally via the technology transfer office at the University of Strathclyde and for the remainder of the sample population the survey invite email was sent directly to the academic's inbox using the Qualtrics survey distribution manager. At the end of the data collection period 818 useable responses were collected which represented an overall response rate of 11.6%.

5.4.1 Missing Value Analysis

Cases with missing values can pose an important challenge to researchers, because typical modelling procedures simply discard these cases from the analysis. When there are few missing values (SPSS suggests less than 5% of the total number of cases), then those values can be considered to be missing at random. That is, whether a value is missing does not depend upon other values, then the typical method of listwise deletion is generally considered as safe (SPSS, 2013). Assessment of the data set showed that 934 respondents started the survey, of those who started 85 respondents accessed the survey and either left the survey without answering any questions or very early on in the questionnaire, these cases were therefore deleted from the data set. As a result, analysis of the data showed that only 3.78% (31 respondents) of the total cases contained missing values in at least one of the specified variables and as a result a listwise deletion of such cases from the data set took place. Therefore, the hierarchical regression analysis was only run with cases which had a complete set of data.

5.5 Measures

The variables included in the study are detailed in the following sections.

5.5.1 Dependent Variables

Ajzen's (1991) Theory of Planned Behaviour outlines that today's intentions should determine one's future behaviour. Prior research has supported this, showing that strongly held intentions are correlated with subsequent entrepreneurial behaviour (e.g. Fini et al., 2012; Krueger, Reilly & Carsrud, 2000; Zahra et al., 2009). Within this work, an academic's entrepreneurial intention is defined as the intention to participate in commercialisation or engagement activities. Academics' entrepreneurial intent was measured using a 7-point Likert scale ranging from very unlikely (1) to very likely (7)

for the items used to measure their intentions to participate in either commercialisation or engagement activities. Following Douglas & Fitzsimmons (2012), the questionnaire asked how likely it was that they would participate in differing forms of entrepreneurial activities within the next 2 years. The academics' entrepreneurial intent to participate in commercialisation and engagement activities led to the creation of two distinct dependent variables.

Dependent Variable 1: For commercialisation intentions respondents were asked if an opportunity arose; “how likely is it that you will attempt to license technology based on your research in the next 2 years?” and “how likely is it that you will attempt to start a company based on your research in the next 2 years?” The two items were then averaged to derive a single score for commercialisation intentions.

Dependent Variable 2: Similar to dependent variable 1, respondents were asked to rate the intention to participate in engagement activities if an opportunity arose for each of the four items on a 7-point scale (e.g. “how likely is it that you will participate in contract consultancy in the next 2 years?”). The four engagement activities (continuous professional development, collaborative research, contract research and contract consultancy) were chosen as they consistently bring in significant revenues to universities as outlined in the annual, HE-BIC survey (HEFCE, 2015). The academic's intentions to participate in entrepreneurial action for each of these activities was again averaged to derive a single score for their intention to participate in engagement activities.

5.5.2 Independent variables

The following section discusses the independent variables used in this study. An academic's chronic regulatory focus was measured using Lockwood, Jordan, and Kunda's (2002) 18-item general regulatory focus scale. This assesses one's promotion and prevention focus over nine items respectively and were assessed using a 7-point

Likert-type scales ranging from strongly disagree (1) to strongly agree (7). The scale items and regulatory orientation associated with each are set out in table 11.

Table 11. Scale Items Related to Individual and Corresponding Regulatory Orientation

Scale Item	Regulatory Focus
In general, I am focused on preventing negative events in my life.	Prevention focus
I am anxious that I will fall short of my responsibilities and obligations.	Prevention focus
I frequently imagine how I will achieve my hopes and aspirations.	Promotion focus
I often think about the person I am afraid I might become in the future.	Prevention focus
I often think about the person I would ideally like to be in the future.	Promotion focus
I typically focus on the success I hope to achieve in the future.	Promotion focus
I often worry that I will fail to accomplish my academic goals.	Prevention focus
I often think about how I will achieve academic success.	Promotion focus
I often imagine myself experiencing bad things that I fear might happen to me.	Prevention focus
I frequently think about how I can prevent failures in my life.	Prevention focus
I am more oriented toward preventing losses than I am toward achieving gains.	Prevention focus
My major goal right now is to achieve my academic ambitions.	Promotion focus
My major goal right now is to avoid becoming an academic failure.	Prevention focus
I see myself as someone who is primarily striving to reach my “ideal self”— to fulfill my hopes, wishes, and aspirations.	Promotion focus
I see myself as someone who is primarily striving to become the self I “ought” to be—to fulfill my duties, responsibilities, and obligations.	Prevention focus
In general, I am focused on achieving positive outcomes in my life.	Promotion focus
I often imagine myself experiencing good things that I hope will happen to me.	Promotion focus
Overall, I am more oriented toward achieving success than preventing failure.	Promotion focus

Leader regulatory focus, this variable aims to reflect an academic’s assessment of their leader’s regulatory focus, was measured with the 7-item leader regulatory focus measure developed by Wu et al. (2008). This assesses promotion and prevention focus by using three and four items respectively and these were again assessed using a 7-point Likert-type scale, which ranged from strongly disagree (1) to strongly agree (7). Since the original measure was worded for the business context and after feedback from academics, the term ‘supervisor’ was changed to line-manager in order to better match the local context in our sample (e.g., “my supervisor is good at many different things” the word “supervisor” was replaced by “line manager”). The scale items and leader regulatory orientation associated with each item is set out in table 12.

Table 12. Scale Items Related to Line Managers and Corresponding Regulatory Orientation

Scale Item	Regulatory Focus
My line-manager is good at many different things.	Promotion focus
My line-manager sets improvement goals for their department/group.	Promotion focus
My line-manager prefers innovative approaches to traditional approaches.	Promotion focus
My line-manager frequently gets on upper management's nerves (reverse scored).	Prevention focus
My line-manager “crosses the line” by doing things that upper management would not formally approve of (reverse scored).	Prevention focus
Not being careful enough has gotten my line-manager into trouble at times (reverse scored).	Prevention focus
My line-manager acts in ways that upper management thinks are objectionable? (reverse scored)	Prevention focus

The level of colleague participation in commercialisation and engagement activities within an academic’s work department/group was measured using two single item 5 point Likert scales ranging from nobody (1) to everybody (5) (Obshonka et al., 2011) in order to reflect the level of colleague participation for each of the dependent variables. The measures were “Within your work group, colleagues have already

participated in any of the following activities; continuous professional development, contract research, contract consultancy or collaborative research” and “Within your work group, colleagues have already participated in the formation of a company and/or have licensed technologies in order to commercialise their research.”

5.5.3 Control Variables

Prior research has found that certain characteristics play an important role in predicting differing types of academic entrepreneurship (Perkmann et al., 2013). As a result, ten control variables were identified and used, these included gender, age, academic rank, employment status, prior entrepreneurial experience, management responsibility, university type, whether their research was applied or basic, resources for innovation and whether they work in STEM disciplines.

5.5.3.1 Gender

Researchers have found that male academics are significantly more likely to participate in academic entrepreneurship than females (Boardman, 2009; Giuliani et al., 2010; Goktepe-Hulten, 2010; Link, Siegel & Bozeman, 2007); The control variables were coded as Female (0) Male (1).

5.5.3.2 Age

Age has been found to have an ambiguous effect on whether one participates in commercialisation and engagement activities, with some studies finding a positive relationship (e.g. Haeussler & Colyvas, 2011; Link et al., 2007) and others a negative relationship (e.g. Bekkers, Maria & Freitas, 2009; D'Este & Patel, 2007). In order to capture the age of academics five categories were used (under 30, 30-39, 40-49, 50-59 and 60 and over).

5.5.3.3 Academic Rank

Researchers have found that an academic's status has a positive impact on the level of industry interactions. This suggests that the more senior an academic the more likely they are to participate in commercialisation activities (D'Este & Patel, 2007; Link et al., 2007; Haeussler & Colyvas, 2011). Academic seniority was measured and coded using the following four academic ranks; Professor = 4, Senior Lecturer/Reader = 3, Lecturer = 2, Research/Teaching Fellow or Research/Teaching Associate = 1

5.5.3.4 Employment status

Researchers have found that having greater perceived security in one's job through obtaining tenure as opposed to contract work, is an indicator of increased participation in entrepreneurial activities (Stuart & Ding, 2006; Bercovitz & Feldman, 2008). The control variables were thus coded as Fixed contract (0); Tenured position (1).

5.5.3.5 Prior Entrepreneurial Experience

The wider entrepreneurship literature discusses that prior entrepreneurial experience increases the probability of the identification and exploitation of opportunities (Shane & Venkataraman, 2000; Shane, 2000). This was assessed by asking participants whether or not they had prior entrepreneurial experience through starting their own company; the control variables were coded No (0); Yes (1).

5.5.3.6 Management Responsibility

One characteristic that has received little attention in the wider literature is whether an academic has management responsibilities and what impact that might have

on their commercialisation intentions. Typically, academics who have risen through the ranks to manage others, are often associated with a successful publication record and have a wide range of contacts (Grimpe & Fier, 2009). Thus, it is worth asking if having line management responsibility leads to stronger motivations to participate in commercialisation and/or engagement activities in order to generate income for their group in order to help support their subordinates? To consider this the control variables were coded as No (0); Yes (1).

5.5.3.7 University Type

One important institutional determinant for participation in engagement activities is the quality of research output. As a result, older studies have suggested that commercialisation activities tend to be concentrated amongst the top-ranked universities, while engagement activities are more prevalent in less research intensive universities (D'Este & Patel, 2007; Di Gregorio & Shane, 2003; Ponomariov, 2007). However, more recent studies (Hughes & Kitson, 2012; Markman et al., 2008) have shown that both commercialisation and engagement activities are becoming part of the everyday activities of all universities (Perkmann et al., 2013). Consequently, the sample includes two universities (University of Glasgow and the University of Edinburgh) which were coded as 'Russell Group' (1) to reflect their research-intensive status, and the remaining Post and Pre-1992 universities were coded as (0).

5.5.3.8 Applied vs Basic research

Prior research has found that academics who concentrate on applied research rather than basic research, increases the likelihood of entrepreneurial action (Bekkers & Bodas Freitas, 2008; Bekkers et al., 2009; Bozeman & Gaughan, 2007). The control variables were coded as basic research (0), applied research (1).

5.5.3.9 Resources for Innovation

The environmental context and availability of resources for academic entrepreneurship suggest that this could be an important determinant. Abreu & Grinevich, (2013) discuss that academic entrepreneurship requires increased innovation when compared to an academic's core duties and the organisational climate for innovation could determine an academic's level of participation in commercialisation and engagement activities. Six items from Scott and Bruce's (1994) measure were thus used to assess the degree to which respondents believed that resources within their organisation were used to encouraged innovative behaviour which were assessed using a 7 point Likert-type scale ranging from strongly disagree (1) to strongly agree (7). The scale items are set out in table 13.

Table 13. Resources for Innovation

Scale item
Assistance in developing new ideas is readily available
There are adequate resources devoted to innovation in this organisation
There is adequate time available to pursue creative ideas here
Lack of funding to investigate creative ideas is a problem in this organisation (Reverse scored)
Personnel shortages inhibit innovation in this organisation (Reverse scored)
This organisation gives me free time to pursue creative ideas during the workday

5.5.3.10 STEM vs Non-STEM Disciplines

Academic discipline has been found to be an important variable when considering commercialisation activities, as opportunities to participate in differing channels vary across academic disciplines (Wright et al., 2004; Hughes & Kitson, 2012). Laukkanen (2003) identified that opportunities to behave entrepreneurially in STEM related disciplines are higher when compared to other disciplines. In order to understand

whether academics working in the STEM disciplines in Scottish universities were more likely to display stronger intentions to participate in commercialisation or engagement activities, a dummy variable was created with non-STEM disciplines coded as (0) and STEM disciplines coded as (1).

5.5.4 The Characteristics of Respondents

In addition to the data collection and analyses discussed above, a descriptive analysis was also performed, in order to provide an overview of the characteristics of respondents (Tables 14 and 15). The online survey achieved a useable response rate of 11.6% ($N=818$).

Table 14. Respondents per University

Name of University	Number of Recipients	Number of Respondents	Percentage
University of Aberdeen	602	80	13.3%
Abertay University	137	9	6.6%
University of Dundee	370	56	15.1%
University of Edinburgh	1031	137	13.3%
University of Glasgow	936	126	13.5%
Glasgow Caledonian University	370	31	8.4%
Heriot-Watt University	496	47	9.5%
Edinburgh Napier University	333	37	11.1%
Queen Margaret University	123	17	13.8%
Robert Gordon University	257	24	9.3%
University of St. Andrews	470	73	15.5%
University of Strathclyde	1208	99	8.2%
University of Stirling	423	53	12.5%
University of the West of Scotland	309	29	9.4%
Total	7065	818	11.6%

As illustrated in Table 15, 62.7% the individual characteristics of respondents were males and 37.3% were females. The Academic Rank of respondents consisted of 21.8% professors, 25.2% senior lecturers, 28.2% lecturers and 24.8% fell into the ‘other’ category e.g. research/teaching fellow, etc. The characteristics of the respondents within this study are broadly in line with other UK wide knowledge exchange survey results (i.e. Hughes & Kitson, 2012).

Table 15. Individual Characteristics of Respondents

	Respondents	% Total Respondents
Gender		
Male	503	62.7%
Female	315	37.3%
Academic Rank		
Professor	178	21.8%
Senior Lecturer/Reader	206	25.2%
Lecturer	231	28.2%
Other (Teaching/Research Fellow, Research Associate, Research/Teaching Assistant)	203	24.8%
Employment Status		
Tenured (Permanent Position)	615	75.2%
Limited-time contract	203	24.8%
Age Group		
Under 30	24	2.9%
30 to 39	261	31.9%
40 to 49	237	29.0%
50 to 59	215	26.3%
60 or over	81	9.9%
Prior entrepreneurial experience		
Yes	127	15.5%
No	691	84.5%
Line management responsibility		
Yes	418	51.1%
No	400	48.9%

Following Hughes and Kitson (2012), 15 major disciplines were categorised; Health Sciences (13.45%); Physics and Astronomy (6.23%); Chemistry (5.26%); Mathematics and Computing (8.19%); Engineering (9.18%); Material science (1.10%); Biological sciences (16.38%) Veterinary and agricultural sciences (1.96%); Architecture, Building and Planning (1.83%); Law, Social Sciences and Economics (12.35%); Business and Financial Studies (11.61%); Languages (2.08%); Creative Arts & Media (1.34%); Education (2.93%); Other Humanities (6.11%). The responses for these disciplines are set out in table 16 below and separated into STEM and non-STEM disciplines.

Table 16. Academic Respondents by Discipline

Academic Discipline	Number of Respondents	% Total Respondents
Physics and Astronomy	51	6.23%
Chemistry	43	5.26%
Mathematics and Computing	67	8.19%
Engineering	76	9.18%
Material Science	9	1.10%
Biological Sciences	134	16.38%
Veterinary and agricultural sciences	16	1.96%
Total STEM Disciplines	395	48.30%
Health Sciences	110	13.45%
Architecture, Building and Planning	15	1.83%
Law, Social Sciences and Economics	101	12.35%
Business and Financial Studies	95	11.61%
Education	11	2.93%
Languages	24	2.08%
Creative Arts & Media	17	1.34%
Other Humanities	50	6.11%
Total Non-STEM Disciplines	423	51.70%
Total	818	100%

The respondents were also asked to select the type of research they predominantly participated in (either basic or applied), based on the following descriptions. Basic research being concerned with theoretical, empirical or experimental (blue sky) research, undertaken to acquire new knowledge about something. Applied research being concerned with investigations taken in order to acquire new knowledge directed towards a particular need, or use, in industry or society. The results set out in table 17 showed that respondents who predominantly had an applied research made up 52% of the respondents while those who predominantly participate in basic research made up 48%.

Table 17. Respondents by Research Type

Research Type	Number of Respondents	% Total Respondents
Basic research	393	48.00%
Applied research	425	52.00%

5.6 Tests of Reliability

The tests of reliability that have been employed in this study are described in the following sections.

5.6.1 Cronbach’s Alpha

Reliability is of central concern to research in the social sciences because measuring instruments are rarely completely valid. The measuring of reliability, in general terms is an attempt to ascertain whether a significant amount of agreement exists between independent efforts to measure the same theoretical construct (i.e., consistency). Two forms of reliability exist: external and internal reliability (Bryman & Cramer, 1999). External reliability refers to the degree of consistency of a measure over time. One way to test external reliability is to use the test-retest technique, where

respondents are asked the same set of questions at two points in time. This technique, for most social science research, including this study, would not be practical. Firstly, it is often difficult to give the same test to the same respondents twice. Secondly, people may remember their answers from the first test, and answer the same way the second time around to be consistent (de Vaus, 1996). de Vaus (1996) argues that the best way to create reliable indicators is to use multiple-item indicator reliability test. In some cases, however, there is little point in asking a question in several different ways (e.g., gender, age, etc.). In which case, the best course is to use questions based on previous reputable work. As a result, several of the measures used in this study have previously been used in prior research within a number of entrepreneurship research studies and journals.

Internal reliability is particularly important in connection to multiple-item scales. It raises the question of whether each scale is measuring a single idea, and hence whether the items that make up the scale are internally consistent (Hair et al., 2010). One of the most common methods of estimating the internal reliability of a scale is the Cronbach's alpha coefficient (Hair et al., 2010). The value of a Cronbach's alpha varies between one and zero and a test value of 0.7 or above is regarded as being highly reliable. The Cronbach's alpha coefficients relating to the reliability of measures used in the current study are set out in table 18 all the multi-scale items used in this study were found to be above the 0.7 value and can therefore be regarded as reliable.

Table 18. Cronbach's Alpha Coefficients for the Measures Used in the Study

Variable	Cronbach's alpha
Commercialisation intentions	0.712
Engagement intentions	0.741
Individual chronic promotion focus	0.869
Individual chronic prevention focus	0.866
Leader promotion focus	0.718
Leader prevention focus	0.902
Resources for innovation	0.791

5.6.2 Test for Multicollinearity

When interpreting variables that are to be multiplied together in order to test for interactions between independent variables and a dependent variable, it is important that checks for multicollinearity occurring within the independent variables are undertaken. Multicollinearity has the potential to occur in multiple regression models when independent variables are highly correlated with other independent variables in the multiple regression equation. This means that if multicollinearity does exist, the regression coefficient can be unreliable because little unique information is available from which to estimate its value (Pedhazur, 1982). In such cases the possibility of multicollinearity existing among the variables can impact the results. Signs of multicollinearity include none of the regression coefficients being statistically significant but the F-test for the model as a whole being significant, or adding additional independent variable(s) (i.e. a new model) radically changes either the size or the direction (positive to negative or vice versa) of the regression coefficients associated with other independent variables. In order to account for multicollinearity, the variables in the regression analysis were tested using the variance inflation factor (VIF), which tests the severity of the extent to which multicollinearity was a problem for each independent variable used in the analysis. The VIF for independent variables in the proposed model range from 1.04 and 1.30. Some researchers suggest that the VIF should not exceed a measure of 10.00 for any single variable (Acock, 2008) whilst others indicate that a conservative VIF measure of 5.00 be used to indicate a multicollinearity problem (O'Brien, 2007) and if so further investigation and corrective action is required. The results of the VIF analysis are set out in table 19.

Table 19. Variance Inflation Factor for the Independent Variables

Variable	VIF	1/VIF
Individual chronic promotion focus	1.15	0.869
Individual chronic prevention focus	1.17	0.854
Leader promotion focus	1.16	0.862
Leader prevention focus	1.04	0.961
Level of colleague participation in commercialisation activities	1.30	0.769
Level of colleague participation in engagement activities	1.29	0.775

As can be seen from table 19, the VIF measures in this study are well below even the conservative threshold of 5.00 (O'Brien, 2007), meaning multicollinearity was not an issue in this data set. Furthermore, the tolerance which can be defined as 1/VIF can also be used to check on the degree of multicollinearity and to explain what proportion of the variance of each of the independent variables is available to predict the dependent variable. A 1/VIF tolerance score of less than 0.10 would indicate that there is a multicollinearity problem. We can see from table 19 that a substantial portion of the variance (in all cases >75%) for each of the independent variables is available to predict the dependent variable. These measures indicate that multicollinearity is not a problem and that the proposed independent variables in the model may all be used in the multi-level analysis.

5.6.3 Test of Non-Response Bias

An analysis of the non-response bias in the survey items was conducted by following Armstrong and Overton's (1977) recommendations. As the survey was sent out in three waves, a test for non-response bias was carried out on all the test variables. T-tests indicated no significant differences between waves 1 & 2, and waves 2 & 3;

there was however one control variable with significant differences between waves 1 & 3. Those individuals who work in Russell Group/research intensive universities ($t = -3.292, p < .01$) were more inclined to respond to the later wave. Individuals who respond to later waves are assumed to have done so because of increased stimulus, as a result their responses are expected to be most comparable to non-respondents (Armstrong & Overton, 1977). Therefore, it needs to be noted that there was likely some non-response bias evident in the survey.

In the following section the main findings of the quantitative study are introduced and are set out using the conceptual model as a framework. Firstly, the descriptive statistics and correlations are displayed and discussed, the results regarding commercialisation activities are reported which is then followed by the results of the engagement activities, and finally a discussion of the findings is undertaken.

5.7 Descriptive Statistics and Correlation Analysis

Descriptive statistics and a correlation analysis for the study's variables can be found in Table 20 below.

Table 20. Correlations and Descriptive Statistics for Study Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Dependent variables																			
1 Commercialisation intentions	1																		
2 Engagement intentions	.34***	1																	
Control variables																			
3 Gender (Male = 1)	.16***	.04	1																
4 Age group ($\geq 60 = 5$)	-.06*	.03	.19***	1															
5 Employment status (Tenured = 1)	-.05	.06*	.16**	.37***	1														
6 Academic rank (Professor = 4)	.02	.00	-.01	.03	-.00	1													
7 Research type (applied = 1)	.15***	.32***	-.05	.07*	.04	-.02	1												
8 Prior entrepreneurial experience (yes = 1)	.23***	.16***	.07*	.15***		.04		1											
9 Research intensive university (Russell group = 1)	.01	-.05	.02	-.10**	-.05	-.01	-.10**	-.09**	1										
10 Management responsibility (yes = 1)	.15***	.16***	.10**	.24***		.02	-.01	.05	.08	1									
11 Resources for innovation	.07**	.04	.03	-.03	-.14**	.01	-.06*	-.08**	.05	.06*	1								
12 STEM v Non-STEM (STEM = 1)	.16***	.02	.18***	.01	-.02	.02	-.09*	-.02		.13***	.16***	.09***	1						
Independent variables																			
13 Individual chronic promotion focus	.20***	.13***	-.01	-.19***	-.11**	-.10**	-.02	.07	-.01	.03		.10***	.01	1					
14 Individual chronic prevention focus	-.02	-.09*	-.06	-.23***	-	-.22***	-.04	-.12***	-.01	-.08**	-.03	.14***	-.01	.14***	1				
15 Leader promotion focus	.10**		-.05	-.13***	-	-.14**	-.00	.01	.01	-.06		.10**		-.03	.10**	1			
16 Leader prevention focus	.04	.10***	.04	-.05	-.03	-.03	-.04	-.00	-.03	.02	-.04	.06	-.05	.01	.03	.10**	1		
17 Level of colleague commercialisation participation	.30***	.21***	.11	.11**	.07	.14***	.07	.06	.06		.18***	.11***	.02	-.07	-.01	-.03	.10**	1	
18 Level of colleague engagement participation	.13**	.33***	-.05	.06	.02	.08		.16***	-.08	.10**		.15***	.04	-.09*	-.04		-.20***	.12**	1
Mean	2.35	3.80	0.72	3.1	0.74	2.58	0.47	0.15	0.38	0.59	3.92	0.48	4.79	3.72	4.16	5.06	2.20	2.70	
Std. Deviation	1.64	1.51	0.45	1.05	0.44	1.10	0.49	0.35	0.48	0.49	1.08	0.50	1.00	1.14	1.13	1.31	0.90	0.96	

N = 818 *p < 0.05; **p < 0.01; ***p < 0.001

Although the correlations amongst variables are not necessarily tests of the model proposed, there are some interesting patterns in these results. The bivariate relationships indicate that individual chronic promotion focus was significantly and positively related to both commercialisation intentions ($r = .20, p < 0.001$) and engagement intentions ($r = .13, p < 0.001$). Individual chronic prevention focus meanwhile was significantly and negatively related to engagement intentions ($r = -0.09, p < 0.01$) but is not significantly related to commercialisation intentions. Leader promotion focus was also found to be significantly and positively related to both commercialisation ($r = 0.10, p < 0.01$) and engagement intentions ($r = 0.10, p < 0.001$), whereas leader prevention focus was not significantly related to either commercialisation or engagement intentions. The level of colleague participation in commercialisation activities was significantly related to both an individual's commercialisation ($r = 0.30, p < 0.001$) and engagement intentions ($r = 0.21, p < 0.001$). The level of colleague participation in engagement activities was also significantly related to both an individual's commercialisation ($r = 0.13, p < 0.01$) and engagement intentions ($r = 0.33, p < 0.001$) These results perhaps provide a preliminary insight into the direct relationship between individual chronic, leader regulatory focus and colleague participation in relation to an academic's intention to participate in commercialisation and engagement activities.

5.8 Commercialisation Intentions

The following table (table 21) sets out the results of the hierarchical regression for the Scottish academic population and their commercialisation intentions.

Table 21. Results of the Hierarchical Regression for the Scottish Academic Population and their Commercialisation Intentions.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Control variables							
Gender (Male = 1)	.17***	.17***	.17***	.18***	.14***	.14***	.15***
Age ($\geq 60 = 5$)	-.17***	-.12**	-.12**	-.12***	-.12***	-.12***	-.13***
Employment status (Tenured = 1)	-.10**	-.10**	-.10**	-.11**	-.10**	-.10**	-.10**
Academic rank (Professor = 4)	.01	.01	.01	.01	.00	.00	.00
Research type (Applied = 1)	.13***	.13***	.13***	.11***	.11***	.12***	.10**
Prior entrepreneurial experience (Yes = 1)	.29***	.26***	.26***	.26***	.25***	.25***	.25***
Research intensive university (Russell Group = 1)	-.01	-.00	-.01	-.02	-.01	-.01	-.02
Management responsibility (Yes = 1)	.18***	.16***	.16***	.16***	.11**	.11**	.11**
Resources for innovation	.07*	.05	.03	.04	.02	.01	.02
STEM v Non-STEM (STEM = 1)	.12***	.12***	.12***	.12***	.14***	.14***	.14***
Main effects							
Individual regulatory focus							
Individual chronic promotion focus		.18***	.18***	.17***	.18***	.18***	.17***
Individual chronic prevention focus		-.03	-.03	-.02	-.02	-.02	-.01
Leader regulatory focus							
Leader promotion focus			.05	.04			.00
Leader prevention focus			-.01	.01			.01
Interaction effects							
Leader promotion focus x Individual chronic promotion focus				.08*			.07*
Leader promotion focus x Individual chronic prevention focus				.00			-.00
Leader prevention focus x Individual chronic promotion focus				-.10**			-.09**
Leader prevention focus x Individual chronic prevention focus				-.07*			-.04
Colleague main effects							
Level of colleague commercialisation participation					.27***	.27***	.26***
Level of colleague engagement participation					-.02	-.02	-.02
Colleague interaction effects							
Level of commercialisation participation x Individual chronic promotion focus						.08**	.08*
Level of commercialisation participation x Individual chronic prevention focus						.01	-.01
R²	.206	.233	.235	.256	.295	.302	.317*
F Statistic	20.985	20.402***	17.649	15.254***	24.002***	21.611*	16.759

*p<0.05; **p<0.01; ***p<0.001

5.8.1 Control Variables

Turning to the intention to participate in commercialisation activities regression results in table 21. Model 1 assessed the effect of a number of control variables on an academic's intention to participate in commercialisation activities. This model included ten control variables (gender, age, employment status, academic rank, research type, prior entrepreneurship experience, research intensive university (Russell Group), management responsibility, climate for innovation and whether the academic worked in STEM discipline). The results show that when viewed in isolation a number of significant factors were identified in relation to an academic's commercialisation intent.

It can be seen from Model 1 that a number of factors predict or assist in formulating commercialisation intentions. Male academics were found to be significantly more likely participate in commercialisation activities ($\beta=.17$, $p<0.001$). Compared to the mean, younger academics rather than older academics were significantly more likely to display commercialisation intentions ($\beta= -.17$, $p<0.001$). Academics employed on limited time contracts (fixed term) ($\beta= -.10$, $p<0.01$) were also more likely to display higher motivations to exploit their research through commercialisation activities and so too were academics with an applied research focus ($\beta= .13$, $p<0.001$). Academics who have prior entrepreneurial experience ($\beta= .29$, $p<0.001$) are more likely to participate in commercialisation activities; not only was this indicator highly significant but it also accounted for R^2 of .086 ($p<0.001$) of Model 1's total R^2 of .206. Individuals who have line management responsibility ($\beta= .18$, $p<0.001$) (those individuals who have subordinates reporting directly to them) are more likely to participate in commercialisation activities. Institutions that are viewed by their employees as having better resources for innovation ($\beta= .07$, $p<0.05$) are more likely to lead to academics displaying commercialisation intentions. Finally, academics working in STEM related disciplines ($\beta= .12$, $p<0.001$) are more likely than academics working in non-STEM disciplines to participate in commercialisation activities. Neither an academic's rank nor research intensive universities were found to be significant predictors of an academic's intentions to participate in commercialisation activities.

5.8.2 Hypothesis Testing of Commercialisation Intentions

Model 2 is the first main effect model and its goal is to assess the effect of an individual's chronic regulatory focus on their commercialisation intentions over and above the control variables. As a result, Hypotheses 1a and 2a attempt to understand if academics who have a chronic promotion or prevention focus will lead to them displaying increased or decreased motivation to participate in commercialisation through measuring their intentions to do so in the next two years.

The test of Commercialisation Hypothesis 1a: Hypothesis 1a proposed that the stronger an academic's individual's chronic promotion focus, the stronger their intention to participate in commercialisation activities. The results presented in table 21 (Model 2) show that individual chronic promotion focus had a positive and significant effect on an academic's intention to participate in commercialisation activities ($\beta=.18$, $p<0.001$) and accounted for an R^2 change of .027, $p<0.001$ of Model 2's increase over the base line model (Model 1). The result thus provides strong support for Hypothesis 1a.

The test of Commercialisation Hypothesis 2a: Hypothesis 2a proposed that the stronger an academic's individual chronic prevention focus, the weaker their intention to participate in commercialisation activities. The results presented in table 21 (Model 2) show that while an academics individual chronic prevention focus had a negative effect on their commercialisation intentions, it was not significant, thus Hypothesis 2a was not supported.

Limited research into the antecedents of individual regulatory focus has suggested that certain situational factors could be antecedents to an academic's regulatory focus which in turn could affect their behaviour (Wu et al., 2008). As such hypotheses 3a and 4a focus on the role the academic leader plays in the academic entrepreneurship process and whether their behaviour has the ability to manifest either a promotion or prevention focused philosophy in their followers. Therefore, Model 3

displays the results for hypotheses 3a and 4a in an attempt to understand if the leader's regulatory focus acts as antecedent to an academic's commercialisation intentions.

The test of Commercialisation Hypothesis 3a: Hypothesis 3a proposed that the more promotion-focused a leader's behaviour is perceived to be, the stronger an academic's commercialisation intentions. The results presented in table 21 (Model 3) show that leaders eliciting promotion focused behaviours have a positive and moderately significant effect on an academic's intention to participate in commercialisation activities ($\beta=.05$, $p<0.10$) and only accounted for $R^2=.003$ ($p<0.10$) of Model 3's increase over the base line model (Model 2). As the results only displayed a moderately significant effect, it was not significant at $p<0.05$, thus Hypothesis 3a is not supported.

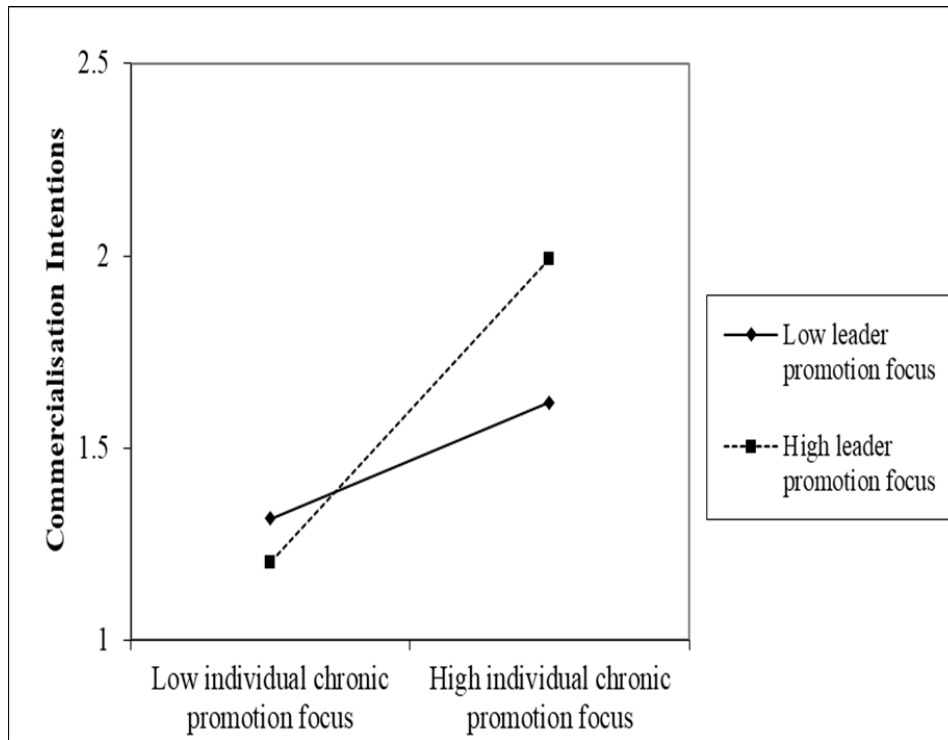
The test of Commercialisation Hypothesis 4a: Hypothesis 4a proposed that the more prevention-focused a leader's behaviour is perceived to be, the weaker an academic's commercialisation intentions. Whilst the relationship was found to be slightly negative it was not significant ($\beta= -.01$, p . N/S) meaning there was no support for Hypothesis 4a.

As prior theoretical research on leader regulatory focus (e.g. Kark & Van Dijk, 2007) has suggested that the leader's regulatory focus may actually interact with an individual's chronic regulatory focus to moderate their behaviours. To test the likelihood that this occurs in an academic setting, Model 4 test the possible interactions between leader regulatory focus and the academic's chronic regulatory focus and whether this can affect and academic's intentions to participate in commercialisation activities.

The test of Commercialisation Hypothesis 5a: Hypothesis 5a proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercial activities. It is clear from the results (Table 21, Model 4) that there is a positive and significant interaction between leader promotion focus x individual chronic prevention focus and an academic's commercial intentions ($\beta=.08$, $p<0.05$). Moreover, the inclusion of the leader promotion focus x individual chronic promotion focus interaction in the

regression equation, explains significant change in R^2 of .005, ($p < 0.05$) for Model 4 over and above the individual chronic and leader regulatory focus main effects (Model 3) for commercialisation intentions providing support for Hypothesis 5a. Simple slope analysis was used as an additional robustness check and can be used to examine whether an interaction actually exists and the range of values for which relationships are statistically significant. Simple slope analysis (Figure 14) also revealed that for leader promotion focus one standard deviation above the mean, the slope was .396 ($p < .001$), while for leader promotion focus one standard deviation below the mean, the slope was .152 ($p < .001$). The lowest value for which the simple slope was statistically significant (.085; $p > .05$) was 1.55 standard deviations below the mean.

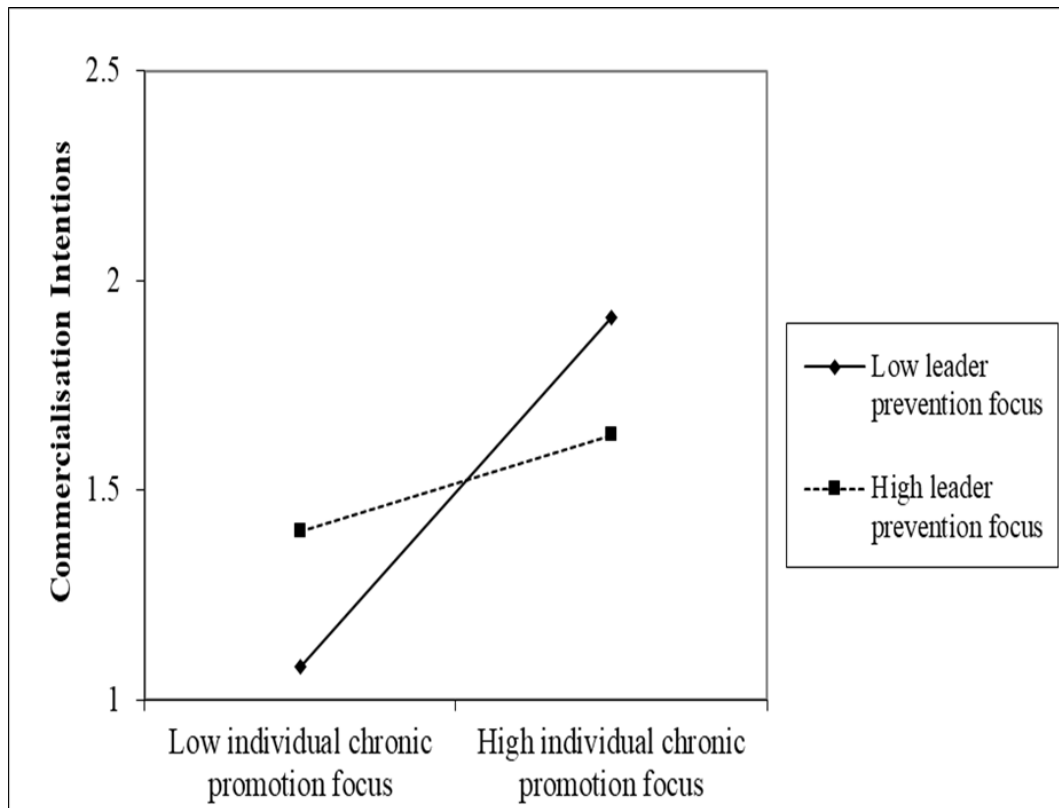
Figure 14. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Promotion Focus on Commercialisation Intentions



The test of Commercialisation Hypothesis 6a: Hypothesis 6a proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities. It is clear from Model 4 that while there is a slight positive relationship between leader promotion focus x individual chronic prevention focus and an academic's intention to participate in commercialisation activities, no significant interaction nor increase in R² was found meaning there was no support for Hypothesis 6a.

The test of Commercialisation Hypothesis 7a: Hypothesis 7a proposed that the stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities. It can be seen in the results (Table 21, Model 4) that a significant and negative relationship exists between leader prevention focus x individual chronic promotion focus ($\beta = -0.10$, $p < 0.01$) was found as hypothesised. The inclusion of the leader prevention focus x individual chronic promotion focus interaction in the regression equation explains a change in R² of .011 ($p < 0.001$) for the model over and above the individual and leader regulatory focus main effects (Model 3) for commercialisation intentions providing support for Hypothesis 7a. The results of the simple slopes analysis show that for low leader prevention focus (one standard deviation below the mean) the gradient of the simple slope was .413 ($p < .001$). For high leader prevention focus (one standard deviation above the mean) the gradient of the simple slope was .121 (N/S) and the slope only remained statistically significant until .74 standard deviations above the mean (slope .159 $p > .05$) (Figure 15).

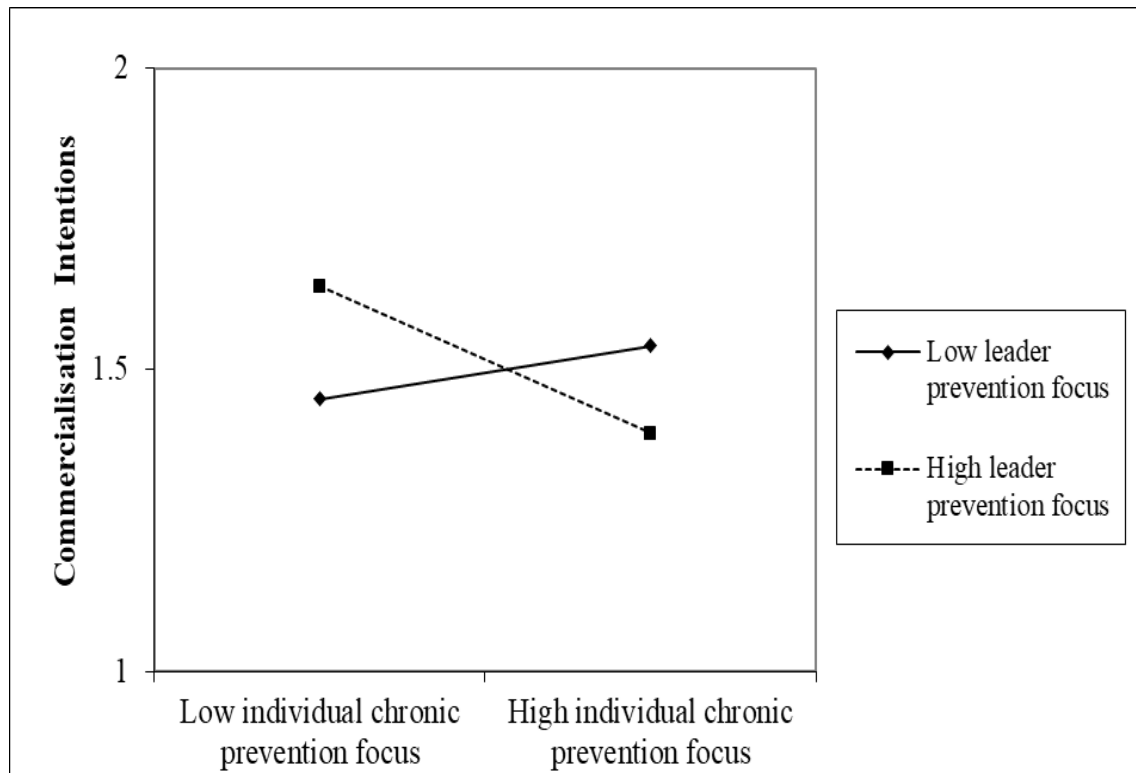
Figure 15. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Prevention Focus on Commercialisation Intentions



The test of Commercialisation Hypothesis 8a: Hypothesis 8a proposed that the stronger the leader’s prevention focus, the more negative the relationship between the individual’s chronic prevention focus and their intention to participate in commercialisation activities. It can be seen in the results (Table 21, Model 4) that a significant and negative relationship exists between leader prevention focus x individual chronic promotion focus ($\beta = -0.07$, $p < 0.05$) was found as hypothesised. The inclusion of the leader prevention focus x individual chronic prevention focus interaction in the regression equation explains a change in R^2 of .004, ($p < 0.05$) of the increase for the model 5 over and above the individual and leader regulatory focus main effects (Model

3). Thus, providing some support for Hypothesis 8a. The simple slopes analysis revealed that for low leader prevention focus (one standard deviation below the mean) the simple slope was slightly positive at .0.37 (N/S) and not significant. For high leader prevention focus (one standard deviation above the mean) the gradient of the simple slope was -.107 (N/S) and again non-significant (Figure 16).

Figure 16. Interaction Diagram Showing the Interaction between Individual Chronic Prevention Focus and Leader Prevention Focus on Commercialisation Intentions



Researchers (e.g. Bercovitz & Feldman, 2008) have previously discussed that the commercialisation behaviour of academics may be influenced by peers (the chair) operating within their local context. As individuals monitor their position in relation to what they consider are important reference points (Higgins, 1997, Higgins & Scholer, 2009) this findings from the qualitative study and the literature suggests that the level of

colleague participation in engagement activities in their respective work groups should prove to be an important motivational force leading to academics being attracted towards or repelled away from these respective reference points. Hypotheses 9a & 10a sought to understand if an academic's intent to participate in commercialisation activities was affected by the level of colleague participation in entrepreneurial activities within their work group.

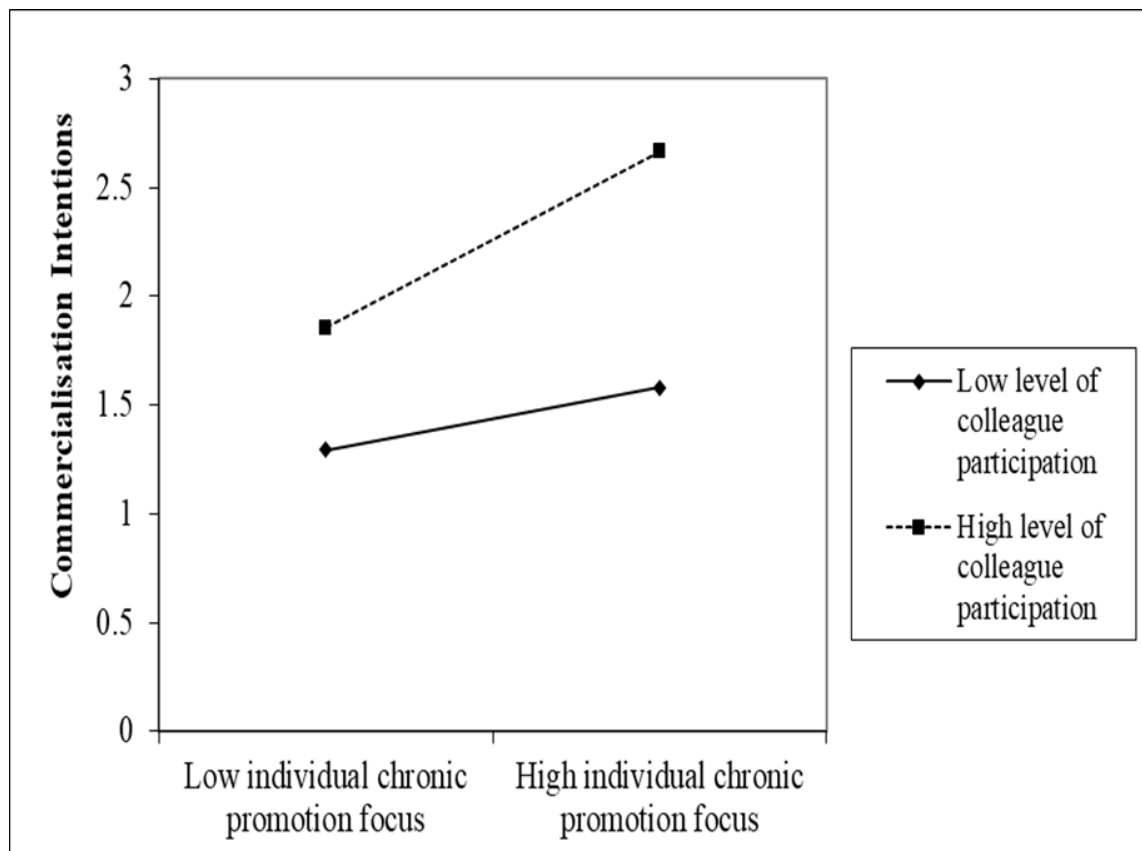
The test of Commercialisation Hypothesis 9a: Hypothesis 9a proposed that the greater the level of commercialisation participation within their work group, the more positive an academic's intention to participate in commercialisation activities. The results presented in table 21 (Model 5), show that the level of commercialisation participation within an academic's work group leads to positive and significant effect on an academic's intention to participate in commercialisation activities ($\beta=.27$, $p<0.001$) and accounted for an R^2 change of .061, $p<0.001$ of Model 5's increase over the base line model (Model 2). The result thus provides strong support for Hypothesis 9a.

The test of Commercialisation Hypothesis 10a: Hypothesis 10a proposed that the greater the level of colleague participation in engagement activities within an academic's work group, the more positive an academics intention to participate in commercialisation activities. The results presented in table 21 (Model 5) show that the level of colleague participation in engagement activities had a slightly negative and non-significant effect on an academic's intention to participate in commercialisation activities meaning there was not support for Hypothesis 10a.

Hypotheses 11a & 12a attempt to understand if an academic's intention to participate in commercialisation activities through using colleagues as a reference point (regulatory reference) and through examining the interaction between an individual's chronic regulatory focus and the level of colleague participation engagement activities in theirs work group and whether this interaction strengthened or weakened their commercialisation intentions.

The test of Commercialisation Hypothesis 11a: Hypothesis 11a proposed that the greater the level of colleague participation in commercialisation activities in their work group, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities. It is evident that the level of commercialisation participation x individual chronic promotion focus interaction is significant and positive (Table 21, Model 6), when predicting an academics commercialisation intention ($\beta = 0.08$, $p < 0.01$). However, the inclusion of the level of commercialisation participation x individual chronic promotion focus interaction in the regression equation, explained a significant increase in variance in the model $R^2 = .006$, $p < 0.01$, over and above the baseline model (Table 21, Model 6). Therefore, Hypothesis 11a is supported. Simple slopes analysis also reveals that for low levels of commercialisation participation (one standard deviation below the mean) the simple slope was $.145$ ($p < .001$). For high levels of commercialisation participation (one standard deviation above the mean) the simple slope was $.407$ ($p < .001$). the slope became statistically non-significant at 1.59 standard deviations below the mean ($.067$, $p > .05$) (Figure 17).

Figure 17. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Level of Colleague Participation in Commercialisation Activities on Commercialisation Intentions



The test of Commercialisation Hypothesis 12a: Hypothesis 12a proposed that the greater the level of colleague participation in commercialisation activities, the more negative the relationship between the individual’s chronic prevention focus and their intention to participate in commercialisation activities. It is clear from Model 6 that there is a slight positive relationship between level of commercialisation participation x individual chronic prevention focus in relation to an academic’s intention to participate in commercialisation activities. However, no significant interaction was found, and the interaction only accounted for .001 (N/S) increase in R^2 , meaning Hypothesis 12a was not supported.

Hypotheses 13a and 14a, the final part of the conceptual model sought to understand if a leader’s regulatory focus determines the level of colleague commercialisation participation within work groups. In order to determine if the leader’s regulatory focus influenced the level of interaction a regression analysis (which included all the control variables plus the individual promotion and prevention focus independent variables) was conducted and the level of participation within a group for commercialisation as the dependent variable (Table 22).

Table 22. Leader’s Regulatory Focus and Level of Participation in Commercialisation Activities

Dependent variable – Level of participation in commercialisation activities

Variables	Coefficient
Gender (Male = 1)	.11**
Age	-.01
Employment status (Tenured = 1)	.01
Academic rank	.04
Research type (Applied = 1)	.08*
Prior entrepreneurial experience (Yes = 1)	.02
Research intensive university	.01
Management responsibility (Yes = 1)	.20***
Resources for innovation	.10**
STEM (Yes = 1)	-.06
Leader promotion focus	.15***
Leader prevention focus	-.01
R²	.108

The test of Commercialisation Hypothesis 13a: Hypothesis 13a proposed that the more promotion-focused a leader's behaviour is perceived to be, the higher the level of colleague participation in commercialisation activities in their respective work groups. The results presented in table 22 show that leader promotion focus had a positive and significant effect on the level of participation in commercialisation activities within

work groups ($\beta=.15$, $p<0.001$). The result thus provides strong support for Hypothesis 13a.

The test of Commercialisation Hypothesis 14: Hypothesis 14a proposed that proposed that the more prevention-focused a leader's behaviour is perceived to be, the lower the level of colleague participation in commercialisation with their work group. The results presented in table 22 show that leader prevention focus had a negative but not significant effect on the level of the level of participation within work groups meaning Hypothesis 14a was not supported.

5.9 Engagement Intentions

The following section explores the findings in relation to the individual and contextual factors on an academic's intention to participate in engagement activities. Firstly, the descriptive statistics and correlations are displayed (table 23) and discussed. The results regarding engagement activities are reported in relation to each of the hypotheses which were developed earlier.

Table 23. Results of the Hierarchical Regression for the Scottish Academic Population and their Engagement Intentions.

	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Control variables							
Gender (Male = 1)	.04	.04	.05	.05	.05	.06	.07*
Age ($\geq 60 = 5$)	-.07	-.03	-.03	-.03	-.04	-.03	-.04
Employment status (Tenured = 1)	.02	-.00	.01	.01	.01	.01	.00
Academic rank (Professor = 4)	.01	.00	.01	.01	-.01	-.01	-.01
Research type (Applied = 1)	.37***	.37***	.36***	.36***	.32***	.32***	.31***
Prior entrepreneurial experience (Yes = 1)	.11***	.06*	.06	.06	.06*	.06*	.05
Research intensive university (Russell Group = 1)	-.05	-.04	-.05	-.05	-.04	-.04	-.04
Management responsibility (Yes = 1)	.19***	.17***	.16***	.16***	.12***	.12***	.13***
Resources for innovation	.06*	.03	-.00	-.00	-.03	-.02	-.02
STEM v Non-STEM (STEM = 1)	.02	.03	.03	.04	.03	.04	.04
Main effects							
Individual regulatory focus							
Individual chronic promotion focus		.21***	.21***	.21***	.20***	.20***	.20***
Individual chronic prevention focus		-.13***	-.15***	-.14***	-.12***	-.12***	-.11***
Leader regulatory focus							
Leader promotion focus			.13***	.13***			.09**
Leader prevention focus			-.02	-.02			-.00
Interaction effects							
Leader promotion focus x Individual chronic promotion focus				.01			.04
Leader promotion focus x Individual chronic prevention focus				.01			-.00
Leader prevention focus x Individual chronic promotion focus				-.06*			-.06*
Leader prevention focus x Individual chronic prevention focus				-.03			-.02
Colleague main effects							
Level of colleague commercialisation participation					.07*	.07*	.05
Level of colleague engagement participation					.29***	.29***	.31***
Colleague interaction effects							
Level of engagement participation x Individual chronic promotion focus						-.05	-.05
Level of engagement participation x Individual chronic prevention focus						.10***	.10***
R₂	.207	.256	.271	.276	.349	.359	.361**
F Statistic	21.125	23.127***	21.326***	16.943	30.700***	27.984**	22.483

*p<0.05;**p<0.01;***p<0.001

5.9.1 Control Variables

Turning to the regression results in relation to engagement activities in table 23. Model 8 assessed the effect of a number of control variables on an academic's intention to participate in engagement activities. Again, this model included the same control variables as outlined previously in model 1. The results show that a fewer number of control variables were identified as being significant in relation to an academic's intention to participate in engagement activities. These are outlined as follows. While not significant, slightly younger academics rather than older academics were more likely to display slightly higher intentions to engage in engagement activities. Academics who have an applied research focus ($\beta = .37, p < 0.001$) and academics who have prior entrepreneurial experience ($\beta = .11, p < 0.001$) were also more likely to display stronger intentions to participate in engagement activities. Academics who have line management responsibility where they have subordinates reporting directly to them are more likely to display higher intent to participate in engagement activities ($\beta = .19, p < 0.001$) compared to those who do not. Institutions which were viewed as having better resources for innovation ($\beta = .06, p < 0.05$) were more likely to lead to academics displaying higher intentions to participate in engagement activities. Importantly there were a number of control variables which are; age; gender, employment status, academic rank, research intensive university and academics working in STEM disciplines, that were, on their own, not found to be significant predictors of an academic's intentions to participate in engagement activities.

5.9.2 Hypotheses Testing of Academic Engagement Intentions

Model 9 is the first main effect model, and this set out to assess the effect of an individual's chronic regulatory focus on an academic's intention to participate in engagement activities. As a result, Hypotheses 1b and 2b attempt to understand if academics chronic regulatory orientation will lead to increased or decreased intentions to

participate in engagement activities through measuring their intentions to do so in the next two years.

The test of Engagement Intentions Hypothesis 1b: Hypothesis 1b proposed that the stronger an academic's individual's chronic promotion focus, the stronger their intention to participate in engagement activities. The results presented in table 23 (Model 9) show that individual chronic promotion focus has a positive and significant effect on an academic's intention to participate in engagement activities ($\beta=.21$, $p<0.001$) and accounted for an R^2 change of .034 ($p<0.001$) of Model 9's increase over the base line model (Model 8). The result thus provides strong support for Hypothesis 1b.

The test of Engagement Intentions Hypothesis 2b: Hypothesis 2b proposed that the stronger an academic's individual chronic prevention focus, the weaker their intention to participate in engagement activities. The results presented in table 23 (Model 9) show that individual chronic prevention focus has a negative and significant effect on an academic's intention to participate in engagement activities ($\beta= -.13$, $p<0.001$) and accounted for an R^2 change of .009 ($p<0.01$) of Model 9's increase over the base line model (Model 8). The result thus provides support for Hypothesis 2b.

The findings from the qualitative study and limited research into the antecedents of individual regulatory focus have suggested that certain situational factors could be antecedents to an academic's regulatory focus which in turn could affect their behaviour. As such hypotheses 3 and 4 focus on the role the academic leader (their line manager, the individual they report directly to) plays in the academic entrepreneurship process and whether their behaviour manifests either a promotion or prevention focused philosophy in their followers. Therefore, Model 10 shows the results for Hypotheses 3b and 4b in an attempt to understand if the leader's regulatory focus directly impacts an academic's intention to participate in engagement activities.

The test of Engagement Intentions Hypothesis 3b: Hypothesis 3b proposed that the more promotion-focused a leader's behaviour is perceived to be, the stronger an academics intention to participate in engagement activities. The results presented in table 23 (Model 10) show that leaders eliciting promotion focused behaviours had a positive and strong significant effect on an academic's intention to participate in engagement activities ($\beta=.13$, $p<0.001$) and accounted for a change in R^2 of .015, ($p<0.001$) of Model 10's increase over the base line model (Model 9). The result thus provides strong support for Hypothesis 3b.

The test of Engagement Intentions Hypothesis 4b: Hypothesis 4b proposed that the more prevention-focused their leader's behaviour is perceived to be, the weaker an academic's intentions to participate in engagement activities. Whilst the relationship was found to be slightly negative, it was not significant ($\beta= -.02$, p . N/S) meaning there was no support for Hypothesis 4b.

As prior research on leader regulatory focus (e.g. Brockner and Higgins, 2004; Kark and Van Dijk, 2007; Wu et.al., 2008), has suggested that the leader's regulatory focus (situational regulatory focus) may interact with followers' individual chronic regulatory focus to moderate an individual's behaviour. To test the likelihood that this occurs in the Scottish academic setting, we turn now to the leader and individual regulatory focus interaction hypotheses.

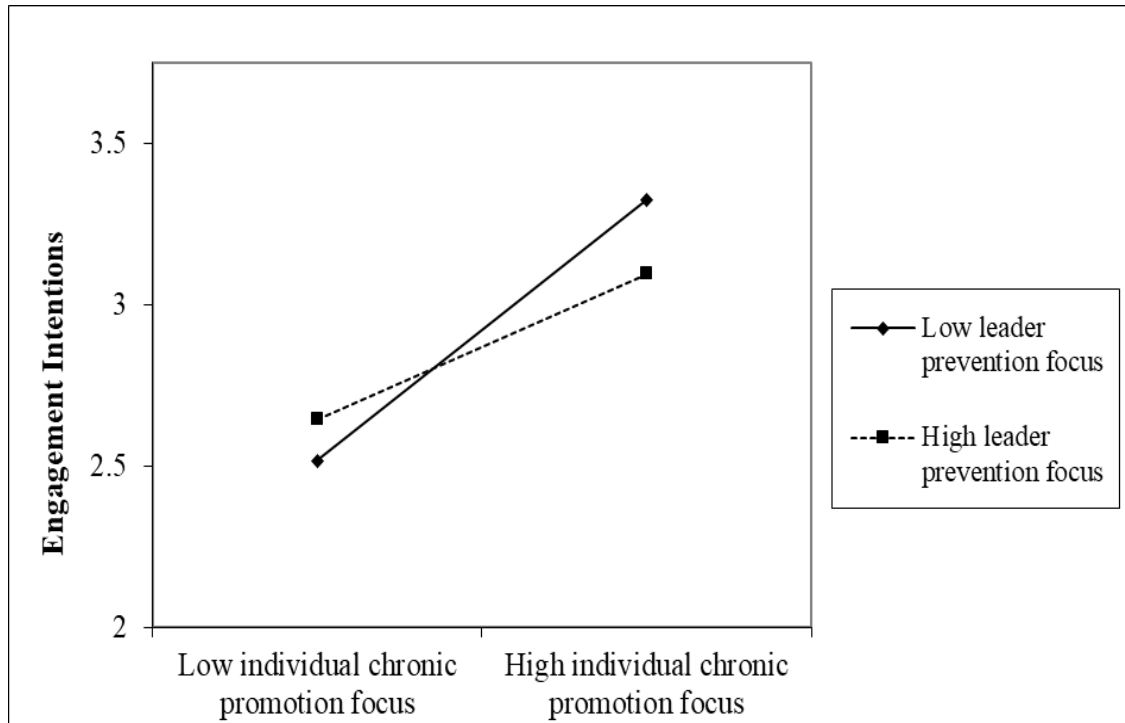
The test of Engagement Intentions Hypothesis 5b: Hypothesis 5b proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities. Whilst the leader promotion focus x individual chronic promotion focus relationship was found to be slightly positive it was not significant ($\beta= .01$, p . N/S), meaning there was no support for Hypothesis 5b.

The test of Engagement Intentions Hypothesis 6b: Hypothesis 6b proposed that the stronger the leader's promotion focus, the more positive the relationship between the

individual's chronic prevention focus and their intention to participate in engagement activities. It is clear from Model 11 that while again there is a slight positive relationship between leader promotion focus x individual chronic prevention focus and an academic's intention to participate in engagement activities ($\beta = .01$, p. N/S), no significant interaction nor increase in R^2 was found meaning there was no support for Hypothesis 6b.

The test of Engagement Intensions Hypothesis 7b: Hypothesis 7b proposed that the stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities. A significant and negative relationship exists (Table 23, Model 11) between leader prevention focus x individual chronic promotion focus ($\beta = -0.06$, $p < 0.05$), as hypothesised. The inclusion of the leader prevention focus x individual chronic promotion focus interaction in the regression equation explains a change in R^2 of .004 ($p < 0.05$) for the model over and above the individual and leader regulatory focus main effects (Model 10) for an academic's intention to engage in engagement activities, providing some support for Hypothesis 7b. The results of the simple slopes analysis show that for low leader prevention focus (one standard deviation below the mean) the gradient of the simple slope was .413 ($p < .001$). For high leader prevention focus (one standard deviation above the mean) the gradient of the simple slope was .221 ($p < .01$) and the slope only became statistically non-significant at 1.36 standard deviations above the mean (slope .188 $p > .05$) (Figure 18).

Figure 18. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Prevention Focus on Engagement Intentions



The Test of Engagement Intentions Hypothesis 8b: Hypothesis 8b proposed that the stronger the leader’s prevention focus, the more negative the relationship between the individual’s chronic prevention focus and their intention to participate in engagement activities. It is clear from Model 11 that while there is a negative relationship between an academic’s intention to participate in engagement activities and the leader’s prevention focus ($\beta = -.03$, $p = N/S$), no significant interaction was found meaning there was no support for Hypothesis 8b.

Hypotheses 9b and 10b sought to understand if an academic’s intention to participate in engagement activities, is affected through the level of colleague participation in entrepreneurial activities as a reference point (regulatory reference).

The Test of Engagement Intentions Hypothesis 9b: Hypothesis 9b proposed that the greater the level of colleague participation in commercialisation activities within their

work group, the more positive an academic's intention to participate in engagement activities. The results presented in table x (Model 12), show that the level of colleagues' commercialisation participation leads to positive and significant effect on an academic's intention to participate in engagement activities ($\beta=.07$, $p<0.05$). It accounted for an R^2 change of .030, $p<0.001$ of Model 12's increase over the base line model (Model 9) and the result provides some support for Hypothesis 9b.

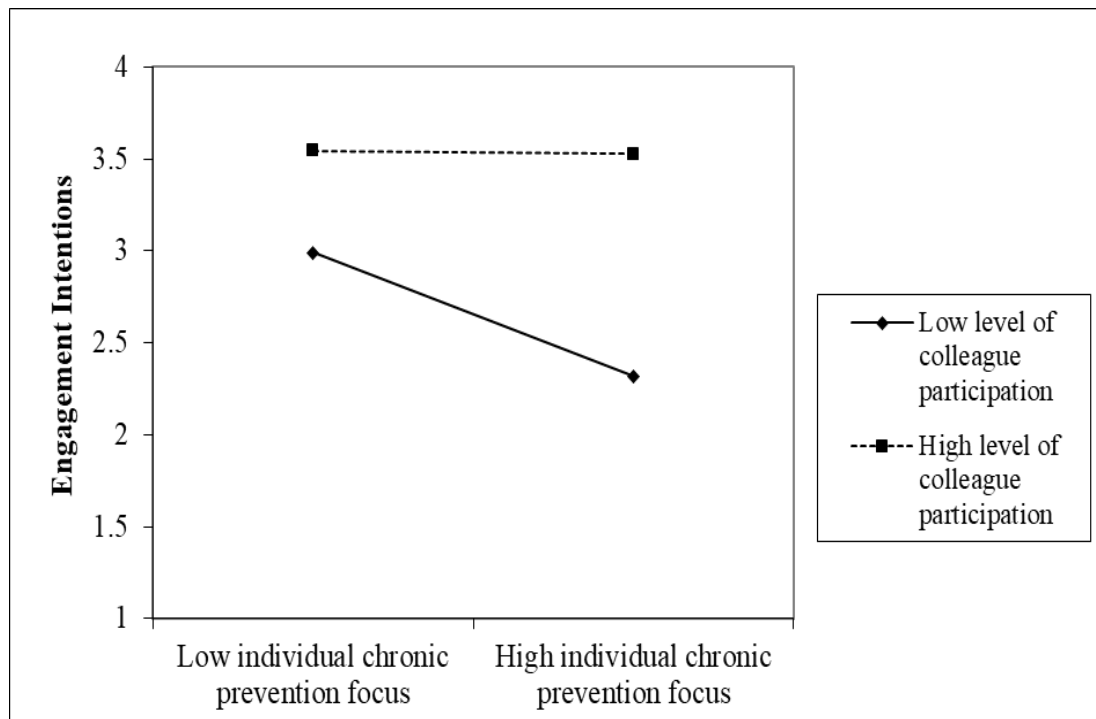
The Test of Engagement Intensions Hypothesis 10b: Hypothesis 10b proposed that the greater the level of colleague participation in engagement activities within their work group, the more positive an academic's intention to participate in engagement activities. The results presented in table 23 (Model 12) show that the greater the level of colleague participation leads to a positive and significant effect on an academic's intention to participate in engagement activities ($\beta=.29$, $p<0.001$). It accounted for an R^2 change of .089, $p<0.001$ of Model 12's increase over the base line model (Model 9) and the result provides strong support for Hypothesis 10b.

Hypotheses 11b & 12b attempt to understand if an academic's intention to participate in engagement activities through using colleagues as a reference point (regulatory reference) and through examining the interaction between an individual's chronic regulatory focus and the level of colleague participation in engagement activities in their work group and whether this interaction affected their engagement intentions.

The Test of Engagement Intensions Hypothesis 11b: Hypothesis 11b proposed that the greater the level of colleague participation in commercialisation activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities. It is clear from Model 13 that there is a negative and non-significant relationship between level of colleague participation in engagement activities x individual chronic promotion focus and an academic's intention to participate in engagement activities ($\beta=-.05$, p . N/S), meaning there was no support for Hypothesis 11b.

The Test of Engagement Intensions Hypothesis 12b: Hypothesis 12b proposed that the greater the level of colleague participation in engagement activities, the more positive the relationship between the individual’s chronic prevention focus and their intention to participate in engagement activities. Model 13 shows that the level of colleague engagement participation x individual chronic prevention focus interaction is significant and positive ($\beta= 0.10, p<0.001$) when predicting an academics intention to participate in engagement activities. Further analysis uncovered that the inclusion of the interaction term level of engagement participation x individual chronic prevention focus accounted for an R^2 change of .008 ($p<0.01$), a significant level of increased variance over and above the main effects found in Model 12, therefore Hypothesis 12b is supported. The simple slopes analysis reveals that for low levels of participation in engagement activities (one standard deviation below the mean) the simple slope was -.298 ($p.<.001$). For high levels of participation in engagement activities (one standard deviation above the mean) the gradient of the simple slope was -.008 (N/S) (Figure 19).

Figure 19. Interaction Diagram Showing the Interaction between Individual Chronic Prevention Focus and Level of Colleague Participation in Engagement Activities on Engagement Intentions



Hypotheses 13b and 14b the final part of the conceptual model seeks to understand if a leader’s regulatory focus determines the level of colleague participation in engagement activities within their group. In order to determine if the leader’s regulatory focus influenced the level of participation a regression analysis (which included all the control variables plus the individual promotion and prevention focus independent variables) was conducted and the level of colleague participation in engagement activities within a work group for as the dependent variable (Table 24).

Table 24. Leader’s Regulatory Focus and Level of Participation in Engagement Activities

Control variables	Coefficient
Gender (Male = 1)	-.06
Age	.03
Employment status (Tenured = 1)	-.02
Academic rank	.04
Research type (Applied = 1)	.15***
Prior entrepreneurial experience (Yes = 1)	.01
Research intensive university	-.03
Management responsibility (Yes = 1)	.12**
Resources for innovation	.16***
STEM (Yes = 1)	-.01
Leader promotion focus	.11**
Leader prevention focus	-.05
R²	.10

The test of Hypothesis 13a: Hypothesis 13a proposed that proposed that the more promotion-focused a leader's behaviour is perceived to be, the higher the level of participation in engagement activities within that work group. Again, the results presented in table 24 show that leader promotion focus had a positive and significant effect on the level of participation in engagement activities within work groups ($\beta=.11$, $p<0.01$). The result thus provides strong support for Hypothesis 13a.

The test of Hypothesis 14a: Hypothesis 14a proposed that proposed that the more prevention-focused a leader's behaviour is perceived to be, the lower the level of colleague participation will be in the work group. The results presented in table 24 show that leader prevention focus had a negative but not significant effect on the level of participation in engagement activities within their work groups meaning Hypothesis 14a was not supported.

5.10 Summary of the Findings

The following table presents a summary of the research hypothesis for both sub-models: (1) the sub-category where the dependent variable is an academic's intention to participate in commercialisation activities, and (2) the sub-category where the dependent variable is an academic's intention to participate in engagement activities. The hypotheses with the suffix "a" refer to commercialisation activities and with the suffix "b" engagement activities. The results of the hypotheses set out above are summarised in Table 25 and significant study findings are summarised in the following discussion.

Table 25. Summary of Commercialisation and Engagement Hypotheses

No.	Hypothesis	Outcome
Individual Chronic Regulatory Focus		
1a	The stronger an academic's chronic promotion focus, the stronger their intention to participate in commercial activities	Supported
2a	The stronger an academic's chronic prevention focus, the weaker their intention to participate in commercial activities	Not supported
1b	The stronger an academic's chronic promotion focus, the stronger their intention to participate in engagement activities	Supported
2b	The stronger an academic's chronic prevention focus, the weaker their intention to participate in engagement activities	Supported

Leader Regulatory Focus

3a	The more promotion-focused a leader's behaviour is perceived to be, the more positive an academics intention to participate in commercialisation activities.	Not supported
4a	The more prevention-focused a leader's behaviour is perceived to be, the more negative an academics intention to participate in commercialisation activities.	Not supported
3b	The more promotion-focused a leader's behaviour is perceived to be, the more positive an academics intention to participate in engagement activities.	Supported
4b	The more prevention-focused a leader's behaviour is perceived to be, the more negative an academics intention to participate in engagement activities.	Not supported

Leader Regulatory Focus x Individual Chronic Regulatory Focus Interactions

5a	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.	Supported
6a	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities	Not supported
7a	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.	Supported
8a	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities.	Supported
5b	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.	Not Supported
6b	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.	Not supported
7b	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.	Supported
8b	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.	Not supported

Level of colleague participation in commercialisation and engagement activities

9a	The greater the level of colleague commercialisation participation, the more positive an academics intention to participate in commercialisation activities.	Supported
10a	The greater the level of colleague participation in engagement activities within their work group, the more positive an academics intention to participate in commercialisation activities.	Not supported
9b	The greater the level of colleague commercialisation participation, the more positive an academics intention to participate in engagement activities.	Supported
10b	The greater the level of colleague participation in engagement activities within their work group, the more positive an academics intention to participate in engagement activities.	Supported

Level of commercialization and engagement participation x Individual Chronic Regulatory Focus Interactions

11a	The greater the level of colleague participation in commercialisation activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.	Supported
12a	The greater the level of colleague participation in commercialisation activities, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities.	Not supported
11b	The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.	Not supported
12b	The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.	Supported

Leader regulatory focus and work group commercialisation and engagement levels

13a	The more promotion focused the leader's behaviour is perceived to be, the higher the level of commercialisation participation in their work group.	Supported
14a	The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague commercialisation participation in their work group.	Not supported

13b	The more promotion focused the leader's behaviour is perceived to be, the higher the level of colleague participation in engagement activities in their work group.	Supported
14b	The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague participation in engagement activities in their work group.	Not supported

5.11 Summary Discussion

Prior research in entrepreneurship suggests that studies in entrepreneurial intent should be carried out using multiple levels of analysis (Davidsson & Wiklund, 2001), as neither individual nor contextual variables on their own adequately explain the nature of entrepreneurial intent. In the qualitative study (Chapter 4), it was identified that the main interactions were between the individual and relevant local contextual factors (Roach & Sauermann, 2015) can provide additional insights into what motivates academics to participate in the commercialisation and/or engagement activities and why process or why they certain entrepreneurial choices. In the following section, the three multi-level themes will be summarised from the findings in relation to the Scottish academic population. Firstly the implications of an individual's chronic regulatory orientation has on their intentions towards participating in commercialisation and/or engagement activities; secondly, the findings in relation to academic leaders and the direct and indirect effects their behaviour may have on their subordinates' intentions towards participating in commercialisation and/or engagement activities; and finally the effects of work-group colleagues will be explored in order to better understand where they have the capacity to directly and/or indirectly affect an academic's intentions to participate in commercialisation and/or engagement activities. The key findings from each of these three themes are next discussed in turn.

The table (26) below sets out the directionality and significance levels for each of the chronic regulatory focus variables in this study.

Table 26. Directionality and Significance Levels for the Chronic Regulatory Focus Variables

	Commercialisation Intentions	Engagement Intentions
Chronic Promotion Focus	+***	+ ***
Chronic Prevention Focus	-	- ***

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

Firstly, in relation to commercialisation activities, the results in the hypotheses and in the table above suggest that the stronger an academic’s chronic promotion focus, the stronger their intention to participate in both commercialisation (Hypothesis 1a) and engagement activities (Hypothesis 1b). These results set out in the table above, also suggest that the stronger an academic’s chronic prevention focus, the lower their intention will be to participate in engagement activities (Hypothesis 2b). These findings suggest that chronic promotion focused academics are more willing to bear the uncertainty and risks (e.g. Sitkin & Pablo, 1992) involved in participating in differing forms of commercialisation activities as well as believing more strongly that they have or can acquire the skills to successfully participate in these activities (e.g. Prodan & Drnovsek, 2010). The result of which leads to significant intentions to participate in commercialisation and engagement activities intentions when compared to their chronic prevention focused colleagues.

Turning next to the first of the situational factors, their leader’s behaviour, and whether this can direct or indirectly effect an academic’s motivation and thus their intention to participate in commercialisation and engagement activities is considered. The table (27) below sets out the directionality and significance levels for each of the direct effects in relation to the leader regulatory focus variables.

Table 27. Directionality and Significance Levels for each of the Direct Effects in Relation to the Leader Regulatory Focus Variables

	Commercialisation Intentions	Engagement Intentions
Leader Promotion Focus	+***	+
Leader Prevention Focus	-	-

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

Regarding the direct effects of leader regulatory focus (Models 3 & 10) on an academic’s commercialisation intentions, the direction of the relationships is clear in that promotion focused leaders have a positive impact on an academic’s intentions to participate in commercialisation and engagement activities, whereas more prevention focused leaders lead to negative intentions by academics to participate in commercialisation and engagement activities. However, only one of the direct effect hypothesis, Hypothesis 3b (Model 10) found a significant direct effect for the leader’s promotion focus which satisfied the conditions over and above the individual’s chronic regulatory focus (Model 9) that strengthens an individual’s intention to participate in engagement activities. This finding suggests that increases in the promotion focus of leaders' behaviour can elicit greater promotion focus in academics within their work group, which in turn leads to increased intention to participate in engagement activities over and above their individual intentions to participate in engagement activities, however it is interesting to note that this increased intention to participate is only in activities where the outcomes may be much more certain.

Turning to the individual’s chronic and the leader regulatory focus interactions. The findings show that interactions between the leader’s promotion focus and the academic’s chronic regulatory focus can affect an academics intention to participate in both commercialisation and/or engagement activities. The table below (28) sets out the directionality and significance levels for each of the interaction variables.

Table 28. Directionality and Significance Levels for each of the Interaction Variables.

Interaction	Commercialisation Intentions	Engagement Intentions
Leader promotion focus x individual chronic promotion focus	+ *	+
Leader promotion focus x individual chronic prevention focus	+	+
Leader prevention focus x individual chronic promotion focus	- **	- *
Leader prevention focus x individual chronic prevention focus	- *	-

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

The results show that the interactions between leader regulatory focus and individual chronic regulatory focus have the potential to moderate an academic's intention to participate in these entrepreneurial activities. More generally the findings show that the interaction between leader regulatory focus and individual chronic regulatory focus leads to positive intentions regardless of an academic's chronic regulatory focus, in relation to participation in both commercialisation and engagement activities. These findings also suggest that the stronger a leader's prevention focus the interaction between the leader's prevention focus and the academic's chronic regulatory focus will lead to a weakening of an academic's intentions to participate in commercialisation and/or engagement activities regardless of their chronic regulatory focus.

Specifically, in relation to participation in commercialisation activities, three significant interaction effects were found within the whole academic population have the potential to moderate an academic's intention to participate in entrepreneurial activities. The results of the leader promotion focus x individual chronic promotion focus (Model 4) found a positive and significant interaction whereby increased levels of leader

promotion focus strengthened chronic promotion focused academics' intention to participate in commercialisation activities (Hypothesis 5a), the interaction is displayed in simple slope figure 14. Turning to leader prevention focus interactions, the results of regression analysis for leader prevention focus x individual chronic promotion focus (Model 4) found that that increased levels of leader prevention focus led to reduction in an academic's intentions to participate in commercialisation activities, as displayed in simple slope Figure x. Finally, analysis for leader prevention focus x individual chronic prevention focus (Model 4) found that that increased levels of leader prevention focus led to further reductions in an academic's intentions to participate in commercialisation activities, as displayed in simple slope figure 16. In relation to participation in engagement activities, only significant interaction effect was found within the whole academic population which could moderate an academic's intention to participate in entrepreneurial activities. The results of regression analysis for leader prevention focus x individual chronic promotion focus (Model 4) found that that increased levels of leader prevention focus behaviours will lead to reduction in an academic's intentions to participate in engagement activities, as displayed in simple slope figure 15.

Turning to the next direct situational factor identified, the level of colleague participation in commercialisation and engagement activities in their work group, and whether this can direct or indirectly effect an academic's motivation and thus their intention to participate in commercialisation and engagement activities. The table (29) below summarises the directionality and significance levels for each of these direct effect variables.

Table 29. Directionality and Significance Levels for each of the Direct Effect Variables.

	Commercialisation Intentions	Engagement Intentions
Level of colleague participation in commercialisation activities	+***	+ *
Level of colleague participation in engagement activities	-	+***

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

It can be seen from Table 29 above (and Model 5) that there is a significant and positive direct effect for the level of colleague participation in commercialisation activities within their work group which in turn leads to a significant motivational effect on an academic's commercialisation intentions (Hypothesis 9a), over and above their own individual commercialisation intentions (Model 2). Interestingly, the level of colleague participation in engagement activities has no impact at all on an academic's commercialisation intentions.

In terms of the level of colleague participation in engagement activities within an academic's work group, the results of the regression analysis (Model 12) show that this is a significant predictor of an academic's intention to participate in engagement activities (Hypothesis 10b). It is interesting to note that the level of colleague participation in commercialisation activities within an academic's work group, that whilst positive, has also a bearing on an academic's intention to participate in engagement activities perhaps outlining the importance of the behaviour of peers, as key reference points towards what behaviours are acceptable, in work groups.

Turning to the interaction between the level of colleague participation in commercialisation and engagement activities in an academic's work group and individual chronic regulatory focus. Increased levels of colleagues participating in work groups has a positive effect on academics. We can see from Table 30 below (and Model 6) that there is a significant and positive interaction between increased levels of colleague participation in commercialisation activities in a work group and chronic promotion focused academics, leading to increased intention to participate in commercialisation activities (Hypothesis 11a). This finding is also confirmed by simple slope analysis in figure 17.

Table 30. Interaction between the Level of Colleague Participation in Commercialisation and Engagement Activities and Individual Chronic Regulatory Focus

Interaction	Commercialisation Intentions	Engagement Intentions
Level of colleague participation in commercialisation activities x individual chronic promotion focus	+ **	-
Level of colleague participation in engagement activities x individual chronic prevention focus	+	+ ***

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

Turning to the level of colleague participation in engagement activities and the interaction with an academic chronic regulatory focus, the results show that there was a significant interaction found in the regression analysis as hypothesised (Hypothesis 12b). The results of the simple slope analysis (Figure 19) suggest that a moderating effect is actually present, which significantly increases individuals high in chronic prevention focus intention to participate in engagement activities, particularly when the level of colleague participation in these activities high. The results of the simple slope analysis show the moderating effect that is present.

Finally, hypothesis 13 and 14 sought to understand if the leader’s regulatory orientation could affect the level of group participation in entrepreneurial activities. The table (31) below sets out the directionality and significance levels for variables.

Table 31. Leader Regulatory Focus and Work Group Commercialisation and Engagement Levels

	Commercialisation Activity Levels	Engagement Activity Levels
Leader promotion focus	+ ***	+ **
Leader prevention focus	-	-

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

The summarised results of the regression analysis (table 31) show that promotion focused leaders have a significant and positive effect on the level of participation of both commercialisation (Hypothesis 13a) and engagement (Hypothesis 13b) activities their subordinates within their respective work groups. The results of the regression analysis also suggest that prevention focused leaders have a slightly negative, but not significant, effect on the level of work group participation in both commercialisation and engagement activities in their work groups. These findings suggest that academic leaders play an important role in the adoption of academic entrepreneurship within universities.

5.11.1 Discussion of Control Variables

When viewed in isolation (Model 1 and Model 8), we find that some control variables were able to predict an academics commercialisation and engagement intentions, the significant findings are summarised as follows. Prior studies have suggested that male academics are more likely to participate in both commercialisation and engagement activities than their female counterparts (e.g. Perkmann et al., 2013). In common with previous studies in the extant literature the findings suggest that male academics are significantly more likely than their female colleagues to participate in commercialisation activities. However, the results of this study in relation to intentions to participate in engagement activities suggest that there is no significant difference between males and females and their intentions to participate in engagement activities. In relation to age, the findings of this study suggest that academics who are slightly younger than the average of the survey respondents were more likely to develop stronger intentions to participate in commercialisation activities. There was no statistical difference between differing age groups and their intentions to participate in engagement activities.

Turning to employment status of academics, the results from the survey suggest that those academics who are on fixed term contracts are more likely to display higher motivation to participate in commercialisation activities. Whilst researchers have previously found that tenured academics were more likely to participate in engagement

activities (e.g. Link, Siegel & Bozeman, 2007), the results from the survey found there was no difference between academics who were tenured and those who were on a fixed term contracts and their intentions to participate in engagement activities. In common with other studies (e.g. Hughes & Kitson, 2012), academics who self-reported that they had an applied research focus rather than a basic research focus were found to be significantly more likely to display strong intentions to participate in commercialisation and engagement activities.

The results of the whole academic population findings found that individuals who have prior entrepreneurial experience were significantly more likely to display strong intentions to participate in commercialisation activities and this remained the case throughout the multi-level analysis. However, while individuals who have prior entrepreneurial experience were significantly more likely to display intentions to participate in engagement activities only in model 8 (the control variables) but once the individuals regulatory focus and contextual factors were included in the multi-level analysis this significant relationship started to become non-significant. Academics and university managers are reported to have different sub-cultures which might deter the possible positive effects of academic entrepreneurship (Siegel et al., 2004). Individuals who self-reported as having line-management responsibilities were found to have stronger intentions to participate in commercialisation and engagement activities than their non-management counterparts.

Researchers have discussed (e.g. Abreu and Grinevich, 2013) that academic entrepreneurship is an activity that involves the innovative combination of resources in order to introduce new goods or services which can allow academics to develop new ideas or combinations of resources to bring more innovative products, processes or services to market. Resource for innovation was found to be a significant control variable in relation to an academic's intention to participate in commercialisation activities (model 1), however once the individuals regulatory orientation and contextual factors were included in the multi-level analysis the significant relationship identified disappeared. No significant relationship was found in relation to engagement activities and resources for innovation. Finally, researchers (e.g. Laukkanen, 2003) identified that

opportunities to behave entrepreneurially in STEM related disciplines are higher when compared to other disciplines. This study found that academics who work in the STEM disciplines were significantly more likely to participate in commercialisation activities compared to their non-STEM counterparts. In terms of an academic's intention to participate in engagement activities the data suggests that STEM academics were slightly more likely to participate in these activities but there was no significant difference between STEM and non-STEM academics.

This chapter has explored the findings in relation to the Scottish academic population and the following chapters will present the findings for the STEM and non-STEM disciplines, for comparability, they will follow the same structure as this chapter.

Chapter 6 STEM Analysis and Findings

6.1 Introduction

One of the main objectives of this multi-level study was to understand, in more detail, to what extent local contextual factors affect academics intentions to participate in commercialisation and engagement activities and whether these factors may be different for academics working in both STEM and Non-STEM disciplines. As previously discussed, independent of an individual academic's chronic regulatory focus, their leader's and colleagues' behaviour can enhance or diminish an academic's intention to participate in a range of commercialisation or engagement activities. Historically, commercialisation activities which involves the formation of companies and the licensing of academic knowledge, has attracted significant levels of research within the wider academic literature (Hughes & Kitson, 2012; Perkmann et al., 2014). This narrow research focus is probably understandable, as these activities can not only be considered as prime examples of generating academic impact, but they also are easily measurable outputs of academic research (Jensen et al., 2003; Markman et al., 2005; Siegel et al., 2003; Di Gregorio & Shane, 2003; Murray, 2004; O'Shea et al., 2007; Stuart & Ding, 2006; Lockett et al., 2005). This prior research has also identified that opportunities to behave entrepreneurially in the STEM related disciplines are greater when compared to non-STEM disciplines (Laukkanen, 2003; Fini et al., 2010; Abreu and Grinevich, 2013). As a result, studies into differing forms of academic entrepreneurship have tended to focus on the STEM disciplines leaving the non-STEM disciplines less well understood (Hughes and Kitson, 2012; Abreu & Grinevich, 2014). Therefore, understanding if individual and contextual differences exist between 'STEM and non-STEM academics' entrepreneurial intentions is important area to understand.

Whilst there has been less commercialisation arising from non-STEM disciplines, the opportunities to exploit research through the creation of new firms are emerging, as a result of the rise of digital technologies (Grimaldi et al., 2011). However, a limited number of researchers are emphasising the importance of research carried out

beyond the STEM disciplines (Abreu & Grinevich, 2014). This is important as the contribution of non-STEM disciplines towards a university achieving their commercialisation goals could be vital, particularly as these disciplines represent a significant proportion of the academic population (Hughes and Kitson, 2012; Abreu & Grinevich, 2014). In addition, if universities wish to maximise the number of academics participating in entrepreneurial activities, in order to maximise income and meet their strategic income targets, there is a need for greater understanding of how academics behave and are influenced in the non-STEM disciplines. Leaders and colleagues working in their local context can potentially moderate academics' entrepreneurial intentions in all disciplines.

Having a greater understanding of how local contextual factors relate to work group norms, for instance at the level of differing academic disciplines (Fini and Lacetera, 2010), and by understanding if differences exist between different disciplines, may also provide

- a) policy guidance for determining possible training interventions aimed at supporting academic entrepreneurship;
- b) increased understanding of enhancing positive and mitigating adverse local contextual factors on an academic's commercialisation and engagement intentions;
- c) information regarding whether this represents a conceptually different type of phenomenon that needs to be treated separately by researchers and university policymakers for STEM and non-STEM disciplines.

Given the factors outlined above, it is apparent that investigating the antecedents of academic entrepreneurship and what consequences these factors may have in relation to generating increased income from academic entrepreneurship for Scottish universities is an appropriate and worthwhile undertaking. The following two chapters will therefore consider two aspects of the context in which academics operate: their affiliation to a STEM or non-STEM discipline and the effect of individual and local contextual factors in which they work. Both factors inform academic participation as they shape the norms

and rules relevant for academics, or because they are the rules of engagement within their work groups in which academics operate (Crane, 1972)

In order to achieve this, the conceptual model outlined in Chapter 4 is used to understand the motivation of the individual and if their leader and/or their work group colleagues can affect their commercialisation and engagement intentions. The findings from the academics surveyed who work in the STEM disciplines are set out below.

6.2 The Characteristics of STEM Respondents

In addition to the data collection and analyses discussed above, a descriptive analysis to provide an overview of the characteristics of respondents is presented. The respondents by each of the Scottish universities are set out in Table 32 below.

Table 32. Respondents Characteristics

Name of University	Total Respondents	Total STEM Respondents	Percentage
University of Aberdeen	80	40	50.0%
Abertay University	9	4	44.4%
University of Dundee	56	19	33.9%
University of Edinburgh	137	79	57.7%
University of Glasgow	126	61	48.4%
Glasgow Caledonian University	31	6	19.4%
Heriot-Watt University	47	26	55.3%
Edinburgh Napier University	37	10	27.0%
Queen Margaret University	17	3	17.6%
Robert Gordon University	24	9	27.5%
University of St. Andrews	73	48	65.7%
University of Strathclyde	99	58	61.0%
University of Stirling	53	18	34.0%
University of the West of Scotland	29	14	48.3%
Total	818	395	48.30%

Following Hughes & Kitson (2011) study, seven STEM disciplines were identified and categorised as follows; Physics and Astronomy (12.91%); Chemistry (10.89%); Mathematics and Computing (16.96%); Engineering (19.24%); Material science (2.28%); Biological sciences (33.67%) and Veterinary and Agricultural sciences (4.05%). The responses collected for each of these disciplines are set out in Table 33 below.

Table 33. Breakdown of STEM Respondents by Subject Discipline

STEM Discipline	Number of STEM Respondents	% of STEM Respondents
Physics and Astronomy	51	12.91%
Chemistry	43	10.89%
Mathematics and Computing	67	16.96%
Engineering	76	19.24%
Material Science	9	2.28%
Biological Sciences	133	33.67%
Veterinary and Agricultural sciences	16	4.05%
Total STEM Disciplines	395	100.00%

In relation to the individual characteristics, 71.9% of the STEM responses were Male and 28.1% Female which is similar to the 2012 large-scale Hughes and Kitson survey, where their STEM responses were Males 72.8% and Females 27.2%. In relation to Academic Rank the respondents were relatively evenly distributed across the four categories, 26.3% of the respondents had the rank of Professor, 27.8% the rank of Reader/Senior lecturer, 23.8% had the rank of Lecturer and 22% had the rank of Teaching/Research Fellow, Research Associate and Research/Teaching Assistant. In relation to the samples employment status 74.2% of the STEM respondents were found to be tenured, while 25.8% were on fixed term contracts. In terms of age, the respondents fell into the following categories: Under 30: 3.0% (Hughes and Kitson 5.9%*), 30-39: 31.6% (Hughes and Kitson 26.75%*), 40-49: 28.6% (Hughes and Kitson 28.96%*), 50-59: 26.3% and 60 and over 10.4% (Hughes and Kitson (2012) used a

single category 50 and over 37.85%*) within this study the 50 and over respondents were found to be at a similar level of 36.7%. Turning next to prior entrepreneurial experience, 14.7% of the STEM respondents had prior entrepreneurial experience whilst 85.3% did not have any. Finally, a high percentage, 59.2% of the respondents, self-reported that they had management responsibilities within the STEM disciplines where subordinates reported directly to them (Table 34).

Table 34. Individual Characteristics of STEM Respondents

	Respondents	% Total STEM Respondents
Gender		
Male	284	71.9%
Female	111	28.1%
Academic Rank		
Professor	104	26.3%
Senior Lecturer/Reader	110	27.8%
Lecturer	94	23.8%
Other (Teaching/Research Fellow, Research Associate, Research/Teaching Assistant)	87	22.0%
Employment Status		
Tenured (Permanent Position)	293	74.2%
Limited-time contract	102	25.8%
Age Group		
Under 30	12	3.0%
30 to 39	125	31.6%
40 to 49	113	28.6%
50 to 59	104	26.3%
60 or over	41	10.4%
Prior entrepreneurial experience		
Yes	58	14.7%
No	337	85.3%
Management responsibility		
Yes	234	59.2%
No	161	40.8%

The STEM respondents were also asked to select the type of research they predominantly participate in (either basic or applied) based on the following descriptions. Basic research being concerned with theoretical, empirical or experimental (blue sky) research, undertaken to acquire new knowledge about something. Applied research was defined as being concerned with investigations taken to acquire new knowledge directed towards a particular need or use in industry or society. The results set out in Table 35 showed that respondents who predominantly had an applied research made up 47.3% of the respondents while those who predominantly participate in basic research made up 52.7%.

Table 35. Respondents by Research Type

Research Type	Number of Respondents	% Total Respondents
Basic research	208	52.7%
Applied research	187	47.3%

The respondents were sub-divided into two group categories, Russell Group (often considered as being research intensive) universities 38.2% and the remainder (former polytechnics and post-1992 universities) accounted for 61.8% of responses (Table 36).

Table 36. Respondents by University Type

University Type	Number of Respondents	% Total Respondents
Russell Group	151	38.2%
No	244	61.8%

In the following section the tests of reliability of the STEM survey variables are discussed.

6.3 Tests of Reliability

The tests of reliability that have been employed in this part of the study are described in the following sections.

6.3.1 Cronbach's Alpha

Reliability is of central concern to research in the social sciences because measuring instruments are rarely completely valid. To check that the scales used were reliable within the STEM study, the Cronbach's alpha of each scale was again retested. The Cronbach's alpha coefficients relating to the reliability of measures used in the STEM disciplines within this study are set out in Table 37, all the multi-scale items used were again found to be either at or above the 0.7 value and can therefore be regarded as reliable.

Table 37. Reliability of STEM Survey Scales

Variable	Cronbach's alpha
Commercialisation intentions	.71
Engagement intentions	.76
Individual chronic promotion focus	.87
Individual chronic prevention focus	.87
Leader promotion focus	.71
Leader prevention focus	.91
Resources for innovation	.79

6.3.2 Test for Multicollinearity

As per chapter five, to make sure that multi-collinearity was not an issue for the variables in the STEM data set, the variables in the regression analysis were again tested using the VIF to tests the extent of multicollinearity for each independent variable used in the analysis. The VIF for independent variables in the proposed model ranged from

1.09 and 1.30. Again, this is well below what is considered the conservative VIF measure of 5.00 (O'Brien 2007) and therefore no further investigation or corrective action is required and multicollinearity was not an issue in the STEM data set. The results of the VIF analysis are set out in Table 38 below. We can see from Table 38 that the tolerance (1/VIF) showed that again a substantial portion of the variance (in all cases =>74%) for each of the independent variables is available to predict the dependent variable. These measures indicate that multicollinearity is not a problem and that the proposed independent variables in the model may all be used in the STEM multi-level analysis.

Table 38. Variance Inflation Factors of STEM Interaction Variables

Variable	VIF	1/VIF
Individual chronic promotion focus	1.17	.85
Individual chronic prevention focus	1.24	.81
Leader promotion focus	1.16	.86
Leader prevention focus	1.05	.95
Level of colleague participation in commercialisation activities	1.36	.74
Level of colleague participation in engagement activities	1.33	.75

In the following section the main findings of the STEM study are introduced and are set out using the conceptual model as a framework. Firstly, the descriptive statistics and correlations are displayed and discussed, the results in relation to STEM academics commercialisation intentions are then reported this is followed by the results of the STEM academics engagement intentions, and finally a summary of the main findings is set out.

6.4 Descriptive Statistics and Correlation Analysis

Descriptive statistics and a correlation analysis for each of the study's seventeen variables can be found in Table 39 below.

Table 39. Correlations and Descriptive Statistics for STEM Study Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Dependent variables																	
1 Commercialisation intentions	1																
2 Engagement intentions	.37***	1															
Control variables																	
3 Gender (male = 1)	.14***	.05	1														
4 Age group ($\geq 60 = 5$)	-.04	.03	.22***	1													
5 Employment status (tenured = 1)	-.05	.08*	.15**	.39***	1												
6 Academic rank (professor = 4)	-.01	.09*	.15**	.56***	.55***	1											
7 Research type (applied = 1)	.17***		-.02	.05	.04	-.04	1										
8 Prior entrepreneurial experience (yes = 1)	.25***	.34***	.15**	.15***	.22***	.12**	.22***	1									
9 Research intensive university (Russell group =1)	.04	-.08	.02	-.09*	-.05	-.01	-.17***	-.12**	1								
10 Management responsibility (yes = 1)	.13***		-.01	.25***	.38***	.49***	-.05	.07	.06	1							
11 Resources for innovation	.08*	.03	.03	-.03	-.14**	-.03	-.03	-.10**	.05	.03	1						
Independent variables																	
12 Individual chronic promotion focus	.20***		-.01	-.19***	-.11**	-.10**	-.02	.07	-.01	.03	.10***	1					
13 Individual chronic prevention focus	-.02	-.09*	-.06	-.23***	-.23***	-.22***	-.04	-.12***	-.01	-.08**	-.03	.14***	1				
14 Leaders promotion focus	.10**		-.05	-.13***	-.15***	-.14**	-.00	.01	.01	.06	.15***	.10**	.14***	1			
15 Leaders prevention focus	.04	.01	.04	-.05	-.03	-.03	-.04	-.00	-.03	.02	-.04	.06	-.05	.01	1		
16 Level of colleague commercialisation participation	.30***		.11	.11**	.07	.14***	.07	.06	.06	.18***	.11***	.02	-.07	.10**	-.01	1	
17 Level of colleague engagement participation	.13**		-.05	.06	.02	.08	.16***	.16***	-.08	.10**	.15***	.04	-.09*	.12**	-.04	.39***	1
Mean	2.35	3.80	0.72	3.1	0.74	2.58	.47	.15	0.38	0.59	3.92	4.79	3.72	4.16	5.06	2.20	2.70
Std. Deviation	1.64	1.51	0.45	1.05	0.44	1.10	0.49	0.35	0.48	0.49	1.08	1.00	1.14	1.13	1.31	0.90	0.96

N = 395 *p <0.05; **p<0.01; ***p<0.001

Although the correlations amongst variables in Table 39 are not necessarily tests of the STEM model proposed, some interesting patterns can be found in these results. The bivariate relationships indicate that individual chronic promotion focus was significantly and positively related to both commercialisation intentions ($r = .20$, $p < 0.001$) and engagement intentions ($r = .13$, $p < 0.001$), suggesting that STEM academics with a chronic promotion focus were more likely to participate in entrepreneurial activities more generally irrespective of the type of activity. Individual chronic prevention focus meanwhile was significantly and negatively related to their intention to participate in engagement activities ($r = -.09$, $p < 0.01$) but is not significantly related to commercialisation intentions. Leader promotion focus was also found to be significantly and positively related to commercialisation ($r = .10$, $p < 0.001$) and engagement intent ($r = .10$, $p < 0.001$), whereas leader prevention focus was not significantly related to commercialisation or engagement intentions. The level of colleague participation in commercialisation activities was significantly related to both commercialisation ($r = .30$, $p < 0.001$) and engagement intentions ($r = .21$, $p < 0.001$). The level of colleague participation in engagement activities was also significantly related to their intention to participate in both commercialisation ($r = .13$, $p < 0.01$) and engagement ($r = .33$, $p < 0.001$) activities. These results perhaps suggest preliminary insights into the direct relationships between individual chronic, leader regulatory focus and colleague participation in relation to STEM academics' intentions to participate in commercialisation and engagement intentions or not.

6.5 STEM Academics Commercialisation Intentions

In the following Tables, firstly the results of the hierarchical regression for the STEM population and their commercialisation intentions are set out (Table 40) and this is followed later in the chapter by the findings in relation to their engagement intentions (Table 42). Again, the hypotheses are covered within five key sections; firstly the control variables are discussed, secondly the individuals' regulatory focus and their intention to participate in commercialisation and engagement activities are measured;

thirdly, the direct and indirect effects of their leader are assessed; fourthly the direct and indirect effects of their colleagues participation on their intention to participate in commercialisation and engagement activities are displayed; and finally the effect of the leader's behaviour on the level of work group entrepreneurial participation level is assessed.

Table 40. Results of the Hierarchical Regression for the STEM Population and their Commercialisation Intentions

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Control variables							
Gender (Male = 1)	.16***	.15***	.16***	.16**	.09**	.13**	.14**
Age	-.13*	-.08	-.08	-.08	-.13	-.10	-.09
Employment status (Tenured = 1)	-.15*	-.15*	-.15*	-.14*	-.14*	-.14**	-.14*
Academic rank	.00	-.01	-.01	-.02	-.03	-.03	.05
Research type (Applied = 1)	.14**	.15**	.14**	.13**	.13**	.14**	.11*
Prior entrepreneurial experience (Yes = 1)	.32***	.28***	.28***	.28***	.27***	.27***	.27***
Research intensive university	.06	.07	.07	.06	.05	.05	.04
Management responsibility (Yes = 1)	.20***	.18***	.18***	.19***	.15**	.15**	.15**
Resources for innovation	.09*	.06	.04	.04	.02	.01	.01
Main effects							
Individual chronic regulatory focus							
Individual chronic promotion focus		.22***	.21***	.23***	.20***	.21***	.22***
Individual chronic prevention focus		-.07	-.08	-.07	-.06	-.06	-.05
Leader regulatory focus							
Leader promotion focus			.07	.06			.01
Leader prevention focus			-.01	-.02			-.01
Leader Interaction effects							
Leader promotion focus x individual chronic promotion focus				.14**			.13**
Leader promotion focus x individual chronic prevention focus				.03			.04
Leader prevention focus x individual chronic promotion focus				-.09			-.09*
Leader prevention focus x individual chronic prevention focus				-.07			-.06
Colleague main effects							
Level of colleague commercialisation participation					.27***	.27***	.26***
Level of colleague engagement participation					-.02	-.02	.00
Colleague interaction effects							
Level of colleague commercialisation participation x individual chronic promotion focus						.09*	.09*
Level of colleague engagement participation x individual chronic prevention focus						.00	-.01
R2	.203	.245	.249	.278	.306	.314	.341
F Statistic	10.905	11.272***	9.743	8.560**	12.915***	11.589	9.172

*p<0.05; **p<0.01; ***p<0.001

6.5.1 STEM Academics Commercialisation Intentions

The test of STEM Commercialisation Hypothesis 1a: Hypothesis 1a proposed that the stronger an individual academic's chronic promotion focus, the stronger their intention to participate in commercial activities. The results presented in Table 40 (Model 2) show that individual chronic promotion focus had a positive and significant effect on an academic's intention to participate in commercialisation activities $\beta=.22$, $p<0.001$ and accounted for an R^2 change of .038, $p<0.001$ of Model 2's increase over the base line model (Model 1). The result thus provides strong support for Hypothesis 1a.

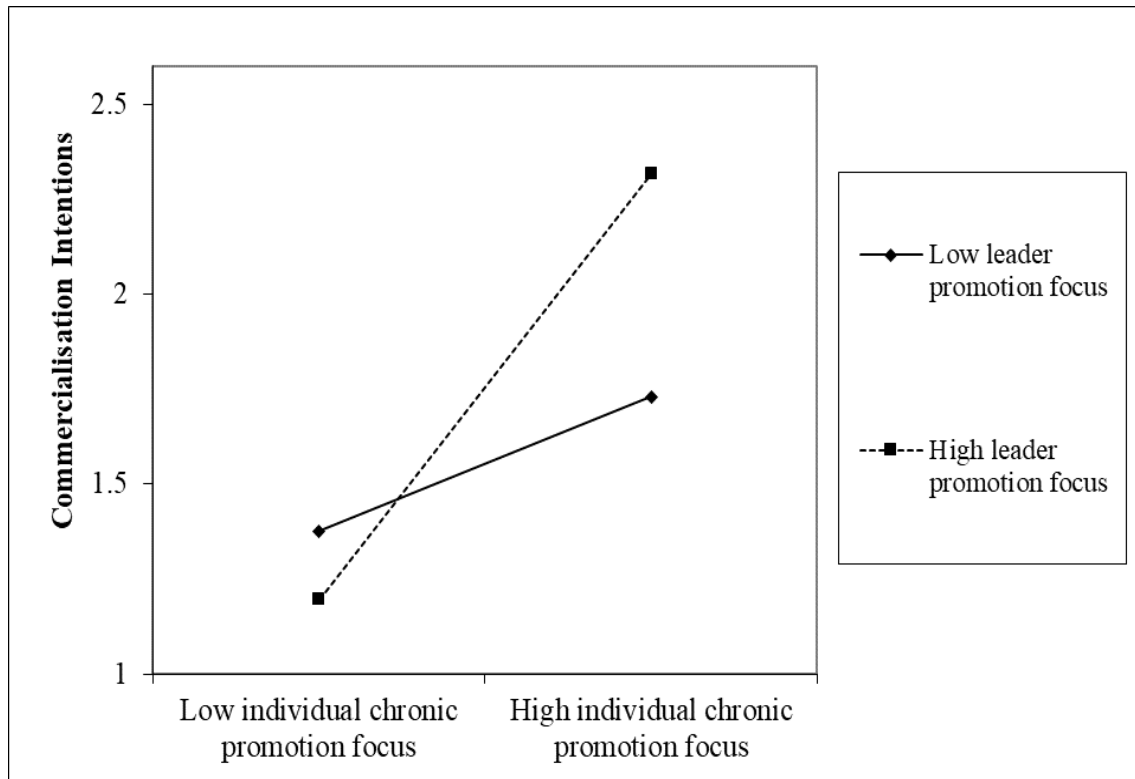
The test of STEM Commercialisation Hypothesis 2a: Hypothesis 2a proposed that the stronger an academic's individual chronic prevention focus, the weaker their intention to participate in commercial activities. The results presented in Table 40 (Model 2) show that an academic's individual chronic prevention focus had a negative effect on their intention to participate in commercialisation activities $\beta= -.07$, p N/S, and was not significant, thus Hypothesis 2a was not supported.

The test of STEM Commercialisation Hypothesis 3a: Hypothesis 3a proposed that the more promotion-focused a leader's behaviour is perceived to be, the stronger an academic's commercialisation intentions. The results presented in Table 40 (Model 3) show that while leaders eliciting promotion focused behaviours have a positive but not significant effect on an academic's intention to participate in commercialisation activities $\beta=.07$, p N/S, meaning there was no support for Hypothesis 3a.

The test of STEM Commercialisation Hypothesis 4a: Hypothesis 4a proposed that the more prevention-focused a leader's behaviour is perceived to be, the weaker an academic's commercialisation intentions. Whilst the relationship was found to be slightly negative it was not significant $\beta= -.01$, p N/S, meaning there was no support for Hypothesis 4a.

The test of STEM Commercialisation Hypothesis 5a: Hypothesis 5a proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercial activities. It is clear from the results (Table 40, Model 4) that there is a positive and significant interaction between leader promotion focus x individual chronic promotion focus and an academic's commercial intentions $\beta=.14$, $p<0.01$. Moreover, the inclusion of the leader promotion focus x individual chronic promotion focus interaction in the regression equation, explains significant change in R^2 of .016, ($p<0.01$) for Model 4 over and above the individual chronic and leader regulatory focus main effects (Model 3) for commercialisation intentions providing support for hypothesis 5a. Simple slope analysis (Figure 20) revealed that for high leader promotion focus, one standard deviation above the mean, the slope was .559 ($p <.001$), while for low leader promotion one standard deviation below the mean, the slope was .177 ($p<.001$). The lowest value for which the simple slope was statistically significant (slope .107; $p > .05$) was -1.36 standard deviations below the mean.

Figure 20. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Promotion Focus on Commercialisation Intentions

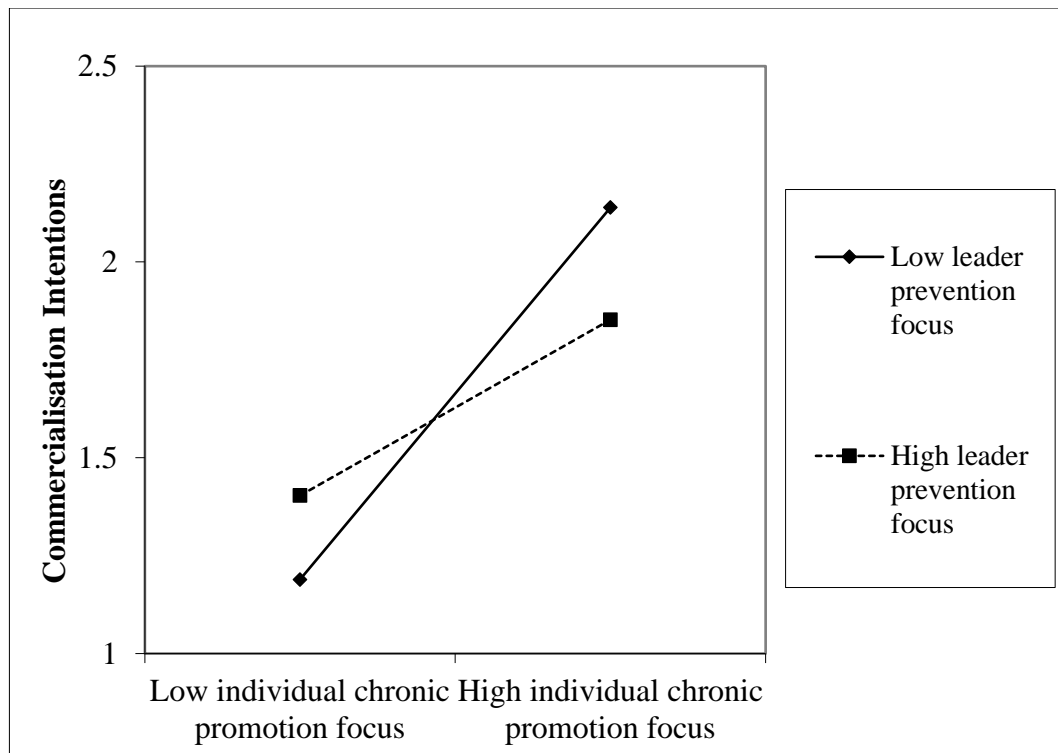


The test of STEM Commercialisation Hypothesis 6a: Hypothesis 6a proposed that the stronger the leader’s promotion focus, the more positive the relationship between the individual’s chronic prevention focus and their intention to participate in commercial activities. It is clear from Model 4 that while there is a slight positive relationship between leader promotion focus x individual chronic prevention focus and an academic’s intention to participate in commercialisation activities, no significant interaction was found meaning there was no support for Hypothesis 6a.

The test of STEM Commercialisation Hypothesis 7a: Hypothesis 7a proposed that the stronger the leader’s prevention focus, the more negative the relationship between the individual’s chronic promotion focus and their intention to participate in commercialisation activities. It can be seen in the results (Table 40, Model 4) that only a

moderately significant and negative relationship exists between leader prevention focus x individual chronic promotion focus $\beta = -0.09$, $p < 0.06$ was therefore not found as hypothesised. The inclusion of the leader prevention focus x individual chronic promotion focus interaction in the regression equation, explained a change in R^2 of .006 ($p < 0.08$) for the model over and above the individual and leader regulatory focus main effects (Model 3) for commercialisation intentions providing no support for Hypothesis 7a. As the test was close to being significant simple slope analysis was also undertaken in order to check and understand the inter-relationships in more detail and revealed that for low leader prevention focus (one standard deviation below the mean) the simple slope was .474 ($p < .001$). For high leader prevention focus (one standard deviation above the mean) the simple slope was .224 (N/S) and the slope became statistically non-significant .81 standard deviations above the mean (slope .247 $p > .05$) (Figure 21).

Figure 21. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Prevention Focus on Commercialisation Intentions



The test of STEM Commercialisation Hypothesis 8a: Hypothesis 8a proposed that the stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities. It can be seen in the results (Table 40, Model 4) that a negative relationship exists between leader prevention focus x individual chronic prevention focus $\beta = -0.07$, p N/S and an academic's intention to participate in commercialisation activities. No significant interaction was found meaning there was no support for Hypothesis 8a.

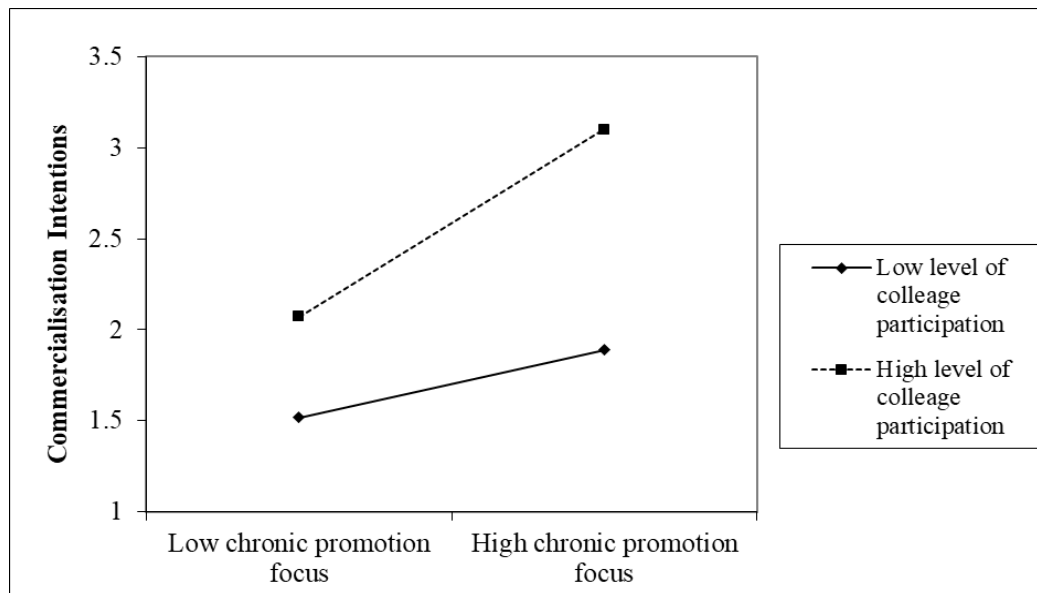
Hypotheses 9a & 10a attempt to understand if an academic's intention to participate in commercialisation activities is through using the level of colleague participation in commercialisation activity as a reference point.

The test of STEM Commercialisation Hypothesis 9a: Hypothesis 9a proposed that the greater the level of colleague participation in commercialisation activities, the more positive an academic's intention to participate in commercialisation activities. The results presented in Table 40 (Model 5) show that the level of commercialisation participation leads to positive and significant effect on an academic's intention to participate in commercialisation activities $\beta = .27$, $p < 0.001$ and accounted for an R^2 change of .061, $p < 0.001$ of Model 5's increase over the base line model (Model 2). The result thus provides strong support for Hypothesis 9a.

The test of STEM Commercialisation Hypothesis 10a: Hypothesis 10a proposed that the greater the level of colleague participation in engagement activities within their work group, the more positive an academic's intention to participate in commercialisation activities. The results presented in Table 40 (Model 6) show that the level of participation in engagement activities had a negative but non-significant effect $\beta = -.02$, p N/S on an academic's intention to participate in commercialisation activities, meaning there was not support for Hypothesis 10a.

The test of STEM Commercialisation Hypothesis 11a: Hypothesis 11a proposed that the greater the level of colleague participation in commercialisation activities, the more positive the relationship between the individual’s chronic promotion focus and their intention to participate in commercialisation activities. It is evident that the level of commercialisation participation x individual chronic promotion focus interaction is significant and positive (Table 40, Model 6), when predicting an academic’s commercialisation intentions $\beta = 0.09$, $p < 0.05$. However, the inclusion of level of commercialisation participation x individual chronic promotion focus interaction in the regression equation, explained a significant increase in variance in the model $R^2 = .009$ ($p < 0.05$) over and above the baseline model (Table 40, Model 5). Therefore, Hypothesis 11a is supported. Simple slopes analysis reveals that for low levels of colleague participation in commercialisation activities (one standard deviation below the mean) the simple slope was $.177$ ($p < .001$). For high levels of participation in commercialisation activities (one standard deviation above the mean) the simple slope was $.514$ ($p < .001$) (Figure 22).

Figure 22. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Level of Colleague Participation on Commercialisation Intentions



The test of STEM Commercialisation Hypothesis 12a: Hypothesis 12a proposed that the greater the level of colleague participation in commercialisation activities, the more negative the relationship between the individual’s chronic prevention focus and their intention to participate in commercialisation activities. It is clear there from Model 6 that there is a positive relationship between the level of commercialisation participation x individual chronic prevention focus, in relation to a STEM academic’s intention to participate in commercialisation activities. However, no significant interaction was found, and the interaction did not account for any increase in R₂, meaning Hypothesis 12a was not supported.

Hypotheses 13a and 14a, the final part of the STEM conceptual model seeks to understand if a leader’s regulatory focus determines the level of colleague participation in commercialisation activities within their group. In order to determine if the leader’s regulatory focus influenced the level of interaction a regression analysis (which included all the control variables plus the leader promotion and prevention focus variables) was conducted and the level of colleague participation in commercialisation activities within their work group was used as the dependent variable (Table 40).

Table 41. Dependent Variable – Level of Colleague Participation in Commercialisation Activities

Control variables	
Gender (Male = 1)	.09
Age	.03
Employment status (Tenured = 1)	-.03
Academic rank	.12
Research type (Applied = 1)	.08
Prior entrepreneurial experience (Yes = 1)	.03
Research intensive university	.06
Management responsibility (Yes = 1)	.23**
Resources for innovation	.12*
Leader promotion focus	.17***
Leader prevention focus	-.00
R₂	.113

The test of STEM Commercialisation Hypothesis 13a: Hypothesis 13a proposed that the more promotion-focused a leader's behaviour is perceived to be, the higher the level of colleague participation in commercialisation activities in their work group. The results presented in Table 41 show that leader promotion focus had a positive and significant effect on the level of colleague participation in commercialisation activities within their work groups $\beta=.17$, $p<0.001$. This result provides strong support for Hypothesis 13a.

The test of STEM Commercialisation Hypothesis 14a: Hypothesis 14a proposed that the more prevention-focused a leader's behaviour is perceived to be, the lower the level of colleague participation in commercialisation activities in their work group. The results presented in Table 41 show that leader prevention focus had a slightly negative, but not significant effect, on the level of level of colleague participation in commercialisation activities within their work groups, meaning Hypothesis 14a was not supported.

In the following section the results of the hierarchical regression for the STEM population and their intention to participate in the selected academic engagement activities are set out then the hypotheses are reported, discussed and summarised.

6.6 STEM Academics Engagement Intentions

In the following section the main findings of the STEM academics surveyed are presented in relation to their intentions to participate in engagement activities and the local contextual factors identified are set out. This section begins with the results of the hierarchical regression, presented in table 42.

Table 42. Results of the Hierarchical Regression for the STEM Population and their Engagement Intentions

	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Control variables							
Gender (Male = 1)	.06	.06	.06	.06	.08	.09*	.09*
Age	-.12	-.08	-.08	-.08	-.09	-.08	-.08
Employment status (Tenured = 1)	-.02	-.03	-.03	-.02	-.01	-.02	-.01
Academic rank	.10	.08	.09	.08	.06	.06	.05
Research type (Applied = 1)	.40***	.40***	.39***	.39***	.34***	.34***	.32***
Prior entrepreneurial experience (Yes = 1)	.11*	.07	.06	.06	.06	.06	.06
Research intensive university	-.04	-.04	-.04	-.04	-.02	-.02	-.02
Management responsibility (Yes = 1)	.18***	.17***	.17***	.17***	.13**	.13**	.14**
Resources for innovation	.05	.01	-.01	-.01	-.05	-.04	-.03
Main effects							
Individual regulatory focus							
Individual chronic promotion focus		.20***	.20***	.20***	.18***	.18***	.18***
Individual chronic prevention focus		-.13**	-.15**	-.15**	-.10*	-.09*	-.10*
Leader regulatory focus							
Leaders promotion focus			.11*	.11*			.07
Leaders prevention focus			-.03	-.03			-.02
Interaction effects							
Leaders promotion focus x Individual chronic promotion focus				.00			.03
Leaders promotion focus x Individual chronic prevention focus				.03			.02
Leaders prevention focus x Individual chronic promotion focus				-.05			-.05
Leaders prevention focus x Individual chronic prevention focus				-.02			-.02
Colleague main effects							
Level of colleague commercialisation participation					.06	.06	.04
Level of colleague engagement participation					.31***	.31***	.31**
Colleague interaction effects							
Level of colleague engagement participation x Individual chronic promotion focus						-.06	-.06
Level of colleague engagement participation x Individual chronic prevention focus						.15***	.15**
R2	.230	.272	.284	.287	.375	.394	.403
F Statistic	12.769	13.010***	11.598*	8.974	17.589***	16.456**	11.992

*p<0.05; **p<0.01; ***p<0.001

6.6.1 Hypotheses Testing of STEM Academics' Engagement Intentions

The test of STEM Hypothesis 1b: Hypothesis 1b proposed that the stronger an academic's individual chronic promotion focus, the stronger their intention to participate in engagement activities. The results presented in Table 42 (Model 9) show that individual chronic promotion focus had a positive and significant effect on an academic's intention to participate in engagement activities $\beta=.20$, $p<0.001$ and accounted for an R^2 change of .028 ($p<0.001$) of Model 10's increase over the base line model (Model 8). The result thus provides strong support for Hypothesis 1b.

The test of STEM Hypothesis 2b: Hypothesis 2b proposed that the stronger an academic's individual chronic prevention focus, the weaker their intention to participate in engagement activities. The results presented in Table 42 (Model 9) show that individual chronic prevention focus had a negative and significant effect on an academic's intention to participate in engagement activities $\beta= -.13$, $p<0.001$ and accounted for an R^2 change of .008 ($p<0.05$) of Model 10's increase over the base line model (Model 8). The result thus provides strong support for Hypothesis 2b.

The test of STEM Hypothesis 3b: Hypothesis 3b proposed that the more promotion-focused a leader's behaviour is perceived to be, the stronger an academic's intention to participate in engagement activities. The results presented in Table 42 (Model 10) show that leaders eliciting promotion focused behaviours had a positive and strong significant effect on an academic's intention to participate in engagement activities $\beta=.11$, $p<0.05$ and accounted for a change in R^2 of .011, ($p<0.05$) of Model 11's increase over the base line model (Model 9). The result thus provides strong support for Hypothesis 3b.

The test of STEM Hypothesis 4b: Hypothesis 4b proposed that the more prevention-focused a leader's behaviour is perceived to be, the weaker an academic's intention to participate in engagement activities. Whilst the relationship was found to be negative, it was non-significant $\beta= -.03$, p . N/S, meaning Hypothesis 4b was not supported.

The test of STEM Hypothesis 5b: Hypothesis 5b proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities. It is clear from Model 11 that while there is a very slight positive relationship between leader promotion focus x individual chronic promotion focus and an academic's intention to participate in engagement activities, no significant interaction nor increase in R² was found meaning there was no support for Hypothesis 5b.

The test of STEM Hypothesis 6b: Hypothesis 6b proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities. Again, we can see from Model 11 that while there is a slight positive relationship between leader promotion focus x individual chronic prevention focus and an academic's intention to participate in engagement activities, no significant interaction was found meaning there was also no support for Hypothesis 6b.

The test of STEM Hypothesis 7b: Hypothesis 7b proposed that the stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities. We find there is a negative interaction between leader prevention focus x individual chronic promotion focus $\beta = -0.05$, N/S and an academic's intention to participate in engagement activities, however no significant interaction was found meaning there was also no support for Hypothesis 7b.

The test of STEM Hypothesis 8b: Hypothesis 8b proposed that the stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities. It is clear from Model 11 that while there is a negative relationship between leader prevention focus x individual chronic prevention focus and an academic's intention to

participate in engagement activities $\beta = -0.05$, N/S. However, no significant interaction nor increase in R^2 was found meaning there was no support for Hypothesis 8b.

The test of STEM Hypothesis 9b: Hypothesis 9b proposed that the greater the level of colleague participation in commercialisation activities within their work group, the more positive an academic's intention to participate in engagement activities. The results presented in Table 42 (Model 12) show that the level of colleague's commercialisation participation leads to positive and but not significant effect on an academic's intention to participate in engagement activities $\beta = .06$, p. N/S, meaning there was no support for Hypothesis 9b.

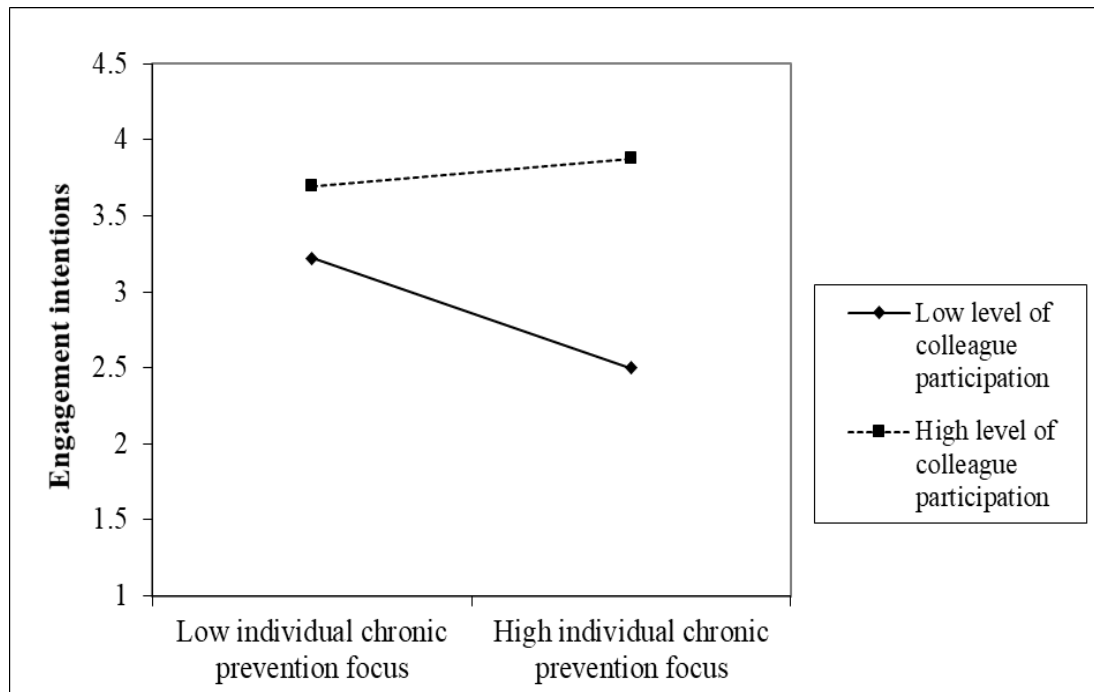
The test of STEM Hypothesis 10b: Hypothesis 10b proposed that the greater the level of colleague participation in engagement activities, the more positive an academic's intention to participate in engagement activities. The results presented in Table 42 (Model 12) show that the level of colleague participation in engagement activities leads to positive and significant effect on an academic's intention to participate in engagement activities $\beta = .31$, $p < 0.001$, and on its own accounted for an R^2 change of .10, $p < 0.001$ of Model 12's increase over the base line model (Model 9). The result thus provides strong support for Hypothesis 10b.

The test of STEM Hypothesis 11b: Hypothesis 11b proposed that the greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities. Model 13 shows there is a negative and non-significant relationship between the level of colleague engagement participation x individual chronic promotion focus in relation to an academic's intention to participate in engagement activities, meaning Hypothesis 11b was not supported.

The test of STEM Hypothesis 12b: Hypothesis 12b proposed that the greater the level of colleague participation in engagement activities, the more positive the relationship

between the individual's chronic prevention focus and their intention to participate in engagement activities. Model 13 shows that the level of colleague engagement participation x individual chronic prevention focus interaction is significant and positive $\beta = 0.15$, $p < 0.001$ when predicting an academic's engagement intentions. Further analysis uncovered that the inclusion of the interaction term level of colleague engagement participation x individual chronic prevention focus accounted for an R^2 change of .016 ($p < 0.01$), a significant level of increased variance over and above the main effects found in Model 12, therefore Hypothesis 12b is supported. Simple slopes analysis reveals that for low individual prevention focus (one standard deviation below the mean) the simple slope was negative $-.327$ ($p < .001$) and for high individual chronic prevention focus (one standard deviation above the mean) the gradient of the simple slope remained positive $.089$ but not significant (Figure 23).

Figure 23. Interaction Diagram Showing the Interaction between Individual Chronic Prevention Focus and Level of Colleague Engagement Participation on Engagement Intentions



Hypotheses 13b and 14b represent the final part of the conceptual model which seeks to understand if a leader's regulatory focus determines the level of colleague participation in engagement activities within their group. In order to determine if the leader's regulatory focus influenced the level of participation in their work group, a regression analysis was conducted with the level of colleague engagement participation within a work group as the dependent variable (Table 43).

Table 43. Leader Regulatory Focus and the Level of Engagement Participation in Work Group

Control variables	
Gender (Male = 1)	-.08
Age	.03
Employment status (Tenured = 1)	-.04
Academic rank	.08
Research type (Applied = 1)	.17**
Prior entrepreneurial experience (Yes = 1)	.04
Research intensive university	-.08
Management responsibility (Yes = 1)	.10
Resources for innovation	.16**
Leader promotion focus	.12*
Leader prevention focus	-.04
R ²	.12

The test of Hypothesis 13b: Hypothesis 13b proposed that the more promotion-focused a leader's behaviour is perceived to be, the higher the level of colleague participation in activities in their work group. Again, the results presented in Table 43 show that leader promotion focus had a positive and significant effect on the level of colleague participation in engagement activities within their work groups $\beta=.12$, $p<0.05$. The result thus provides support for Hypothesis 13b.

The test of Hypothesis 14b: Hypothesis 14b proposed that the more prevention-focused a leader's behaviour is perceived to be, the lower the level of colleague participation in activities in their work group. The results presented in Table 43 show that leader prevention focus had a negative but not significant effect on the level of colleague participation in engagement activities within their work groups, meaning Hypothesis 14b was not supported.

The results of the hypotheses set out above are summarised in Table 44 and significant STEM study findings are summarised in the following discussion.

Table 44. Summary of STEM Academics Commercialisation and Engagement Hypotheses

No.	Hypothesis	Supported/Not supported
Individual Chronic Regulatory Focus		
1a	The stronger an academic's chronic promotion focus, the stronger their intention to participate in commercialisation activities	Supported
2a	The stronger an academic's chronic prevention focus, the weaker their intention to participate in commercialisation activities	Not supported
1b	The stronger an academic's chronic promotion focus, the stronger their intention to participate in engagement activities	Supported
2b	The stronger an academic's chronic prevention focus, the weaker their intention to participate in engagement activities	Supported
Leader Regulatory Focus		
3a	The more promotion-focused a leader's behaviour is perceived to be, the more positive an academics intention to participate in commercialisation activities.	Not supported
4a	The more prevention-focused a leader's behaviour is perceived to be, the more negative an academics intention to participate in commercialisation activities.	Not supported
3b	The more promotion-focused a leader's behaviour is perceived to be, the more positive an academics intention to participate in engagement activities.	Supported

4b	The more prevention-focused a leader's behaviour is perceived to be, the more negative an academics intention to participate in engagement activities.	Not supported
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Leader Regulatory Focus x Individual Chronic Regulatory Focus Interactions

5a	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.	Supported
6a	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities	Not supported
7a	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.	Not Supported
8a	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities.	Not supported
5b	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.	Not Supported
6b	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.	Not supported
7b	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.	Not supported
8b	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.	Not supported

Level of Colleague Commercialisation and Engagement Participation

9a	The greater the level of colleague commercialisation participation, the more positive an academics intention to participate in commercialisation activities.	Supported
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10a	The greater the level of colleague participation in engagement activities within their work group, the more positive an academics intention to participate in commercialisation activities.	Not supported
9b	The greater the level of colleague commercialisation participation, the more positive an academics intention to participate in engagement activities.	Not supported
10b	The greater the level of colleague participation in engagement activities within their work group, the more positive an academics intention to participate in engagement activities.	Supported
Level of Colleague Commercialisation and Engagement Participation x Individual Chronic Regulatory Focus Interactions		
11a	The greater the level of colleague participation in commercialisation activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.	Supported
12a	The greater the level of colleague participation in commercialisation activities, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities.	Not supported
11b	The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.	Not supported
12b	The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.	Supported
Leader Regulatory focus and Work Group Commercialisation and Engagement Levels		
13a	The more promotion focused the leader's behaviour is perceived to be, the higher the level of commercialisation participation in their work group.	Supported
14a	The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague commercialisation participation in their work group.	Not supported
13b	The more promotion focused the leader's behaviour is perceived to be, the higher the level of colleague participation in engagement activities in their work group.	Supported

14b	The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague participation in engagement activities in their work group.	Not supported
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The summary of the STEM findings is presented in the following section and begins with a review of the 'three main themes' and concludes with a discussion of the control variables.

6.7 Summary of STEM findings

In the section that follows, the three multi-level themes will be summarised in relation to the key findings from the study of the academics working in the STEM disciplines. Firstly, the impact of an individual's chronic regulatory orientation has on their intentions towards participating in commercialisation and engagement activities; secondly, the findings in relation to their academic leaders and the direct and indirect effects their behaviour may have on their subordinates' intentions towards participating in commercialisation and engagement activities; and finally the effects of work group colleagues will be explored to understand whether the level of participation in their work group they are exposed to directly and/or indirectly affect a STEM academic's intentions to participate in commercialisation and engagement activities. The key findings from each of these three themes are next discussed in turn.

The table below (Table 45) sets out the directionality and significance levels in relation to STEM academics chronic regulatory focus and STEM academics' commercialisation and engagement intentions.

Table 45. Directionality and Significance Levels in Relation to STEM Academics Chronic Regulatory Focus and STEM Academics' Commercialisation and Engagement Intentions.

	Commercialisation Intentions	Engagement Intentions
Chronic Promotion Focus	+ ***	+ ***
Chronic Prevention Focus	-	- **

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

Firstly, in relation to commercialisation activities, the results suggest that the stronger an academic's chronic promotion focus, the stronger their intention to participate in commercialisation (Hypothesis 1a) and engagement activities (Hypothesis 1b). The results for the STEM disciplines also suggest that the stronger an academic's chronic prevention focus, the lower their intention to participate in both commercialisation and engagement activities (Hypothesis 2b). These findings suggest that chronic promotion focused academics are more likely to be motivated to participate in entrepreneurial activities as well as believing they have, or can acquire, the skills to successfully participate in these activities. The result of which should lead to increased intentions to participate in commercialisation and engagement activities, when compared to their prevention focused STEM academic colleagues.

Turning next to the first of the situational factors, their leader's behaviour and how this can potentially direct or indirectly effect an academic's motivation and thus their intention to participate in commercialisation and engagement activities is considered. Firstly, the direct effects of leader regulatory focus (Models 3 & 10) on an academic's commercialisation intentions are set out in table 46 below.

Table 46. Direct Effects of Leader Regulatory Focus (Models 3 & 10) on an Academic's Commercialisation Intentions

	Commercialisation Intentions	Engagement Intentions
Leader Promotion Focus	+	+ *
Leader Prevention Focus	-	-

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

The direction of the relationships show that promotion focused leaders lead to increased intentions to participate in commercialisation and engagement activities, whilst prevention focused leaders lead to negative intentions to participate in commercialisation and engagement activities. However, only one of the direct effect hypothesis, Hypothesis 3b (Model 10) found a significant and positive direct effect for the leader's promotion focus which satisfied the conditions over and above the individual's chronic regulatory focus that strengthens an individual's intention to participate in engagement activities. This finding suggests that leaders who are high in promotion elicit increases in STEM academics' intention to participate in engagement activities over and above their individual intentions to participate in engagement activities.

Turning next to the leader and individual regulatory focus interactions and whether these interactions have the potential to affect STEM academics entrepreneurial intentions (Table 47).

Table 47. Leader and Individual Regulatory Focus Interactions

Interaction	Commercialisation Intentions	Engagement Intentions
Leader promotion focus x individual chronic promotion focus	+ **	+
Leader promotion focus x individual chronic prevention focus	+	+
Leader prevention focus x individual chronic promotion focus	-	-
Leader prevention focus x individual chronic prevention focus	-	-

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

Again, the findings show that interactions between the leader’s promotion focus and the academic’s chronic regulatory focus leads to increased intentions, regardless of a STEM academics chronic regulatory focus, for both commercialisation and engagement activities. When leaders are perceived to be prevention focused, interactions between the leader’s prevention focus and the academic’s chronic regulatory focus lead to a weakening of academic intentions in relation to participation in commercialisation and engagement activities, regardless of their chronic regulatory focus. However only one interaction effect was found to be significant within the STEM hierarchical regression analysis which can significantly moderate an academic’s commercialisation intentions. The results of the leader promotion focus x individual chronic promotion focus (Model 4) found a positive and significant interaction which increases chronic promotion focused academic’s intention to participate in commercialisation activities (Hypothesis 5a) the positive impact on a STEM academics intentions is displayed in the simple slope analysis (Figure 20). The inclusion of the leader prevention focus x individual chronic promotion focus interaction in the regression equation, explained a change in R² of .006 (p<0.08) for the model over and above the individual and leader regulatory focus main

effects (Model 3) for commercialisation intentions providing no support for Hypothesis 7a. However, as robustness check was carried out as this test was close to being significant, simple slope analysis revealed that for low leader prevention focus (one standard deviation below the mean) the simple slope was .474 ($p < .001$). For high leader prevention focus (one standard deviation above the mean) the simple slope was .224 (N/S) and the slope became statistically non-significant .81 standard deviations above the mean.

The next direct situational factor is STEM academics' work group colleagues' behaviour, in relation to the level of participation in commercialisation and engagement activities, and whether this can direct or indirectly effect an academic's motivation and thus their intention to participate in commercialisation and engagement activities. Table 48 below which sets out the results, finds that only the level of colleague commercialisation activity within an academic's work group has a positive effect on STEM academics intention to participate in commercialisation activities, whilst the level of colleague participation in engagement activities has a slightly negative effect on an academic's commercialisation intentions.

Table 48. Effects of Colleagues' Behaviour on an Academic's Intention to Participate in Commercialisation and Engagement Activities.

	Commercialisation Intentions	Engagement Intentions
Level of colleague participation in commercialisation activities	+***	+
Level of colleague participation in engagement activities	-	+***

+ positive relationship found; - negative relationship found; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

It can be seen from table 48 above that there is a significant and positive direct effect for the level of colleague participation commercialisation activities within their work group leading to a significant motivational effect on an academic's intentions (Hypothesis 9a), over and above their own individual commercialisation intentions (Model 2). Interestingly, the level of colleague participation in engagement activities has

no impact at all on a STEM academic's intentions to participate in commercialisation activities. In terms of the level of colleague participation in engagement activities within an academic's work group, the results of the regression analysis (Model 12) show that this is a significant predictor of a STEM academics intention to participate in engagement activities (Hypothesis 10b).

Turning to the interactions between the level of colleague participation in commercialisation and engagement activities in an academic's work group and individual chronic regulatory focus. We can see from Table 49 below that there is a moderately significant and positive interaction when there are greater levels of colleague participation in commercialisation activities and chronic promotion focused academics, leading to increased motivation of STEM academics intention to participate in commercialisation activities (Hypothesis 11a). This finding is also confirmed by simple slope analysis in figure 22.

Table 49. Interactions between the Level of Colleague Participation in Commercialisation and Engagement Activities in an Academic's Work Group and Individual Chronic Regulatory Focus

Interaction	Commercialisation Intentions	Engagement Intentions
Level of colleague participation in commercialisation activities x individual chronic promotion focus	+ *	-
Level of colleague participation in engagement activities x individual chronic prevention focus	+	+ ***

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

Turning to the interaction between the level of colleague participation in engagement activities and chronic promotion focus, the results show that that there was no relationship found in the regression analysis between the level of colleague participation in commercialisation activities and a STEM academics intentions to participate in engagement activities. However, these findings show that the level of

colleague participation engagement in their work group acts as an important motivational factor for prevention focused STEM academic's and their motivation to participate in commercialisation activities can be influenced by the behaviour of peers. This result may seem surprising given that when viewed in isolation, individuals who are high in chronic prevention focus display significant negative intentions (Table 42, Model 9) to participate in engagement activities.

Finally, hypothesis 13 and 14 sought to understand if the leader's regulatory orientation could affect the level of group participation in entrepreneurial activities. The results of the regression analysis (Table 50) show that promotion focused leaders have a significant and positive effect on the level of participation in work groups for both commercialisation (Hypothesis 13a) and engagement (Hypothesis 13b) activities their subordinates within their respective work groups.

Table 50. Orientation of the leader's regulatory orientation and effect on the level of group participation in entrepreneurial activities

	Commercialisation Activity Levels	Engagement Activity Levels
Leader promotion focus	+ ***	+ *
Leader prevention focus	-	-

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

The results of the regression analysis also suggest that prevention focused leaders have a non-significant but weakening effect on their work group participation in commercialisation and engagement activities in their work groups. These findings suggest that if universities wish to increase their level of income from commercialisation and engagement activities within the STEM disciplines, then it is important to have leaders who are role-models and who can create the norms which will lead to increased entrepreneurial behaviour.

6.8 STEM Control Variables Results

When viewed in isolation (Model 1 and Model 8), we find that some control variables were able to predict a STEM academics commercialisation and engagement intentions, the significant findings are summarised as follows. In common with previous studies in the wider literature the findings from the STEM related disciplines suggest that male academics are significantly more likely than their female colleagues to participate in commercialisation activities. However, the results of this study in relation to intention to participate in engagement activities within the STEM disciplines suggest that there is no significant difference between males and females and their intentions to participate in engagement activities. In relation to age, the findings of this study suggest that academics who are slightly younger than the average of the survey respondents were more likely to develop stronger intentions to participate in commercialisation activities. There was no difference between differing age groups and their intentions to participate in engagement activities. The results from academics working STEM disciplines suggest that academics who are on fixed term contracts are more likely to display stronger commercialisation intentions. However, there was no difference between academics who were tenured and those who were on a fixed term contracts and their intentions to participate in engagement activities. STEM academics who have an applied research focus rather than a basic research focus were found to be significantly more likely to display strong intentions to participate in both commercialisation and engagement activities. The results of the STEM findings found that individuals who have prior entrepreneurial experience were significantly more likely to display strong intentions in commercialisation activities and this remained the case throughout the multi-level analysis. However, individuals who have prior entrepreneurial experience were significantly more likely to display intentions to participate in engagement activities only in model 8 (the control variables) but once the individuals regulatory focus and contextual factors were included in the multi-level analysis the significant relationship identified disappeared. Academics within the STEM disciplines who have line-management responsibilities were found to have strong intentions to participate in

commercialisation and engagement activities than their non-manager counterparts. Resource for innovation was found to be a significant control variable in relation to their intention to participate in commercialisation (model 1) activities however once the individuals regulatory orientation and contextual factors were included in the multi-level analysis the significant relationship identified disappeared. No significant relationship was found in relation to a STEM academics intention to participate engagement activities and resources for innovation.

This chapter has explored the findings in relation to the STEM disciplines and the following chapter presents the findings for the non-STEM disciplines, again it will follow a similar structure to ensure comparability.

Chapter 7 Non-STEM Analysis and Findings

7.1 Introduction

Since researchers have identified that academics working in the STEM disciplines are more likely to engage in entrepreneurial activities than their non-STEM counterparts then there is a need to understand whether the non-STEM academics who perhaps have fewer opportunities and may not be as exposed to contextual factors such as colleagues or leaders who regularly participating in these activities will impacts their intention to participate in commercialisation and engagement activities.

One of the main objectives of this multi-level study was to understand to what extent local contextual factors affect academics intentions to participate in commercialisation and engagement activities and whether these factors may differ between academics working in STEM and Non-STEM disciplines. In an attempt to understand the Non-STEM disciplines contextual factors in more detail, and if regulatory focus theory will be applicable to all academic disciplines, academics who self-reported that they worked in Non-STEM disciplines were identified and separated from those who work in the STEM disciplines. Again, the conceptual model was used to understand the motivation of the individual and if their leader and/or their work group colleagues can affect their intentions to participate in commercialisation and engagement activities.

7.2 The Characteristics of Non-STEM Respondents

In addition to the data collection and analyses discussed above, this study also performed a descriptive analysis to provide an overview of the characteristics of respondents. The respondents by each of the Scottish universities are set out in table 51 below.

Table 51. Non-STEM Respondents by University

Name of University	Total Respondents	Total Non-STEM Respondents	Percentage
University of Aberdeen	80	40	50.0%
Abertay University	9	5	55.6%
University of Dundee	56	37	60.1%
University of Edinburgh	137	58	42.3%
University of Glasgow	126	65	51.6%
Glasgow Caledonian University	31	25	80.6%
Heriot-Watt University	47	21	44.7%
Edinburgh Napier University	37	27	73.0%
Queen Margaret University	17	14	82.4%
Robert Gordon University	24	15	62.5%
University of St. Andrews	73	25	34.3%
University of Strathclyde	99	41	39.0%
University of Stirling	53	35	66.0%
University of the West of Scotland	29	15	51.7%
Total	818	423	51.7%

Following Hughes & Kitson's (2011) study, eight Non-STEM disciplines were categorised as follows; Health Sciences (26.00%); Architecture, Building and Planning (3.56%); Law, Social Sciences and Economics (5.67%); Business and Financial Studies (22.47%); Education (2.60%); Languages (5.67%); Creative Arts & Media (4.01%) and Other Humanities (11.82%). The distribution of responses for each of these disciplines is set out in table 52 below.

Table 52. Individual Characteristics of Non-STEM Respondents

Non-STEM Discipline	Number of Non-STEM Respondents	% of Non-STEM Respondents
Health Sciences	110	26.00%
Architecture, Building and Planning	15	3.56%
Law, Social Sciences and Economics	101	23.87%
Business and Financial Studies	95	22.47%
Education	11	2.60%
Languages	24	5.67%
Creative Arts & Media	17	4.01%
Other Humanities	50	11.82%
Total Non-STEM Disciplines	423	100.00%

In relation to the individual characteristics, 54.1% of the Non-STEM respondents were Male and 45.9% Female. In relation to Academic Rank the respondents were relatively evenly distributed across the four categories, 21.5% of the respondents had the rank of Professor, 26.5% the rank of Reader/Senior lecturer, 28.6% had the rank of Lecturer and 23.4% had the rank of Teaching/Research Fellow, Research Associate and Research/Teaching Assistant. In relation to the sample's employment status 76.1% of the Non-STEM respondents were found to be tenured, while 23.9% were on fixed term contracts. In terms of age, the respondents fell into the following categories: Under 30: 2.8%, 30-39: 32.2%, 40-49: 29.3%, 50-59: 26.2% and 60 and over 9.5%. Turning next to prior entrepreneurial experience, 16.3% of the Non-STEM respondents had prior entrepreneurial experience whilst 83.7% did not have any. Finally, 43.5% of the respondents, self-reported that they had management responsibilities within the Non-STEM disciplines, where subordinates reported directly to them (Table 53).

Table 53. Individual Characteristics of Non-STEM Respondents

	Respondents	% Total STEM Respondents
Gender		
Male	229	54.1%
Female	194	45.9%
Academic Rank		
Professor	91	21.5%
Senior Lecturer/Reader	112	26.5%
Lecturer	121	28.6%
Other (Teaching/Research Fellow, Research Associate, Research/Teaching Assistant)	99	23.4%
Employment Status		
Tenured (Permanent Position)	322	76.1%
Limited-time contract	101	23.9%
Age Group		
Under 30	12	2.8%
30 to 39	136	32.2%
40 to 49	124	29.3%
50 to 59	111	26.2%
60 or over	40	9.5%
Prior entrepreneurial experience		
Yes	69	16.3%
No	354	83.7%
Line management responsibility		
Yes	184	43.5%
No	239	56.5%

The Non-STEM respondents were also asked to select the type of research they predominantly participate in (either basic or applied) as described in section 6.1 of the previous chapter. The results set out in Table 54 showed that respondents who predominantly had an applied research made up 56.3% of the respondents while those who predominantly participate in basic research made up 43.7%.

Table 54. Respondents by Research Type

Research Type	Number of Respondents	% Total Respondents
Basic research	185	43.7%
Applied research	238	56.3%

The respondents were sub-divided into two group categories as detailed in section 6.1 of chapter six. These were comprised of 26.5% Russell Group universities and the remainder accounted for 73.5% of responses (Table 55).

Table 55. Respondents by University Type

Russell group (Research Intensive)	112	26.5%
No	311	73.5%

In the following section the tests of reliability of the Non-STEM survey variables are discussed.

7.3 Tests of Reliability

As per the previous chapter, the tests of reliability that have been employed in this part of the study are described in the following sections.

7.3.1 Cronbach's Alpha

To check that the scales used were reliable within the Non-STEM study, the Cronbach's alpha of each scale was again retested. The Cronbach's alpha coefficients relating to the reliability of measures used in the Non-STEM disciplines within this

study are set out in table 56, all the multi-scale items used were again found to be either at or above the 0.7 value and can therefore be regarded as reliable.

Table 56. Reliability of Non- STEM Survey Scales

Variable	Cronbach's alpha
Commercialisation intentions	.70
Engagement intentions	.72
Individual chronic promotion focus	.86
Individual chronic prevention focus	.87
Leader promotion focus	.75
Leader prevention focus	.90
Resources for innovation	.79

7.3.2 Test for Multicollinearity

As per the other studies in this to make sure that multi-collinearity was not an issue for the variables in the Non-STEM data set, the variables in the regression analysis were again tested using the VIF to tests the extent of multicollinearity for each independent variable used in the analysis. The VIF for independent variables in the proposed model ranged from 1.09 and 1.30. Again, this is well below what is considered the conservative VIF measure of 5.00 (O'Brien, 2007) and therefore no further investigation or corrective action is required, and multicollinearity was not an issue in the Non-STEM data set. The results of the VIF analysis are set out in table 57 below. We can see from table 57, that the tolerance (1/VIF) showed that again a substantial portion of the variance (in all cases =>77%) for each of the independent variables is available to predict the dependent variable. These measures indicate that multicollinearity is not a problem and that the proposed independent variables in the model may all be used in the multi-level analysis of non-STEM academics intentions to participate in commercialisation and engagement activities.

Table 57. Variance Inflation Factors of Non-STEM Interaction Variables

Variable	VIF	1/VIF
Individual chronic promotion focus	1.14	.88
Individual chronic prevention focus	1.11	.90
Leader promotion focus	1.18	.85
Leader prevention focus	1.09	.92
Level of colleague participation in commercialisation activities	1.30	.77
Level of colleague participation in engagement activities	1.27	.79

In the following section the main findings of the non-STEM study are introduced and are set out using the conceptual model as a framework. Firstly, the descriptive statistics and correlations are displayed and discussed, firstly the results in relation to an academic's commercialisation intentions are reported which are then followed by the results of their intentions to participate in engagement activities and finally a summary of the findings is set out.

7.4 Descriptive Statistics and Correlation Analysis

The descriptive statistics and a correlation analysis for the study's non-STEM variables are set out in Table 58 below.

Table 58. Correlations and Descriptive Statistics for Non-STEM Study Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Dependent variables																	
1 Commercialisation intentions	1																
2 Engagement intentions	.30***	1															
Control variables																	
3 Gender (male = 1)	.14**	.03	1														
4 Age group ($\geq 60 = 5$)	-.09*	.03	.17***	1													
5 Employment status (tenured = 1)	-.03	.04	.19**	.34***	1												
6 Academic rank (professor = 4)	-.05	.08*	.16***	.48***	.55***	1											
7 Research type (applied = 1)	.17***	.31***	-.06	.09*	.02	.00	1										
8 Prior entrepreneurial experience (yes = 1)	.22***	.15***	.06	.15***	.10*	.03	.20***	1									
9 Research intensive university (Russell group = 1)	-.07	-.03	-.02	-.010*	-.00	-.01	-.01	-.06	1								
10 Management responsibility (yes = 1)	.12**	.16***	.13**	.22***	.26***	.43***	.06	.04	.07	1							
11 Resources for innovation	.03	.05	.01	-.02	-.14**	-.05	-.07	-.05	.03	.08	1						
Independent variables																	
12 Individual chronic promotion focus	.18***	.17***	-.04	-.19***	-.08	-.06	.02	.11**	.05	.03	.03	1					
13 Individual chronic prevention focus	-.03	-.08*	-.05	-.15***	-.15***	-.14***	.03	-.10*	.04	-.01	-.06	.10**	1				
14 Leaders promotion focus	.07	.15***	-.06	-.02	-.11**	-.05	.07	.03	.04	.08	.21***	.07*	.03	1			
15 Leaders prevention focus	-.04	-.01	.04	-.04	-.01	-.02	-.00	-.02	-.01	.10*	.02	.01	.09*	.13**	1		
16 Level of colleague commercialisation participation	.33***	.21***	.13**	.02	.05	.09*	.10*	.06	-.02	.25***	.08*	.00	-.03	.14**	-.03	1	
17 Level of colleague engagement participation	.10*	.29***	-.03	.02	-.02	.02	.12**	.02	.05	.14**	.14***	.05	-.01	.17***	-.07	.34***	1
Mean	1.84	3.73	0.54	3.07	0.76	2.46	.56	.16	0.26	0.43	3.73	4.90	3.80	4.03	4.39	1.81	2.68
Std. Deviation	1.38	1.51	0.49	1.03	0.42	1.07	0.49	0.37	0.44	0.49	1.08	0.99	1.11	1.28	0.72	0.93	1.02

N = 423 *p <0.05; **p<0.01;***p<0.001

Although the correlations amongst variables are not necessarily tests of the non-STEM model proposed, some interesting patterns can be found in these results. The bivariate relationships indicate that individual chronic promotion focus was significantly and positively related to both Non-STEM academics' commercialisation intentions ($r = .18, p < 0.001$) and engagement intentions ($r = .17, p < 0.001$). Individual chronic prevention focus was negatively but not significantly related to commercialisation intentions ($r = -.03, N/S$) but is significantly and negatively related to their intention to participate in engagement activities ($r = -.08, p < 0.05$).

Leader promotion focus was also found to be significantly and positively related to engagement intentions ($r = .15, p < 0.001$) but is not significantly related to commercialisation intentions. Whereas leader prevention focus was not significantly related to either to an academic's intention to participate in commercialisation or engagement activities. The level of colleague participation was significantly related to both their intention to participate in commercialisation ($r = .30, p < 0.001$) and engagement activities ($r = .21, p < 0.001$).

The level of colleague participation in commercialisation and engagement activities is also significantly related a non-STEM academics intention to participate in both commercialisation ($r = .33, p < 0.001$) and engagement activities ($r = .21, p < 0.001$). The level of colleague participation in engagement activities was also significantly related to an academic's intention to participate in both commercialisation ($r = .10, p < 0.05$) and engagement activities ($r = .29, p < 0.001$). These results provide a preliminary insight into the direct relationship between individual chronic, leader regulatory focus and colleague engagement in relation to non-STEM academic's intentions to participate in commercialisation and engagement activities.

7.5 Non-STEM Academics' Commercialisation Intentions

In the following tables, firstly the results of the hierarchical regression for the non-STEM population and their intentions to participate in commercialisation activities are set out (Table 59) and then their intention to participate in engagement activities

(Table 61). Again, the hypotheses are covered within four key sections, firstly the individuals regulatory focus and their intention to participate in commercialisation and engagement activities are measured. Secondly, the direct and indirect effects of their leader are assessed, thirdly the direct and indirect effects of that their work group colleagues have on their commercialisation and engagement intentions are displayed and finally the effect of the leader's regulatory orientation on the level of work group academic entrepreneurship is assessed.

Table 59. Hierarchical Regression for Non-STEM Population and Intentions to Participate in Commercialisation Activities

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Control variables							
Gender (Male = 1)	.17***	.18***	.18***	.18***	.15**	.15***	.15***
Age	-.21***	-.16**	-.16**	-.14*	-.14*	-.14**	-.13*
Employment status (Tenured = 1)	-.06	-.05	-.05	-.06	-.05	-.05	-.05
Academic rank	-.00	.02	.02	.03	.02	.02	.03
Research type (Applied = 1)	.14**	.13**	.13**	.12*	.11*	.12**	.10*
Prior entrepreneurial experience (Yes = 1)	.28***	.25***	.25***	.24***	.25***	.25***	.24***
Research intensive university (Russell group = 1)	-.09	-.09*	-.09*	-.10*	-.08*	-.08*	-.08*
Management responsibility (Yes = 1)	.17**	.15**	.16**	.16**	.09	.09	.10*
Resources for innovation	.05	.04	.02	.02	.02	.01	.02
Main effects							
Individual regulatory focus							
Individual promotion focus		.15**	.15**	.14**	.15***	.15***	.14**
Individual prevention focus		.02	.02	.02	.02	.02	.02
Leader regulatory focus							
Leaders promotion focus			.06	.04			.02
Leaders prevention focus			.03	.05			.05
Leader Interaction effects							
Leader promotion focus x individual promotion focus				.05			.02
Leader promotion focus x individual prevention focus				-.04			-.05
Leader prevention focus x individual promotion focus				-.15***			.14**
Leader prevention focus x individual prevention focus				-.06			.04
Colleague main effects							
Level of colleague commercialisation participation					.27***	.27***	.27***
Level of colleague engagement participation					-.02	-.02	-.02
Colleague interaction effects							
Level of colleague commercialisation participation x individual promotion focus						.07	.07
Level of colleague commercialisation participation x individual prevention focus						.00	.00
R2	.185	.205	.208	.241	.266	.272	.297
F Statistic	10.382	9.628**	8.274	7.559**	11.388***	10.090	8.038

*p<0.05;**p<0.01;***p<0.001

7.5.1 Non-STEM Academics Commercialisation Intentions

The test of Non-STEM Hypothesis 1a: Hypothesis 1a proposed that the stronger an individual academic's chronic promotion focus, the stronger their intention to participate in commercialisation activities. The results presented in table 59 (Model 2) show that individual chronic promotion focus had a positive and significant effect on a non-STEM academic's intention to participate in commercialisation activities $\beta=.15$, $p<0.01$ and accounted for an R^2 change of .020, $p<0.01$ of Model 2's increase over the base line model (Model 1). The result provides strong support for Hypothesis 1a.

The test of Non-STEM Hypothesis 2a: Hypothesis 2a proposed that the stronger an academic's individual chronic prevention focus, the weaker their intention to participate in commercialisation activities. The results presented in table 59 (Model 2) show that while an academic's individual chronic prevention focus had only a slightly positive effect on a non-STEM academic's commercialisation intentions $\beta= .02$, p N/S, this was however not significant and Hypothesis 2a was not supported.

The test of Non-STEM Hypothesis 3a: Hypothesis 3a proposed that the more promotion-focused a leader's behaviour is perceived to be, the stronger non-STEM academics' intention to participate in commercialisation activities. The results presented in table 59 (Model 3) show that leaders eliciting promotion focused behaviours have a positive effect on non-STEM academics intention to participate in commercialisation activities $\beta=.06$, p N/S. However, the result was not significant, meaning there was no support for Hypothesis 3a.

The test of Non-STEM Hypothesis 4a: Hypothesis 4a proposed that the more prevention-focused a leader's behaviour is perceived to be, the weaker non-STEM academics' commercialisation intentions. The relationship was found to be not significant $\beta= .03$, p N/S meaning there was no support for Hypothesis 4a.

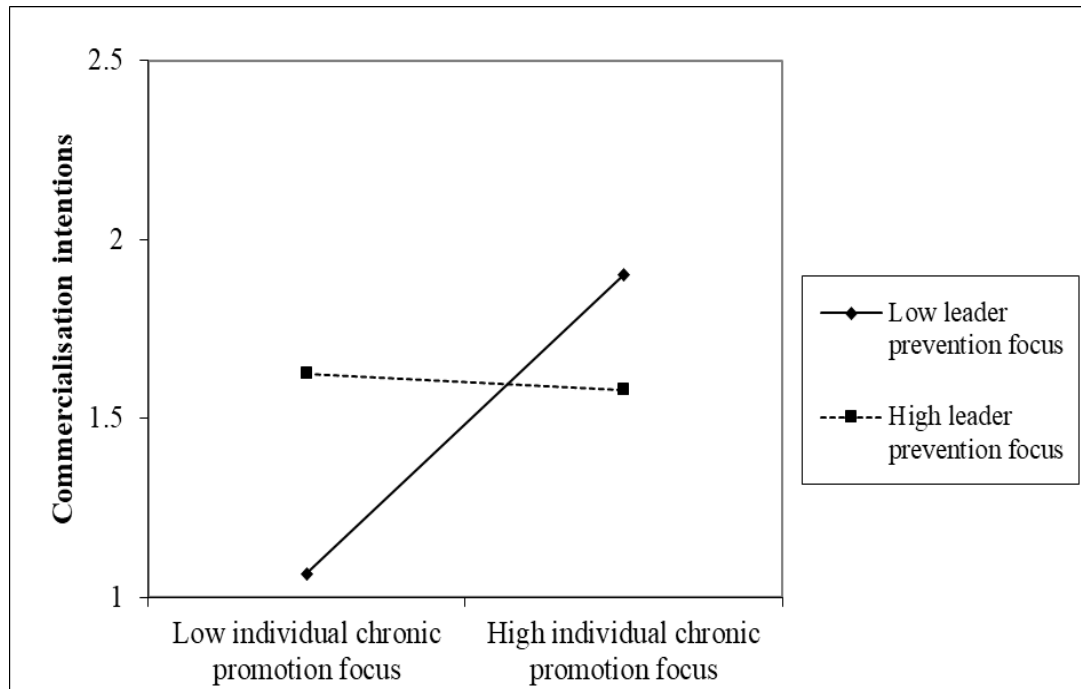
The test of Non-STEM Hypothesis 5a: Hypothesis 5a proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities. It is clear from the results (Table 59, Model 4) that there is a positive interaction between leader promotion focus x individual chronic promotion focus and non-STEM academics' commercialisation intentions $\beta=.05$, N/S. However, the result was not significant, meaning there was no support for Hypothesis 5a.

The test of Non-STEM Hypothesis 6a: Hypothesis 6a proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities. It is clear from Model 4 that while there is a slight negative relationship between leader promotion focus x individual chronic prevention focus and an academic's intention to participate in commercialisation activities. However, the result was not significant, meaning there was no support for Hypothesis 6a.

The test of Non-STEM Hypothesis 7a: Hypothesis 7a proposed that the stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities. It can be seen in the results (Table 59, Model 4) that a significant and negative relationship exists between leader prevention focus x individual chronic promotion focus $\beta= -0.15$, $p<0.001$ was found as hypothesised. The inclusion of the leader prevention focus x individual chronic promotion focus interaction in the regression equation explained a change in R^2 of .027 ($p<0.001$) for the model over and above the individual and leader regulatory focus main effects (Model 3) for commercialisation intentions providing support for hypothesis 7a. Simple slope analysis (Figure 24) revealed that for low leader prevention focus (one standard deviation below the mean) the simple slope was .502 ($p.<.001$). For high leader prevention focus (one standard deviation above the mean) the simple slope was -.104 (N/S) meaning the non-STEM academics'

commercialisation intentions became statistically non-significant at .27 standard deviations above the mean (slope .166, $p > .05$).

Figure 24. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Prevention Focus on Commercialisation Intentions



The test of Non-STEM Hypothesis 8a: Hypothesis 8a proposed that the stronger the leader’s prevention focus, the more negative the relationship between the individual’s chronic prevention focus and their intention to participate in commercialisation activities. It can be seen in the results (Table 59, Model 4) that a negative relationship exists between leader prevention focus x individual chronic prevention focus $\beta = -0.06$, p N/S and an academic’s intention to participate in commercialisation activities. No significant interaction was found, meaning there was no support for Hypothesis 8a.

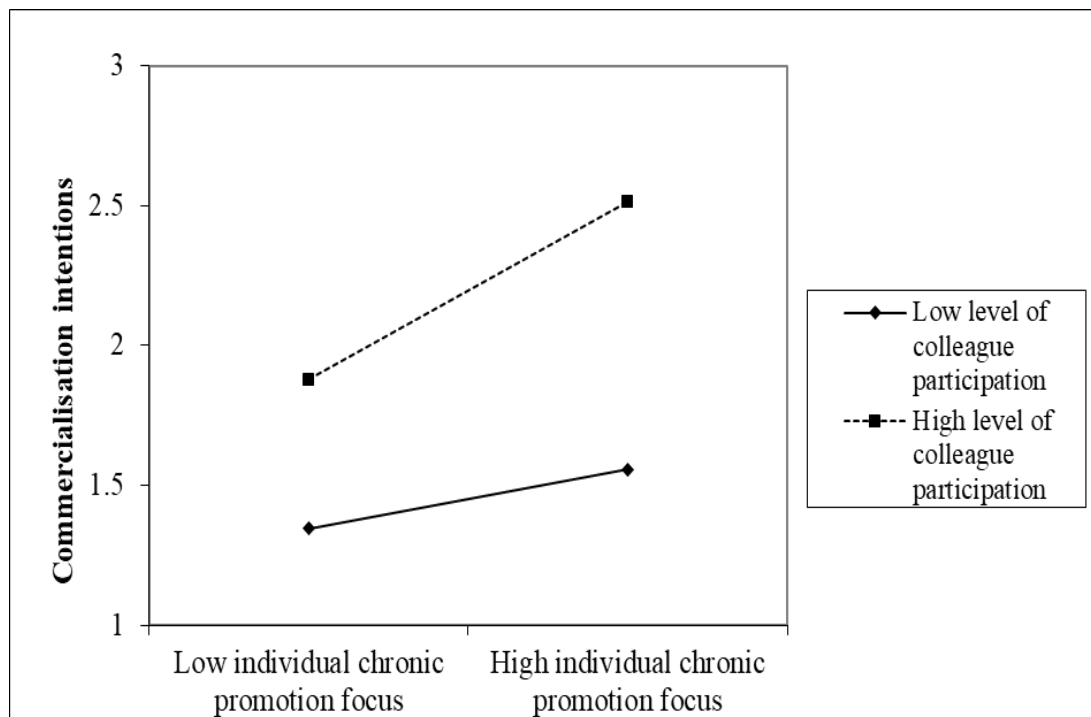
The test of Non-STEM Hypothesis 9a: Hypothesis 9a proposed that the greater the level of colleague participation in commercialisation activities, the stronger a non-STEM academics' intention to participate in commercialisation activities. The results presented in table 59 (Model 5) show that the level of colleague participation in commercialisation activities leads to a positive and significant effect on an academic's intention to participate in commercialisation activities $\beta=.27$, $p<0.001$ and accounted for an R^2 change of .062, $p<0.001$ of Model 5's increase over the base line model (Model 2). The result thus provides strong support for Hypothesis 9a.

The test of Non-STEM Hypothesis 10a: Hypothesis 10a proposed that the greater the level of colleague participation in engagement activities within their work group, the more positive an academic's intention to participate in commercialisation activities. The results presented in table 59 (Model 5) show that the level of colleague participation in engagement activities had a negative and non-significant effect $\beta= -.02$, p N/S on a non-STEM academics' intention to participate in commercialisation activities, meaning there was not support for Hypothesis 10a.

The test of Non-STEM Hypothesis 11a: Hypothesis 11a proposed that the greater the level of colleague participation in commercialisation activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities. It is evident that the level of college participation in commercialisation activities x individual chronic promotion focus interaction, is positive (Table 59, Model 6), when predicting a non-STEM academics' commercialisation intentions $\beta= 0.07$, but only at $p<0.10$. However, the inclusion of level of collage participation in commercialisation activities x individual chronic promotion focus interaction in the regression equation, explained an increase in variance in the model $R^2=.005$ ($p<0.10$) over and above the baseline model (Table 59, Model 5). Therefore, hypothesis 11a was not supported. However, as the interaction was significant at $p<0.10$ a simple slope analysis was conducted as a further check. Simple slopes analysis reveals that for low level of colleague participation in commercialisation

activities (one standard deviation below the mean), the simple slope was .106 ($p < N/S$). For high levels of colleague participation in commercialisation activities (one standard deviation above the mean), the simple slope was .320 ($p < .001$) (Figure 25) and an increase in their commercialisation intentions can be seen.

Figure 25. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Level of Colleague Participation in Commercialisation Activities on non-STEM academics Commercialisation Intentions



The test of Non-STEM Hypothesis 12a: Hypothesis 12a proposed that the greater the level of colleague participation in commercialisation activities, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities. It is clear from Model 7 that there was no statistically significant interaction found, meaning Hypothesis 12a was not supported.

Hypotheses 13a and 14a represent the final part of the conceptual model which seeks to understand if a leader's regulatory focus determines the level of colleague participation in commercialisation activities within their group. In order to determine if the leader's regulatory focus influenced the level of participation, a regression analysis was conducted and the level of colleague participation commercialisation activities in their work group as the dependent variable (Table 60).

Table 60. Dependent Variable – Level of Colleague Commercialisation Participation

Control variables	
Gender (Male = 1)	.12*
Age	-.08
Employment status (Tenured = 1)	.00
Academic rank	.01
Research type (Applied = 1)	.09
Prior entrepreneurial experience (Yes = 1)	.01
Research intensive university	-.05
Management responsibility (Yes = 1)	.23***
Resources for innovation	.07
Leader promotion focus	.15**
Leader prevention focus	.00
R ²	.121

The test of Non-STEM Hypothesis 13a: Hypothesis 13a proposed that the more promotion-focused a leader's behaviour is perceived to be, the higher the level of colleague commercialisation participation in their work group. The results presented in table 60 show that leader promotion focus had a positive and significant effect on the level of commercialisation within their work groups $\beta=.15$, $p<0.01$. The result thus provides strong support for Hypothesis 13.

The test of Non-STEM Hypothesis 14a: Hypothesis 14a proposed that the more prevention-focused a leader's behaviour is perceived to be, the lower the level of

colleague commercialisation participation in their work group. The results presented in table 60 show that leader prevention focus had no significant effect on the level of commercialisation within their work groups, meaning Hypothesis 14a was not supported.

7.6 Non-STEM Academics' Engagement Intentions

In the following section the main findings of the non-STEM academics' intention to participate in engagement activities are set out. This section begins with the results of the hierarchical regression which are presented in table 61.

Table 61. Hierarchical Regression for Non-STEM Population and Intentions to Participate in Engagement Activities

	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Control variables							
Gender (Male = 1)	.02	.02	.04	.04	.03	.03	.05
Age	-.10	-.04	-.04	-.03	-.04	-.04	-.04
Employment status (Tenured = 1)	-.03	-.03	-.02	-.03	-.02	-.02	-.02
Academic rank	.11	.08	.08	.08	.09	.09	.09
Research type (Applied = 1)	.36***	.36***	.35***	.34***	.31***	.31***	.29***
Prior entrepreneurial experience (Yes = 1)	.11*	.06	.06	.05	.07	.06	.05
Research intensive university	-.05	-.05	-.06	-.06	-.06	-.06	-.06
Management responsibility (Yes = 1)	.13**	.13**	.11*	.11*	.07	.07	.07
Resources for innovation	.07	.05	.01	.01	-.01	-.00	-.02
Main effects							
Individual regulatory focus							
Individual promotion focus		.23***	.22***	.22***	.22***	.22***	.21***
Individual prevention focus		-.13**	-.13**	-.14**	-.12**	-.12**	-.13**
Leader regulatory focus							
Leader promotion focus			.16**	.15**			.13**
Leader prevention focus			.00	.01			.04
Leader Interaction effects							
Leader promotion focus x individual promotion focus				-.02			-.02
Leader promotion focus x individual prevention focus				-.01			-.02
Leader prevention focus x individual promotion focus				-.10*			-.09*
Leader prevention focus x individual prevention focus				-.03			-.03
Colleague main effects							
Level of colleague commercialisation participation					.08	.08	.06
Level of colleague engagement participation					.27***	.27***	.26***
Colleague interaction effects							
Level of colleague engagement participation x individual promotion focus						-.04	-.05
Level of colleague engagement participation x individual prevention focus						.06	.07
R2	.193	.247	.267	.278	.334	.339	.362
F Statistic	10.999	12.241***	11.433**	9.186	15.774**	13.846	10.794

*p<0.05; **p<0.01; ***p<0.001

7.6.1 Hypotheses Testing of Engagement Intentions

The test of Non-STEM Hypothesis 1b: Hypothesis 1b proposed that the stronger an academic's individual chronic promotion focus, the stronger their intention to participate in engagement activities. The results presented in table 61 (Model 9) show that individual chronic promotion focus had a positive and significant effect on an academic's intention to participate in engagement activities $\beta=.23$, $p<0.001$ and accounted for an R^2 change of .038 ($p<0.001$) of Model 9's increase over the base line model (Model 8). The result thus provides strong support for Hypothesis 1b.

The test of Non-STEM Hypothesis 2b: Hypothesis 2b proposed that the stronger an academic's individual chronic prevention focus, the weaker their intention to participate in engagement activities. The results presented in table 61 (Model 9) show that individual chronic prevention focus had a negative and significant effect on an academic's intention to participate in engagement activities $\beta= -.13$, $p<0.001$ and accounted for an R^2 change of .009 ($p<0.05$) of Model 10's increase over the base line model (Model 8). The result provides strong support for Hypothesis 2b.

The test of Non-STEM Hypothesis 3b: Hypothesis 3b proposed that the more promotion-focused a leader's behaviour is perceived to be, the stronger a non-STEM academics' intention to participate in engagement activities. The results presented in table 61 (Model 10) show that leaders eliciting promotion focused behaviours had a positive and strong significant effect on non-STEM academics' intention to participate in engagement activities $\beta=.16$, $p<0.001$ and accounted for a change in R^2 of .020, ($p<0.001$) of Model 10's increase over the base line model (Model 9). The result thus provides strong support for Hypothesis 3b.

The test of Non-STEM Hypothesis 4b: Hypothesis 4b proposed that the more prevention-focused a leader's behaviour is perceived to be, the weaker a non-STEM academics' intention to participate in engagement activities. Whilst the relationship was

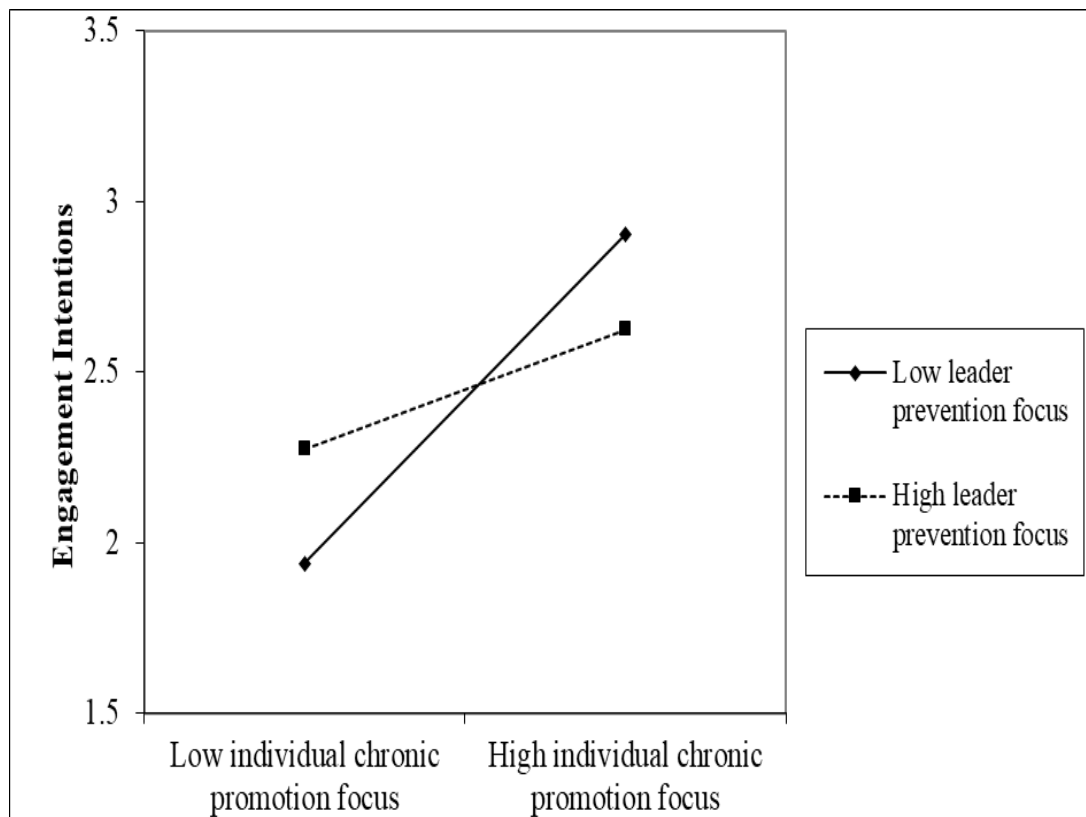
found to be negative, it was non-significant $\beta = -.00$, p . N/S, meaning Hypothesis 4b was not supported.

The test of Non-STEM Hypothesis 5b: Hypothesis 5b proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities. It is clear from Model 11 no significant interaction nor increase in R^2 was found, meaning there was no support for Hypothesis 5b.

The test of Non-STEM Hypothesis 6b: Hypothesis 6b proposed that the stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities. Again, we can see from Model 11 that no significant interaction was found, meaning there was also no support for Hypothesis 6b.

The test of Non-STEM Hypothesis 7b: Hypothesis 7b proposed that the stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities. We find there is a negative interaction between leader prevention focus x individual chronic promotion focus $\beta = -0.10$, $p < 0.05$ and an academic's intention to participate in engagement activities which accounted for a change in R^2 of .011, ($p < 0.05$) of Model 11's increase over the base line model (Model 10). The result thus provides support for Hypothesis 7b. Simple slope analysis revealed that for low leader prevention focus (one standard deviation below the mean) the simple slope was .499 ($p < .001$). For high leader prevention focus (one standard deviation above the mean) the simple slope was .167 (p . N/S) (Figure 26).

Figure 26. Interaction Diagram Showing the Interaction between Individual Chronic Promotion Focus and Leader Prevention Focus on Engagement Intentions



The test of Non-STEM Hypothesis 8b: Hypothesis 8b proposed that the stronger the leader’s prevention focus, the more negative the relationship between the individual’s chronic prevention focus and their intention to participate in engagement activities. It is clear from Model 11 that there is a negative relationship between leader prevention focus x individual chronic prevention focus and an academic’s intention to participate in engagement activities $\beta = -0.03$, N/S. However, no significant interaction nor increase in R^2 was found meaning there was no support for Hypothesis 8b.

The test of Non-STEM Hypothesis 9b: Hypothesis 9b proposed that the greater the level of colleague participation in commercialisation activities, the more positive an academic’s intention to participate in engagement activities. The results presented in

table 61 (Model 12) show that the level of colleague participation in commercialisation activities in their work group leads to positive but not significant effect on an academic's intention to participate in engagement activities $\beta=.08$, p. N/S, meaning there was no support for Hypothesis 9b.

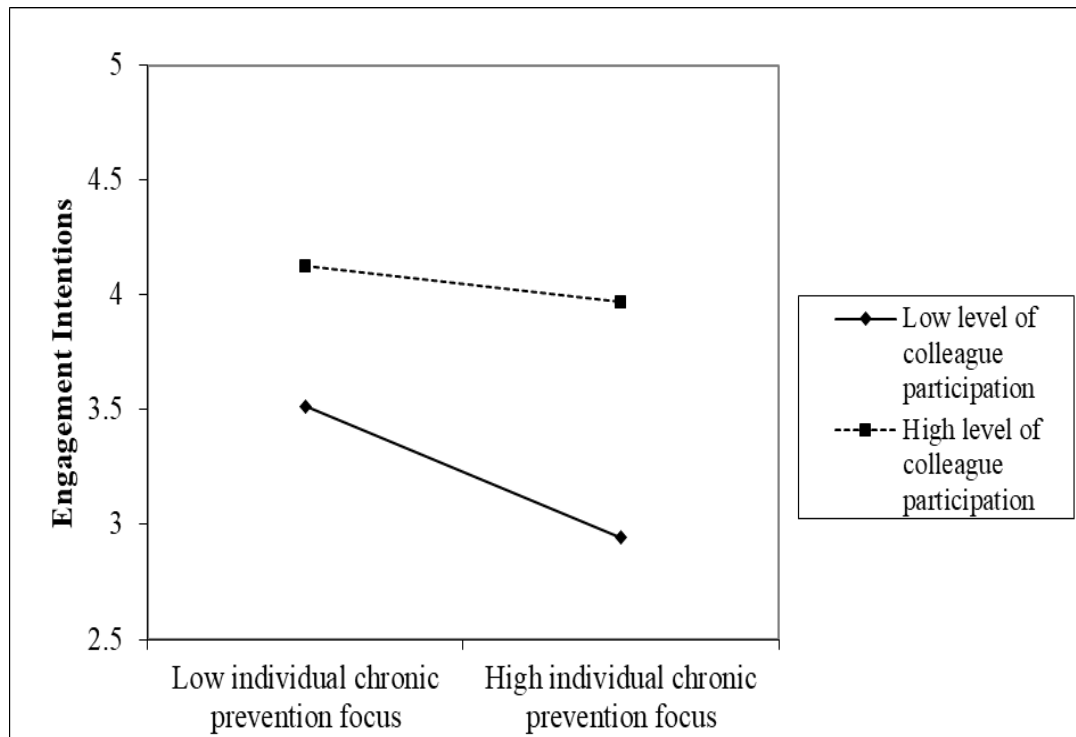
The test of Non-STEM Hypothesis 10b: Hypothesis 10b proposed that the greater the level of colleague participation in engagement activities in their work group, the more positive an academic's intention to participate in engagement activities. The results presented in table 61 (Model 12) show that the level of colleague participation in engagement activities leads to positive and significant effect on an academic's intention to participate in engagement activities $\beta=.27$ $p<0.001$ and on its own accounted for an R^2 change of .081, $p<0.001$ of Model 12's increase over the base line model (Model 9). The result provides strong support for Hypothesis 10b.

The test of Non-STEM Hypothesis 11b: Hypothesis 11b proposed that the greater the level of colleague participation in engagement activities in their work group, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities. Model 13 shows there is a negative and non-significant relationship between level of colleague participation in engagement activities x individual chronic promotion focus in relation to an academic's intention to participate in engagement activities, meaning Hypothesis 11b was not supported.

The test of Non-STEM Hypothesis 12b: Hypothesis 12b proposed that the greater the level of colleague participation in engagement activities in their work group, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities. Model 13 shows that the level of colleague participation in engagement activities x individual chronic prevention focus interaction was positive $\beta= 0.06$, p. N/S but not significant when predicting engagement intentions. Simple slope analysis was conducted as a further robustness check. The

simple slopes analysis (Figure 27) reveals that for low individual prevention focus (one standard deviation below the mean) the simple slope was negative $-.241$ ($p < .001$) and for high individual chronic prevention focus (one standard deviation above the mean) the gradient of the simple slope $-.083$ (p . N/S).

Figure 27. Interaction Diagram Showing the Interaction between Individual Chronic Prevention Focus and Level of Colleague Participation in Engagement Activities on Engagement Intentions



Hypotheses 13a and 14a represent the final part of the conceptual model which seeks to understand if a leader’s regulatory orientation determines the level of colleague participation in commercialisation and engagement activities within their group. In order to determine if the leader’s regulatory focus influenced the level of interaction, a regression analysis was conducted and the level of colleague participation in engagement activities within their work group as the dependent variable (Table 62).

Table 62. Leader Regulatory Focus and the Level of Colleague Participation in Engagement Activities

Control variables	
Gender (Male = 1)	-.04
Age	.01
Employment status (Tenured = 1)	-.01
Academic rank	-.02
Research type (Applied = 1)	.13*
Prior entrepreneurial experience (Yes = 1)	-.04
Research intensive university	.03
Management responsibility (Yes = 1)	.12*
Resources for innovation	.15**
Leader promotion focus	.11*
Leader prevention focus	-.07
R ²	.097

The test of Non-STEM Hypothesis 13b: Hypothesis 13b proposed that the more promotion-focused a leader's behaviour is perceived to be, the higher the level of participation in engagement activities in their work group. Again, the results presented in table 62 show that leader promotion focus had a positive and significant effect on the level of colleague participation in engagement activities within their work groups $\beta=.11$, $p<0.05$. The result thus provides support for Hypothesis 13b.

The test of Non-STEM Hypothesis 14b: Hypothesis 14b proposed that proposed that the more promotion-focused a leader's behaviour is perceived to be, the weaker the level of participation in engagement activities in their work group. The results presented in table 62 show that leader prevention focus had a negative but not significant effect on the level of colleague participation in engagement activities within their work groups, meaning Hypothesis 14b was not supported.

The results of the hypotheses set out above are summarised in Table 63 and significant Non-STEM study findings are summarised in the following discussion.

Table 63. Summary of Non-STEM Academics Commercialisation and Engagement Hypotheses

No.	Hypothesis	Supported/Not supported
Individual Chronic Regulatory Focus		
1a	The stronger an academic's chronic promotion focus, the stronger their intention to participate in commercial activities	Supported
2a	The stronger an academic's chronic prevention focus, the weaker their intention to participate in commercial activities	Not supported
1b	The stronger an academic's chronic promotion focus, the stronger their intention to participate in engagement activities	Supported
2b	The stronger an academic's chronic prevention focus, the weaker their intention to participate in engagement activities	Supported
Leader Regulatory Focus		
3a	The more promotion-focused a leader's behaviour is perceived to be, the more positive an academics intention to participate in commercialisation activities.	Not supported
4a	The more prevention-focused a leader's behaviour is perceived to be, the more negative an academics intention to participate in commercialisation activities.	Not supported
3b	The more promotion-focused a leader's behaviour is perceived to be, the more positive an academics intention to participate in engagement activities.	Supported
4b	The more prevention-focused a leader's behaviour is perceived to be, the more negative an academics intention to participate in engagement activities.	Not supported
Leader Regulatory Focus x Individual Chronic Regulatory Focus Interactions		
5a	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.	Not supported

6a	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities	Not supported
7a	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.	Supported
8a	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities.	Not supported
5b	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.	Not Supported
6b	The stronger the leader's promotion focus, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.	Not supported
7b	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.	Supported
8b	The stronger the leader's prevention focus, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.	No supported
Level of colleague participation in commercialisation and engagement activities		
9a	The greater the level of colleague commercialisation participation, the more positive an academics intention to participate in commercialisation activities.	Supported
10a	The greater the level of colleague participation in engagement activities within their work group, the more positive an academics intention to participate in commercialisation activities.	Not supported
9b	The greater the level of colleague commercialisation participation, the more positive an academics intention to participate in engagement activities.	Not supported
10b	The greater the level of colleague participation in engagement activities within their work group, the more positive an academics intention to participate in engagement activities.	Supported

**Level of colleague participation in commercialisation and engagement activities
x Individual Chronic Regulatory Focus Interactions**

11a	The greater the level of colleague participation in commercialisation activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in commercialisation activities.	Not supported*
12a	The greater the level of colleague participation in commercialisation activities, the more negative the relationship between the individual's chronic prevention focus and their intention to participate in commercialisation activities.	Not supported
11b	The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic promotion focus and their intention to participate in engagement activities.	Not supported
12b	The greater the level of colleague participation in engagement activities, the more positive the relationship between the individual's chronic prevention focus and their intention to participate in engagement activities.	Not supported*

Leader regulatory focus and work group commercialisation and engagement levels

13a	The more promotion focused the leader's behaviour is perceived to be, the higher the level of commercialisation participation in their work group.	Supported
14a	The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague commercialisation participation in their work group.	Not supported
13b	The more promotion focused the leader's behaviour is perceived to be, the higher the level of colleague participation in engagement activities in their work group.	Supported
14b	The more prevention focused the leader's behaviour is perceived to be, the lower the level of colleague participation in engagement activities in their work group.	Not supported

7.7 Summary of Non-STEM findings

In the following section the three main themes will be summarised from the non-STEM survey, firstly the implications of an individual's chronic regulatory orientation has on their intentions of participating in commercialisation and engagement activities; secondly, the findings suggest that leaders are capable of having both direct and indirect effects on their subordinates intentions towards participating in commercialisation and engagement activities; thirdly, their work group colleagues also have the capacity to directly and indirectly alter an academics intention to participate in commercialisation and engagement activities.

The table below (Table 64) sets out the directionality and significance levels in relation to non-STEM academics chronic regulatory focus and non-STEM academics' commercialisation and engagement intentions.

Table 64. Directionality and Significance Levels in Relation to Non-STEM Academics Chronic Regulatory Focus and Non-STEM Academics' Commercialisation and Engagement Intentions.

	Commercialisation Intentions	Engagement Intentions
Chronic Promotion Focus	+**	+***
Chronic Prevention Focus	+	-**

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

Firstly, in relation to commercialisation activities, non-STEM academics high in chronic promotion focus are most likely to display strong commercialisation intentions (Hypothesis 1a). When academic intentions to participate in engagement activities based on their regulatory focus are considered, non-STEM academics who are high in chronic promotion focus are also most likely to display strong intentions to participate in engagement activities (Hypothesis 1b). The results also identified that the stronger an

individual's chronic prevention focus, the lower non-STEM academics intentions are to participate in engagement activities (Hypothesis 2b).

Turning next to the first of the situational factors, their leader's behaviour and how this can potentially direct or indirectly effect an academic's motivation and thus their intention to participate in commercialisation and engagement activities is considered. Firstly, the direct effects of leader regulatory focus (Models 3 & 10) on an academic's commercialisation intentions are set out in table 65 below.

Table 65. Leaders Regulatory Focus Effects on Non-STEM Academics' Commercialisation and Engagement Intentions.

	Commercialisation Intentions	Engagement Intentions
Leader Promotion Focus	+	+ **
Leader Prevention Focus	+	-

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

The direction of the relationships show that promotion focused leaders lead to increased intentions to participate in commercialisation and engagement activities, whilst prevention focused leaders lead to negative intentions to participate in commercialisation and engagement activities. However, only one of the direct effect (Hypothesis 3b) indicated that there is a significant and positive direct effect for the leader's promotion focus over and above the individual's chronic regulatory focus which strengthens non-STEM academics' intention to participate in engagement activities. This finding suggests that leaders who are high in promotion elicit increases in non-STEM academics' intention to participate in engagement activities.

Turning next to the leader and individual regulatory focus interactions and whether these interactions have the potential to affect STEM academics entrepreneurial intentions. The findings from models 4 and 11 are summarised in the table 66 below.

Table 66. Leader and Individual Regulatory Focus Interactions and Effects of Interactions on STEM Academics Entrepreneurial Intentions

Interaction	Commercialisation Intentions	Engagement Intentions
Leader promotion focus x individual chronic promotion focus	+	-
Leader promotion focus x individual chronic prevention focus	-	-
Leader prevention focus x individual chronic promotion focus	- ***	- *
Leader prevention focus x individual chronic prevention focus	-	-

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

The summary table shows a significant negative interaction between leader prevention focus and non-STEM academic’s chronic promotion focus for participation in both commercialisation and engagement activities. The results of the leader prevention focus x individual chronic promotion focus (Model 4) show a significant and negative interaction which reduces a chronic promotion focused academic’s intention to participate in commercialisation activities (Hypothesis 7a), the impact of this interaction is displayed in the simple slope analysis (Figure 24). Likewise, the results of the leader prevention focus x individual chronic promotion focus (Model 11) found a negative and significant interaction which moderates chronic promotion focused non-STEM academics’ intention to participate in engagement activities (Hypothesis 7b). the impact of this interaction is displayed in the simple slope analysis (Figure 26).

The next direct situational factor examined is non-STEM academics’ work group colleagues’ behaviour, in relation to the level of participation in commercialisation and engagement activities, and whether this can direct or indirectly effect an academic’s

motivation and thus their intention to participate in commercialisation and engagement activities. Table 67 below summarises the results.

Table 67. Non-STEM Academics’ Colleagues’ Behaviour and Direct or Indirect Effects of an Academic’s Intention to Participate in Commercialisation and Engagement Activities

	Commercialisation Intentions	Engagement Intentions
Level of colleague participation in commercialisation activities	+ ^{***}	+
Level of colleague participation in engagement activities	-	+ ^{***}

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

It can be seen from the table that there is a significant and positive direct effect for the level of colleague participation in commercialisation activities within their work group which has a positive and significant effect on non-STEM academic’s commercialisation intentions (Hypothesis 9a). Interestingly the level of colleague participation in engagement activities in their work group has no impact at all on an academic’s commercialisation intentions. In terms of the level of colleague participation in engagement activities within an academic’s work group, the results of the regression analysis table x (Model 12) show that this is a significant predictor of a non-STEM academic intention to participate in engagement activities (Hypothesis 10b). Again, it is interesting to note that the level of commercialisation participation within an academic’s work group has no bearing on an academic’s intention to participate in engagement activities.

The interaction between the level of colleague participation in commercialisation and engagement activities in a non-STEM academic’s work group and their individual chronic regulatory focus is presented in the table below (Table 68).

Table 68. Interaction Between the Level of Colleague Participation in Commercialisation and Engagement Activities in a Non-STEM Academic’s Work Group and their Individual Chronic Regulatory Focus

Interaction	Commercialisation Intentions	Engagement Intentions
Level of colleague participation in commercialisation activities x individual chronic promotion focus	+	-
Level of colleague participation in engagement activities x individual chronic prevention focus	+	+

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

We can see from Table x (Model 6) that all the interactions are not significant at <p0.05 or below. However, Hypothesis 12b proposed that the greater the level of colleague participation in engagement activities in their work group, the more positive the relationship between the individual’s chronic prevention focus and their intention to participate in engagement activities. Model 13 shows that the level of colleague participation in engagement activities x individual chronic prevention focus interaction was positive $\beta= 0.06$, p. but was only significant at p<0.10 when predicting non-STEM academics intentions to participate in engagement activities. Simple slope analysis was conducted as a further robustness check. The results of the simple slope analysis (Figure 27) suggest that a moderating effect is actually present, which increases individuals high in chronic prevention focus intentions to participate in engagement activities particularly when the level of colleague participation in engagement activities in their work group is high (one standard deviation above the mean).

Finally, hypothesis 13 and 14 sought to understand if the leader’s regulatory orientation could affect the level of group participation in entrepreneurial activities. The results of the regression analysis (Table 69) show that promotion focused leaders have a significant and positive effect on the level of participation in work groups for both

commercialisation (Hypothesis 13a) and engagement (Hypothesis 13b) activities their subordinates within their respective work groups.

Table 69. leader’s regulatory orientation and the effects on Non-STEM Academics Participation in Entrepreneurial Activities

	Commercialisation Activity Levels	Engagement Activity Levels
Leader promotion focus	+ **	+ *
Leader prevention focus	-	-

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

The results show that promotion focused leaders have a significant and positive effect on the participation levels in commercialisation activities (Hypothesis 13a) and engagement activities (Hypothesis 13b) within their work groups. Prevention focused leaders on the other hand have a negative but not significant effect on the level of participation in commercialisation and engagement activities within their respective work groups.

7.8 Control Variable Results

When viewed in isolation (Model 1 and Model 9) we find that some control variables can predict commercialisation and engagement intentions of non-STEM academics. Again, in common with the findings in chapters 5 & 6 and the wider literature, male academics working in non-STEM disciplines are more likely than their female colleagues to display greater intentions to participate in commercialisation activities. However, the results of this study in relation to intention to participate in engagement activities within the non-STEM disciplines suggest that there is no significant difference between males and females and their intentions to participate in engagement activities. In relation to age, the findings of this study suggest that academics who are slightly younger than the average of the survey respondents were

significantly more likely to develop stronger intentions to participate in commercialisation activities. The results from academics working in non-STEM disciplines suggest that while there no significant difference between academics who are on fixed term contracts to those who are tenured and their intention to participate in engagement or commercialisation activities. Academics who have an applied research focus rather than a basic research focus were found to be significantly more likely to display strong intentions to participate in both commercialisation and engagement activities. The results of the non-STEM findings found that individuals who have prior entrepreneurial experience were significantly more likely to display strong intentions in commercialisation activities and this remained the case throughout the multi-level analysis. However, in relation to engagement intentions once the individuals regulatory focus and the contextual factors were included in the multi-level analysis the initial significant relationship identified disappeared. Finally, those individuals in academia who self-reported that they have management responsibilities were also most likely to display strong intention to participate in commercialisation and engagement activities.

The following chapter, the discussion, will bring together the findings of the different stages of this study by drawing on the both the academic entrepreneurship and wider entrepreneurship literature, regulatory focus theory and will also consider the wider implications for our understanding of the motivational factors in relation to the wider Scottish academic population and academics working in STEM and non-STEM disciplines and local contextual factors, leaders and colleagues, and how they affect academics' intentions to participate in commercialisation and engagement activities.

Chapter 8 Discussion and Conclusion

8.1 Introduction

This chapter presents a synthesis of the previous empirical studies and discussion in the relation to the main research aim and objectives of the thesis. One of the main issues identified in the literature review is that there is currently a lack of understanding in relation to how individual participation in entrepreneurial activities, are affected by their organisational and institutional contexts. The first section therefore considers the individual and contextual factors that may influence academic participation in commercialisation and engagement activities. The second section will address the contextual factors identified and whether they can directly or indirectly affect academics' entrepreneurial intentions. One of the main outcomes of the literature review is that academic entrepreneurship should be studied as a multi-level phenomenon. It may be determined by both the characteristics of individuals and their context, this section will consider this in relation to the whole Scottish academic population intentions to participate in engagement and commercialisation activities. The third section will discuss whether these individual and contextual factors impact academics working in STEM and non-STEM disciplines differently. This objective is in relation to the call that prior research has tended to focus on commercialisation activities and on those academics, who work in STEM related disciplines. However, more recent research has identified that academics are participating not only more frequently in engagement activities (compared to commercialisation activities), but many academics who are actively participating in entrepreneurial activities are working in non-STEM disciplines and there is a need for increased understanding of these factors. An evaluation of the conceptual model developed, implications for practice are discussed, limitations are identified and areas for future research are considered. The chapter concludes with a discussion of the overarching aim of the thesis, the usefulness of the model created within this thesis and the main contributions to knowledge.

8.2 Individual and Contextual Factors

The first section will address the first research objective of the thesis:

Objective 1: *To consider the individual and contextual factors that influence academic participation in entrepreneurial activities.*

This objective was designed to consider not only an academic's motives and key factors that impact their intention to participate in commercialisation (more uncertain outcomes; spin-offs / licensing) and/or engagement (more certain outcomes; consulting/ contracting/ collaboration/ professional development) activities within the Scottish university context, but also to explore if certain factors in their institutional and/or organisational contexts had the potential to affect their motivation and subsequent intentions. Within the entrepreneurship literature, context has been identified as being important for understanding "when, how, and why entrepreneurship happens and who becomes involved" (Welter 2011, p.166). This objective was therefore introduced, given the lack of knowledge which seeks to understand how institutional and/or organisational contextual factors directly or indirectly affect individual academic participation in academic entrepreneurship activities (e.g. Rasmussen, Mosey and Wright, 2014; Perkmann, et al., 2013; Tartari et al. 2014; Bercovitz & Feldman 2008; Johnson et al. 2017). As a result, this exercise helped with the identification of key individual and contextual factors that impact academic participation in entrepreneurial activities, allowing for a multi-level conceptual model to be developed and tested quantitatively in a larger sample in objectives two and three of the thesis.

In this section, the findings in relation to the individual and contextual factors which may impact participation in commercialisation and/or engagement activities in Scottish universities are discussed. The section commences with a discussion of the key individual factors identified in the qualitative study and how they positively or negatively affect academic participation in commercialisation and/or engagement activities.

8.2.1 Individual Academics

Within the extant literature, Perkmann et al., (2013) indicate that participation in both commercialisation and engagement activities tends to be individually driven and pursued on a discretionary basis. Therefore, universities are highly reliant on motivated academics to achieve their organisational goals. The section that follows explores the findings, in relation to an academic's motives and the perceived risks of academic participating in commercialisation and/or engagement activities.

8.2.1.1 Individual Motives

When considering academic motives, the findings relating to the individual benefits of participating in commercialisation and/or engagement activities are broadly in line with other authors (e.g. Lam 2011; Hayter 2011). In particular, the main motivations identified were related to promotion focused values, where academic motives to participate in entrepreneurial activities were related to self-direction (autonomy) and the fact that they found participation in entrepreneurial activities stimulating. Some academics were primarily concerned with generating the financial resources they required, in order to reduce their reliance on traditional research funding (D'Este & Perkmann 2010) and to also provide them with the autonomy to allocate resources at their personal discretion. These additional resources allowed them to employ academics or researchers, to conduct research in areas that they were interested in which increased their and their research groups reputation. Personal financial gain, in line with the extant literature (Lam 2011; Baldini et al. 2007), was not deemed to be an important motivating factor, as to whether academics participated in commercialisation and/or engagement activities. Core concepts of academic identity include academic freedom and autonomy (Drennan et al. 2017; Jain, George and Maltarich, 2009). The implications of these findings for university senior management teams relates to the development of university reward policies. University senior management teams need to consider that there are a mix of individual motives when developing reward schemes for

academic participation in commercialisation and/or engagement activities and these motives include academic freedom and autonomy. The quantitative analyses within this thesis have consistently found that promotion focused academics are most likely to display strong intentions towards participating in commercialisation and/or engagement activities. For maximum effectiveness, university reward schemes should be aligned with promotion-based values which include self-direction (autonomy), stimulation and achievement.

8.2.1.2 Risk of Participating in Entrepreneurial Activities

The risk involved in participating in academic entrepreneurship was a key factor to emerge from the qualitative study. With the introduction of outcome agreements, academia is becoming more target driven. The feelings of risk or doubt that academics experience when considering participating (or not) in entrepreneurial activities may manifest themselves through where academics perceive themselves to be in relation to particular benchmarks – their core academic targets (e.g. publications, grant success, teaching quality etc.). To achieve recognition and promotion, academics typically identified that they have to allocate a great deal of attention towards traditional academic activities, particularly outputs from publications and income from grant writing. It was also perceived by some academics that participation in commercialisation activities requires a fundamentally different skill set compared to the skills that are required to undertake core activities such as teaching, grant writing and publishing journal articles (D’Este & Patel, 2007) and this can increase their feelings in relation to perceptions of risk or uncertainty, when considering whether to participate in commercialisation and/or engagement activities. These findings are in line with the extant literature suggesting that considerable tensions still exist between balancing academic entrepreneurship and traditional academic activities (Ambos et al. 2008; Philpott et al. 2011). This would suggest that the situation regarding these tensions has largely not improved in the last decade and remains an issue in the development academic entrepreneurship. For the majority of academics, it is unlikely that entrepreneurship forms a core part of their

professional identity. By asking academics to behave in this manner, University leaders are asking academics to embrace a role that is not aligned with their perceptions of their academic role.

Senior university managers acknowledged they are highly reliant on individual academics identifying and exploiting commercialisation and/or engagement opportunities, in order for them to hit their entrepreneurial targets within the outcome agreements. The findings from the qualitative study suggest that participating in commercialisation and engagement activities still requires the academic concerned to exercise judgment as to the risks involved and what activities, amongst a range of alternatives, are most likely to be valued and rewarded.

As academics are expected by university leaders to excel in core activities such as teaching, grant writing and publishing journal articles (D'Este & Patel, 2007) they in turn need to allocate a significant level of attention towards excelling in these core activities, leaving limited time for other activities. Therefore, in addition to the role incongruence mentioned above, there are resource and cognitive limitations. As all individuals have limited attentional capacity (Gifford, 2010; Kahneman et al., 1992; Simon, 1947), this concept is perhaps an important factor in understanding who is likely to act entrepreneurially in academia. The qualitative study revealed that the costs or risks associated with academics allocating a significant level of their limited attentional capacity through participating in commercialisation and/or engagement activities, can have a negative effect on academic careers. This thesis contributes to academic entrepreneurship literature on risk and uncertainty by drawing on the concept of limited attention in relation to 'juggling the many academic plates' (Gifford, 2010), in order to explain why some academics are more or less motivated to exploit their research or knowledge through participating in commercialisation and/or engagement activities. McMullen and Shepherd (2006) suggest that when individuals experience feelings in relation to perceptions of risk or uncertainty, this creates a sense of doubt for the individual. Academics will vary significantly in their motivation to take entrepreneurial action (D'Este & Patel, 2007; Hayter, 2011; Lam, 2011; Perkmann et al, 2013) and this may be because of this sense of doubt. Despite these risks being clear, the quantitative

analysis herein shows that the stronger an academics chronic promotion focus, the more they are prepared to allocate a greater level of their limited attention towards participating in commercialisation and/or engagement activities and in turn display stronger entrepreneurial motives. This occurs even though there are likely to be many other demands upon on their attention, in the guise of other academic plates that need to be kept spinning. In turn, this is likely to affect their motivation to participate in some of these other core activities. On the other hand, the stronger an academics chronic prevention focus, the less they are prepared to allocate their attention towards participating in commercialisation and/or engagement activities and in turn display weaker entrepreneurial motives.

Universities need to recognise to a greater extent that participating in commercialisation and engagement activities often requires academics to allocate a significant level of their attentional capacity towards satisfying the demands of the external organisations they are working with. Academics who choose to exchange their knowledge or inventions have to work with external partners. These partners operate in a very different environment, where results and financial returns are important, information can often be proprietary which may limit opportunities for publication, and they expect academic experts to resolve their problems at short notice. In order to alleviate doubts about participating with external partners, academics need to be confident they are able to participate without being unduly penalised and that their participation is valued. Universities could address this issue by providing academics who generate income above a certain amount of money, or spend a given number of hours with external partners, reduced publication targets, dedicated entrepreneurial allowances in their annual activity plans, and academic promotions. This would send a signal to other academics that participation in entrepreneurial activities is valued by their institutions.

8.2.2 Institutional Factors

This section offers a discussion of the institutional contexts in which academic entrepreneurship takes place.

8.2.2.1 Change in Government Policy

To date, few studies have investigated the policy instruments governments use to improve entrepreneurial outputs from universities (Hossinger et al., 2019). A key point to emerge from the qualitative study with Senior Management was the impact the shift in Scottish government policy, through their introduction of the outcome agreements, was clearly having on Scottish universities. There was evidence from the interviews with the university senior managers that the Scottish government's 'push' that universities increase their revenues from commercialisation and engagement has led to a greater focus, as to how they encourage academics to participate in entrepreneurial activities. This in turn means holding universities accountable against measurable outputs, in relation to the activities set out in the academic entrepreneurship spectrum. This minimises the level of funding the Scottish government is required to provide to Scottish universities and increases the level of knowledge that is transferred from universities into the regional and wider economy (Chapple et al. 2005). Scottish universities are now clearly being pushed into embracing the third mission of contributing to regional and economic development in addition to teaching and research, as defined by Etzkowitz et al. (2000). While this governmental policy change is intended to have several outcomes, these only appear to affect universities and not individual academics, directly. There was no evidence from the interviewees within this thesis that over-arching policy changes impact an academic's motivation to participate in commercialisation and engagement activities. There appears to be a disconnect between higher level policy and what academics feel their role entails. The previously mentioned concepts of academic freedom and autonomy may go some way to explaining this result.

8.2.2.2 Academic Discipline

It has been acknowledged by researchers that there has been a paucity of research seeking to understand the level of academic involvement in commercialisation and engagement activities, across different academic disciplines (Abreu & Grinevich 2013; Perkmann et al., 2013). Scholarly discipline is an important variable when considering academic entrepreneurship, as opportunities to participate in commercialisation and engagement activities vary across disciplines (Wright et al., 2004; Hughes & Kitson, 2012). In line with extant work (e.g. Laukkanen, 2003; Abreu & Grenivich, 2014), a number of interviewees in STEM related disciplines indicated that they were regularly participating in either commercialisation and/or engagement activities and a small number of the interviewees discussed they have participated in all the activities across the academic entrepreneurial spectrum, as set out in Figure 8. However, a lack of analysis of academics participating in engagement and commercialisation activities beyond the STEM disciplines has led to an absence of data on the participation of academics who work in non-STEM disciplines (Hughes & Kitson, 2012; Abreu & Grinevich, 2013). The evidence from the qualitative study indicated that a number of the academics interviewed, working in non-STEM disciplines, had been involved in different forms of commercialisation and engagement activities. Similar to the findings of other researchers (Grimaldi et al., 2011; Abreu & Grenivich, 2014), the results of the interviews suggest that academics participating in commercialisation activities, is also becoming more common in non-STEM disciplines. In line with more recent literature, a number of interviewees working in non-STEM disciplines (e.g. Arts, Social, and Health Science) indicated that they were either in the process of starting up a company, or were actively exploring using digital technologies, in order to start businesses based on their research and knowledge. Researchers need to keep pace with such developments and it is therefore important to also understand the contextual and individual factors of academics working in non-STEM disciplines. Hughes & Kitson's (2012) UK wide study found that 65.7% of their respondents who had participated in entrepreneurial activities, were not working in STEM related disciplines and these make up the majority of the

academic population. In the quantitative studies, relating to objective 3, there were no differences at the individual level between promotion and prevention focussed individuals working in STEM and non-STEM disciplines, in their entrepreneurial intentions. One of the contributions of this thesis is the exploration and analysis of non-STEM academic entrepreneurial intentions and behaviours. University management teams need to be aware that their messaging should not be solely, or disproportionately, focussed on exploiting STEM related knowledge.

8.2.3 Organisational Level Factors

As identified in the literature review, the organisational context can also affect academics' intentions to participate in academic entrepreneurship. These can be examined through understanding the wider organisational context. This includes university type and the level of resources that an institution is willing to allocate to support innovation and academic entrepreneurship and they can also be examined against the local context in which an academic works. Findings from the qualitative study, in relation to both wider context and local context and the impact that they may have on academic participating in commercialisation and engagement activities, will be discussed in the following sections.

8.2.3.1 The Wider Organisational Context

In relation to the wider organisational context, there was evidence from the qualitative study that the Scottish government's push in implementing outcome agreements is resulting in university senior management teams placing much greater emphasis, as to how their academics can participate in entrepreneurship activities, with a view to generating measurable outputs. As a result, thinking in relation to academic entrepreneurship has shifted and this has led to the development and implementation of new strategies throughout Scottish universities. In turn, this has led to universities moving from a laissez-faire attitude towards academic entrepreneurship, to senior

management teams creating dedicated strategies in a real attempt to increase the level of entrepreneurial outputs within their organisations.

Within their respective institutions, senior managers recognised that there was now a need for not only increased levels of participation in commercialisation and engagement activities but also increased research, teaching and economic benefits that can result from increased levels of academic participation throughout their organisations. All the senior managers acknowledged that a greater level of university funding needed to come from academic participation in commercialisation and engagement activities and that the ability to win research council funding had become increasingly difficult, which is in line with findings by Gulbrandsen and Smeby (2005). There was no mention of how this change in focus has been explored with line managers or what academics think of participating in entrepreneurship. The strategies for enabling these activities are discussed in the following sections.

8.2.3.2 Allocation of Resources

The allocation of scarce resources within universities was identified as an important factor in relation to academics participating across commercialisation and/or engagement activities. The mature universities (pre-1992) have established reputations with industry, and funding councils. They tend to have greater level of resources to draw upon and are more likely to be committed to supporting academic participation right across the academic entrepreneurship spectrum, in an effort to both maximise their returns and fulfil their obligations in the outcome agreements. Evidence from the younger university, despite having spun out a company before, was that they were less prepared to support blue-sky research and had found the process of spinning out a company difficult. They had also been disappointed with the return on investment when considering the level of resource required for these ventures and were focusing on increasing academic participation in engagement activities.

This can be viewed as a lower risk strategy, with the return on investment agreed in advance and it additionally provides them with the opportunity to enhance their

reputation with industry partners. As a result, decisions to spin-out a company, in an attempt to increase future revenue streams, may not now be considered as the best allocation of limited resources, when viewed across a wider portfolio of academic entrepreneurship activities. This is particularly evident when the opportunities to participate in engagement activities with external partners are considered, as they are more frequent, require lower resource allocation and have the potential to generate economic impacts for all parties over a relatively short period. As a result, this may well lead the senior management within universities to concentrate on developing strategies that have a greater focus towards increasing academic participation in lower risk engagement activities. One key benefit of adopting this type of strategy is that because engagement activities are largely aligned with core academic skills of research and teaching (i.e. CPD, Contract or Collaborative Research), a much greater level of the academic population is likely to be more comfortable with participating in these activities. In addition, the income available per year from successful participation in engagement activities, as shown in the HE-BCI survey figures, is multiple times the return of the investment in commercialisation activities (D'Este & Patel, 2008).

The mature universities in the sample who discussed that they had historically encouraged widespread academic participation in commercialisation, are now shifting their commercialisation strategies to limit the number of companies being spun out of universities. Institutions therefore are now focusing on fewer, but 'higher value' opportunities, and are collaborating with venture capitalists who have the expertise to evaluate the commercialisation opportunities and to also provide additional external investment. As a result of these changing strategies, the number of companies being spun-out of universities is falling. This finding is supported by the HE-BCI survey data in figure 2 which shows a steady decline in the number of university spin-outs over the past five years. It was also suggested that universities have found that many academics do not have the business acumen to develop successful spin-out companies. Instead universities are now often encouraging the academic's whose knowledge and research underpinned the IP, to remain within the university and take technical or advisory roles in the new business, as they are often not the best people to grow the businesses. In

addition to universities now backing fewer but higher value opportunities, universities need to be aware that these strategies are likely to lead to considerably fewer role models, who are an important cog in the commercialisation process within university departments, as they have knowledge of the commercialisation process (Huyghe & Knockaert, 2015; Bercovitz & Feldman, 2008; Tartari et al., 2014, Rasmussen, Mosey & Wright, 2014).

8.2.4 Local Contextual Factors

While the universities have developed strategies, along with mission and vision statements, in relation to academic entrepreneurship, it is still the case that the majority of academics struggle to see how this is relevant to them, or don't wish to have strategies that may limit academic freedom and autonomy imposed on them. The findings from the qualitative study indicate that the messages from senior management, in relation to the need for increased participation in academic entrepreneurship, tend not to filter down to the academic's local context. This in turn has the potential to limit the level of academic entrepreneurship in their organisations, as many academics are likely to be unaware that outcome agreements in relation to academic entrepreneurship exist or are relevant to them.

A major factor to emerge in the wider adoption of commercialisation and engagement activities was that academic leaders (line-managers) within their organisations were key to the adoption and execution of any new strategy. Academic leaders were viewed as important, because they not only set the tone but also help create the environment where the academics work. These findings suggest that it is the local context, the departments and research groups, where the academics work which is a major factor in whether academics participated in commercialisation activities or not, as opposed to factors in the wider organisational context. These findings suggested that a deeper consideration of the local context and the identification of the key factors that may affect academic participation in commercialisation and/or engagement activities is required. This is discussed in the following section.

8.2.4.1 The Local Context

The results of the qualitative study suggested that two key factors have the potential to impact, either directly or indirectly, on an academic's commercialisation and/or engagement intentions. These are the line manager (academic leader) and colleagues who work in the academic's local context. Limited extant research has previously suggested that the local context may impact an academic's motivation to participate in commercialisation and/or engagement activities (Bercovitz & Feldman, 2008; Stuart & Ding, 2006; Tartari et al., 2014; Rasmussen, Mosey & Wright, 2014). The following section will firstly discuss the impact academic leaders have on academics and then the impact of their work group colleagues, on an academic's motivation to participate in commercialisation and/or engagement activities.

8.2.4.2 Academic Leader's and Work Group Culture

The academic leader was found to be an important factor as to whether academics participated in commercialisation and/or engagement activities or not. With the introduction of Scottish governmental outcome agreements, it could be argued that academia is becoming more target driven. It was identified that academic leaders are exerting considerably more influence over where academics within their respective work groups focus their attention. Universities now need to meet an increased number of targets and the findings of this study have shown that academic leaders may be limiting their subordinates' academic freedom, in order to meet targets that are important to themselves.

The evidence from the qualitative study identified two distinct cultures that had developed within academic work groups. Academic leaders typically fall in to two main groups, those who have historically embraced academic entrepreneurship and those who focus upon more traditional academic outputs. Those leaders who have already embraced academic entrepreneurship had developed hybrid 'traditional academic and entrepreneurial cultures' within their groups. Academic participation in

commercialisation and engagement activities was viewed as an important and valued way of generating additional income, while increasing reputation with industry, in addition to focusing on traditional core academic outputs. Conversely, the other group of academic leaders indicated that while they may be willing to allow some of their academics to participate in the less uncertain engagement activities, they still had a very strong focus on maintaining a more 'traditional academic' culture, within their work groups. They stressed that their academics were expected to allocate a significant level of attention towards grant writing, writing papers for publication and teaching excellence and that they should primarily continue to focus on these areas. This suggests that academic leaders have the capacity to act as attention directors (Simon, 1947), and have the ability to shift an academic's attention towards (Bercovitz & Feldman, 2008; Rasmussen, Mosey & Wright, 2014), or away from, participating in differing academic entrepreneurial activities.

Academic leaders are often concerned with excelling in their core academic activities whilst attempting to bridge the funding gap through winning grant applications, or via entrepreneurial endeavours. This will result in leaders having differing motivations and affects the strategies they adopt. As a result, leaders within academia are likely to experience self-regulatory states of eagerness or vigilance (Higgins, 2002), in differing intensities. This results in leaders eliciting different behaviours, when they consider subordinate participation in commercialisation and/or engagement activities which should be apparent to the academics in their work groups.

The results of both the qualitative and quantitative studies both highlight the important role that academic leaders play in the adoption of entrepreneurial activities within their work groups. As a result, university senior management teams should consider involving a greater number of academic leaders as co-creators of their knowledge exchange strategies, rather than creating top-down strategies in order to increase outputs across institutions.

8.2.4.3 Academic Perceptions of their Leader's Behaviour

Theories of leadership have implied that differing leadership styles and behaviours will result in different orientations in terms of entrepreneurial thinking, risk taking and innovation (Avolio et al., 1999; Bass & Avolio, 1994). To date there has been little research that has sought to understand how academic leaders affect their subordinates (Bercovitz & Feldman, 2008). The behaviour and actions of their academic leader are important cues which can influence the motivations (regulatory focus) of those academics in their respective work groups (Brockner & Higgins, 2001), affecting an academic's willingness to participate in commercialisation and/or engagement activities. In the wider literature, Brockner & Higgins (2001) suggest that leaders, through their differing behaviours, may elicit greater or reduced levels of motivation (promotion or prevention focus) in their academics, as leaders play a major role in priming self-concepts. Observing academic leader's successfully role model participation in commercialisation and engagement activities can have a significant positive motivational impact on subordinates and can increase their confidence. This suggests that leaders can positively impact an academic's attitude towards participation in commercialisation and/or engagement activities. On the other hand, interviews revealed that some academic leaders may not have the time, skills, or knowledge to enable them to be a good entrepreneurial role model. Through encouraging academics to allocate increased or decreased attention towards or away from entrepreneurial activities, leaders, and the behaviours they exhibit, are likely to be a key factor in influencing others. As a result, they can direct individuals by projecting their vision and the subsequent benefits for both parties (Lockwood et al., 2002).

The results from the qualitative study confirm that the actions and behaviour of leaders can lead to entrepreneurially minded academics directing their attention away from entrepreneurial endeavours and instead focusing on outputs that bring them the greatest reward (i.e. meeting publication targets for the REF). The influence of academic leaders, primarily through their actions and behaviour, may actually influence academics' intentions to participate (or not) in commercialisation and/or engagement

activities, by signalling either directly or indirectly what is valued and expected (Jain et al. 2009). The influence of academic leaders identified above, on an academic's intentions to participate in commercialisation and/or engagement activities, was tested in the quantitative studies of this thesis. These studies confirmed that academic leaders have the potential (directly and/or indirectly) to have positive or negative influences on academic participation in commercialisation and/or engagement activities.

As discussed above, role modelling was found to be an important factor, but this was not limited to the leader, several interviewees also discussed the influence of peers. The following section will discuss the influence of work group colleagues (peers) on an academic's intentions to participate (or not) in commercialisation and/or engagement activities.

8.2.4.4 The Behaviour of Work Group Colleagues (Peers)

The qualitative study identified that the behaviour of work group peers was an important situational factor for academic participation in commercialisation and/or engagement activities. This is in line with the limited amount of research into this area, where it has been proposed that academics motivation to participate in commercialisation and/or engagement activities is affected by being exposed to group norms (Bercovitz & Feldman, 2011), or by individual peers working within their local environment (Tartari et al., 2014). The results of the quantitative studies confirmed that the level of colleague participation in commercialisation and/or engagement activities within their group, is an important contextual factor for academics.

The qualitative study revealed that observing a greater number of their work group colleagues participating in commercialisation and/or engagement activities, in addition to their core academic duties, acts as an important reference point. Colleague observation reinforces the legitimacy of participating in commercialisation and/or engagement activities and that group norms are important and should also be considered as a motivating factor, as to whether academics participate in entrepreneurial activities (Louis et al., 1989; Kenney & Goe, 2004; Haeussler & Colyvas, 2011; Rasmussen,

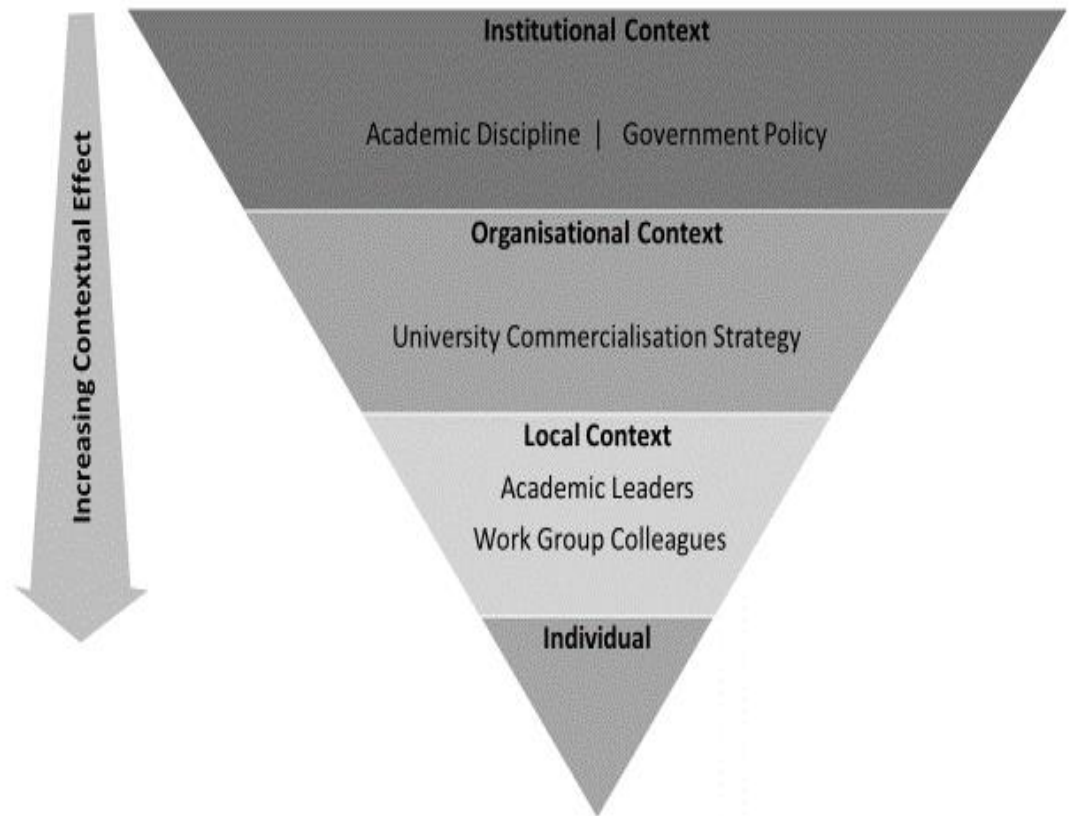
Mosey & Wright, 2014). The implication is that the higher the level of colleague participation within their work group, in commercialisation and engagement activities (two key reference points), the greater an academic's motivation to participate in these activities, through maintaining their 'group membership'. The results of the quantitative studies confirmed that the level of colleague participation in commercialisation and/or engagement activities within their group, is an extremely important contextual factor. This is in line with literature where Haeussler and Colyvas (2011) found that when an academic's colleagues value participation in certain entrepreneurial activities, then an academic is more likely to participate. Conversely, they are less likely to do so if colleagues value traditional academic activities. There has been a lack of understanding in relation to how academics respond to local norms and how these relate to different academic disciplines (Perkmann et al., 2013). The findings of this study contribute to the literature, regarding the effect work group colleagues (peers) and group norms have on academic participation in commercialisation and/or engagement activities.

8.2.5 Summary

The entrepreneurship literature has identified that researchers should pay greater attention towards the context in which entrepreneurship takes place, as researchers "have a tendency to underestimate the influence of external factors and overestimate the influence of internal or personal factors when making judgements about the behaviour of other individuals" (Gartner, 1993 p.234). This qualitative section in relation to objective 1, contributes to the existing body of literature on academic entrepreneurship. While the literature recognises that a number of contexts (institutional and organisational) have the potential to impact academic participation in commercialisation and/or engagement activities (Perkmann et al., 2013), the findings as illustrated in figure 28, suggest that it is the academics' local context that has the greatest influence on their participation in commercialisation and/or engagement activities. In relation to the contextual effects discussed above, this can be likened to Newton's theory of gravity, whereby the closer

an object is to another planet (the central point), the more powerful the gravitational force it experiences.

Figure 28. Effects of Context on the Individual



Drawing on this analogy, if an academic is the central point of academic entrepreneurship, then the influences that are closest to them, are most likely to have the strongest influence on their behaviour and actions (e.g. leaders and colleagues). The further away the influence, the weaker that effect on their behaviour and actions (e.g. organisational strategy and then government policies). This study suggests that government policies and their subsequent impact on university strategies only provides the general stimuli, in relation to increased participation in commercialisation and/or engagement activities, within universities. However, as identified in the quantitative

studies, it is a combination of individual and situational factors, leaders and work group colleagues (the attention directors) operating in an academic's local context that can ultimately focus an academic's attention and direct their motivation towards or away from participation in academic entrepreneurship. It also suggests that academia is evolving into an increasingly target driven environment which includes universities meeting a greater number of measurable outcomes. This thesis adds to the body of work that focuses on the tensions between balancing academic entrepreneurship and traditional academic activities (Ambos et al., 2008; Philpott et al., 2011). In order to understand these tensions in more detail, this thesis draws on the concept of limited attention to augment regulatory focus theory. This offers a way to explain why some academics are more or less motivated to exploit their research or knowledge through participating in commercialisation and/or engagement activities. As humans only have limited attentional capacity (Gifford, 2010; Kahneman et al., 1992), this can lead to academics experiencing feelings in relation to the risks of participating in entrepreneurial endeavours which can manifest themselves as a sense of doubt when they consider diverting their attention away from their core academic activities.

Within the academics' local context, this thesis therefore adds to the small body of literature which has studied the impact of academic leaders and colleagues on academic entrepreneurship (Bercovitz and Feldman, 2008; Stuart and Ding, 2006). As the academic leader is the controller of work group resource, this study reveals that academic leaders not only have the capacity to directly or indirectly lead to a positive impact on academic participation in commercialisation and/or engagement activities but also have the capacity to have a negative impact on academic's intentions.

The findings from the qualitative study show that to understand academic participation in commercialisation and/or engagement activities more deeply, it should include the study of appropriate contextual factors. In order to do this, a multi-level approach was used in order to understand how an academics motivation to participate in entrepreneurial activities is impacted, either directly or indirectly, or positively or negatively, through the factors identified in their local context. As a result, the findings of the qualitative study led to a testable conceptual model being developed (figure 13).

The model draws upon regulatory focus theory and adopts a multi-level perspective to assess the influence of contextual effects on an academic's entrepreneurial intentions. The model sets out that independent to an individual academic's chronic regulatory focus (individual motivations), their leader's and colleagues' behaviour can enhance or diminish an academic's intention to participate in commercialisation and/or engagement activities. The results from the quantitative study which examined the identified factors in relation to the Scottish academic population are discussed in the section that follows.

8.3 Multi-level analysis of the Scottish Academic Population

Objective two of this thesis is stated below and is addressed in the following discussion.

Objective 2: *To evaluate the identified individual and contextual factors that affect academic participation in commercialisation and engagement activities in Scottish universities.*

The purpose of this research objective was to investigate the local contextual factors identified in the qualitative study that, at the cognitive level, encourage or discourage academics to engage in more or less uncertain entrepreneurial activities across Scottish universities. Given that academia is becoming an ever-increasing resource constrained environment (Gulbrandsen & Smeby, 2005), academics are more likely than ever to have to consider taking entrepreneurial action, to increase revenues. This in turn can assist in mitigating not only reductions in traditional funding, but also the impact of Covid-19 on university/work group finances and will help support growth and innovation in national and regional economies, in the aftermath of the pandemic.

Drawing upon regulatory focus theory and adopting a multi-level perspective, a conceptual model was developed based on the findings of the qualitative study. The model was tested to determine whether independent of an individual academic's chronic regulatory focus, their leader's and colleagues' behaviour can strengthen or weaken an academic's intention to participate in commercialisation and/or engagement activities. Overall, the findings from the whole Scottish academic population support several of the

hypotheses set out in the conceptual model (Figure 13). The significant findings of the study are discussed in the following paragraphs.

It was suggested in the qualitative study that participating in academic entrepreneurship carries risks (Abreu and Grinevich, 2013) and because individuals have limited attentional capacity, their chronic regulatory orientation should explain why some academics are more or less motivated to exploit their research or knowledge, through participating in commercialisation and/or engagement activities. When academics experience feelings in relation to the risks involved with participating in academic entrepreneurship, this has the potential to create a sense of doubt and as a result academics should vary significantly in their motivation to take entrepreneurial action.

When individual academics intentions towards participating in commercialisation and/or engagement activities are analysed, the findings show that the stronger an academic's chronic promotion focus, the more likely these academics are to view participation in academic entrepreneurship as a gain scenario (Higgins, 1998). These results support the findings of the qualitative study which suggested that academics high in chronic promotion focus will be more motivated to participate in commercialisation and/or engagement activities. As a result, they are therefore much more willing to allocate a greater level of their limited attention capacity towards entrepreneurial endeavours. The stronger an academics chronic promotion focus the greater their motivation to maximise the return in risk-return decisions (McMullen & Shepherd, 2002) and they display stronger intentions to participate in commercialisation and/or engagement activities, in addition to their other academic duties. Conversely, the analysis of the data revealed that the stronger an academic's chronic prevention focus, the less willing they will be to allocate a greater level of their limited attention towards participating in engagement activities. In turn, these academics will be less motivated and more likely to view participation in academic entrepreneurship as a loss scenario (Higgins, 1998). As a result, chronic prevention focused academics will seek to minimise risks, in risk-return decisions (McMullen & Shepherd, 2002), resulting in weaker intentions to participate in engagement activities, instead focusing their attention

towards achieving other academic outputs. When viewed in isolation (without taking the local contextual factors into account) this suggests that participation in both commercialisation and engagement activities is individually driven and is pursued on a discretionary basis (Perkmann et al., 2013).

While a small number of research articles have identified that local contextual factors (e.g. Tartari et al., 2014; Bercovitz & Feldman, 2008, Rasmussen, Mosey & Wright, 2014) can have a positive impact on academic entrepreneurship. It was suggested in the qualitative study that academic leaders and/or work group colleagues had the potential to, both positively or negatively, and directly or indirectly impact an academic's motivation to participate in commercialisation and/or engagement activities over and above their individual motives. The following section discusses the direct impact academic leaders have on academic intentions through their behaviours and actions, evoking different levels of situational promotion or prevention focus in their subordinates.

8.3.1 Academic Leader Effects

The findings from the Scottish academic population show that leaders displaying promotion focused behaviours had a positive direct effect on an academic's intentions to participate in both commercialisation and engagement activities. However, only the leader direct effect (Hypothesis 3b) on academic intentions to participate in engagement activities, found a strong significant and positive direct effect for the leader's promotion focus, over and above the individual's chronic regulatory focus. This in turn significantly strengthens an academics' intentions to participate in engagement activities where outcomes are less uncertain. This corroborates the suggestion in the qualitative study that the actions and behaviour of academic leaders were perhaps more likely to support subordinates participating in engagement activities. This could be as a result of leader's role modelling or displaying positive language and behaviour towards participation in engagement activities, as leaders can understand the allocation of resource and income, as they are made clear in advance. Meanwhile the behaviour and

actions of prevention focused leaders leads to negative (but not significant) intentions to participate in both commercialisation and engagement activities.

These results suggest that a leader demonstrating promotion focused behaviour is more likely to elicit a promotion focus in their subordinates while a leader demonstrating prevention focused behaviour, is more likely to elicit a prevention focus in their subordinates This is in line with the findings from the qualitative study and the entrepreneurship literature (Wu et al., 2008), where it was suggested that academic leaders have the ability to direct an academic's attention towards or away from commercialisation and/or engagement activities, by projecting their vision and the subsequent benefits for both parties. This finding further develops the theoretical work developed by Brockner & Higgins (2001), who suggested that leaders and their differing behaviours will evoke different levels of situational promotion or prevention focus in their subordinates, which in turn affects their motivation to participate in commercialisation and/or engagement activities.

When applying regulatory focus theory as a lens, it has been suggested that chronic and situational regulatory foci can interact to affect an individual's behaviour (Brockner & Higgins, 2001; Shah, Higgins & Friedman, 1998). The regression results (Hypotheses 5a and 8a) which were confirmed by further simple slope analysis (Figure 14 and Figure 16), highlight that this interaction is strengthened when there is congruence between leaders and individual academics (e.g. high leader promotion x high individual chronic promotion, or high leader prevention focus x high individual chronic prevention focus). This is particularly evident when outcomes are more uncertain, such as when participating in commercialisation activities. These findings validate Kark & Van Dijk (2007) theorising, when they suggested that a leader's regulatory focus should interact with an individual's chronic regulatory focus and when there is congruence between situation and chronic promotion foci, motivation to take entrepreneurial action will be strengthened or weakened as a result. Specifically, in relation to Hypotheses 5a this positive effect is in line with Lockwood, Jordan, and Kunda's (2002) research who also found congruency effects, when they demonstrated that individuals are increasingly motivated by role models who encourage strategies that fit their chronic regulatory

focus. This suggests that promotion focused academics are inspired by leaders, who are positive role models, or who highlight strategies for achieving commercialisation success, particularly when outcomes are uncertain (Bercovitz & Feldman, 2008; Rasmussen, Mosey & Wright, 2014). On the other hand, leaders whose behaviour and actions highlight that participation in commercialisation activities is not valued, leads to a further weakening of chronic prevention focused academics commercialisation intentions.

A mismatch or incongruence between situational and chronic regulatory foci was also a major finding from the regression results. There was statistical support for both Hypothesis 7a and 7b which was again confirmed through simple slopes analysis (Figure 15 and Figure 18), where interactions between prevention focused leaders and chronic promotion focused individuals exist. This leads to weakened intentions to participate in both commercialisation and engagement activities. The results highlight that when incongruence occurs, the moderating effect of situational and chronic regulatory foci weakens an individual's motivation to take entrepreneurial action (Van-Dijk & Kluger, 2004). As identified from exploration of Hypothesis 1a & Hypothesis 1b, individuals high in chronic promotion focus are more likely to be willing to participate in both commercialisation and engagement activities, this incongruence effect potentially has important implications for entrepreneurial universities. In particular, when such incongruence occurs between situational and individual regulatory states (e.g. high individual chronic promotion focus x high leader prevention focus), this has the ability to destabilise an individual's behaviour (Camacho, Higgins & Luger, 2003; Lisjak, Molden & Lee, 2012). As a result, if the behaviour and actions of an academic leader are signalling to motivated academics in their work group that participation in commercialisation and/or engagement activities is not valued or expected, over time this may result in a loss of entrepreneurial motivation. This resulting loss of entrepreneurial motivation could eventually lead to either complete inactivity or dissatisfaction, as academics high in chronic promotion focus are not being motivated to fulfil their 'ideal' selves when considering academic entrepreneurial choices.

8.3.2 Work Group Colleague Effects

The next significant direct contextual-level factor in the conceptual model, was the level of colleague participation in commercialisation and/or engagement activities in an academic's work group and the role group norms plays in the entrepreneurial process. It was suggested in the qualitative study, through watching a greater the number of their work group colleagues participating in commercialisation and/or engagement activities (two key reference points), in addition to their core academic duties, can lead to increased motivation to participate in these activities. The main effect findings highlight that an academics intention to participate in commercialisation and/or engagement activities, increases in line with the level of colleague participation in commercialisation and/or engagement activities. This suggests that entrepreneurial peers are an important reference point for other academics working in the group and these findings are in line with prior literature (e.g. Rasmussen, Mosey & Wright, 2014; Tartari et al., 2014; Huyghe & Knockaert, 2015; Louis et al., 1989). Importantly the findings show that it is not just colleagues engaging in any entrepreneurial activity in the department that has an increased effect on an academic's entrepreneurial intent. An academic's intention to participate in commercialisation activities is directly related to the level of colleague participation in commercialisation and not the level of colleague participation in engagement activities. The opposite is true in relation to academic intentions to participate in engagement activities, here their motivation to participate in engagement activities is strengthened by the level of colleague participation in engagement activities and not colleague participation in commercialisation activities. This outlines that an academic's motivation to participate (or not) in commercialisation and/or engagement activities is very strongly influenced by the specific type of entrepreneurial behaviour undertaken by their work group colleagues. As a result, this increases the work groups overall level of entrepreneurial competency (Rasmussen, Mosey & Wright, 2014).

The results of the Scottish academic population study also found strong support for the interaction between the level of colleague participation in commercialisation activities and chronic promotion focused individuals. This significant interaction was

also confirmed through the simple slopes analysis (Figure 17) and may be explained by the fact that individuals high in promotion focus will see participation in commercialisation activities as a desired end state and their motivation is strengthened by observing other colleagues participating, highlighting the importance of maintaining favourable commercialisation norms within work groups (van Berg et al., 2008; Nicolaou & Souitaris, 2015,).

Finally, as hypothesised, a significant interaction was found between the level of colleague participation in engagement activities and prevention focused individuals. This result may seem surprising given that when viewed in isolation, individuals who are high in chronic prevention focus display significant negative intentions (Table 23, Model 9) to participate in engagement activities. The simple slopes interaction diagram (figure 19) highlights for higher levels of colleague participation in engagement activities, this can intensify the value of group membership. The findings indicate that as the level of colleague participation in engagement activities increases, this leads to individuals high in prevention focus sustaining their intentions to participate in engagement activities. The simple slopes interaction diagram also revealed that as the level of colleague participation in engagement activities decreases, the intent of individuals high in chronic prevention rapidly decreases. In both cases these outcomes suggest that chronic prevention focused academics strongly react to the level of colleague participation in engagement activities in their groups, in turn motivating them to match the level of other colleagues, in order to maintain group membership or norms. This is because chronic prevention focused individuals also have values which are aligned with security and responsibility and this suggests they are more likely to be sensitive to changes in the social or group norms (Lam, 2011). Similar to findings by Roach and Sauermann (2015) in the wider entrepreneurship literature, these findings also identified that different contextual factors, such as role models, leaders and work group norms, can elicit different behaviours in chronic promotion or prevention focused academics.

8.3.3 Academic Leader and Group Entrepreneurial Norms

The final element of the conceptual model sought to understand whether the actions and behaviours of a leader (viewed through their situational regulatory focus), determined the level of colleague participation in commercialisation and/or engagement activities, within their work groups. Regression analysis was conducted, and the results confirmed that promotion focused leaders result in increased levels of colleague participation in both commercialisation and engagement activities, in their work groups. The behaviour and actions of academic leaders assists in the creation of situational group norms, acting as attention directors (Simon, 1947), by signalling to academics what entrepreneurial actions are valued and expected (if any) by their academics (Jain et al., 2009; Rasmussen, Mosey & Wright, 2014). The results of both the qualitative and quantitative studies highlight that academic leaders play an extremely important role not only in the academic's local context but also in achieving university outcomes related to academic entrepreneurship. The findings suggest that the behaviours they adopt can lead to very different outcomes towards entrepreneurial thinking, risk taking and innovation (Avolio et al., 1999; Bass & Avolio, 1994) within their work groups. Specifically, academic leaders can direct an academic's attention towards or away from participating in commercialisation and/or engagement activities through acting as role models or projecting their vision by creating traditional academic or hybrid group norms and the subsequent benefits for all.

8.3.4 Summary

The results of this study highlight that context can be an important factor in an academic's intentions to participate in commercialisation and/or engagement activities. As academics typically do not work in isolation, these findings can have implications for commercialisation and engagement outputs from universities. The local context is clearly an important element in the entrepreneurial process (Roach & Sauermann, 2015) which can lead to different outcomes for promotion and prevention focused academics.

The findings, particularly in relation to the choice of moderators (leaders and colleagues) within the study, address Foo et al.'s (2016) study, where they concluded that having a promotion focus alone is not enough to predict entrepreneurial intent and that other contextual factors need to be taken into account to fully understand entrepreneurial intent within academia.

Perkmann et al. (2013, p.432) discussed that there is a current lack of understanding in relation to “how individuals respond to local norms, such as those prevailing in their immediate, departmental work contexts and how these relate to different academic disciplines”. This quantitative study of the whole academic population makes several contributions to the literature. Firstly, it adds to the growing body of work on the antecedents of academic participation in commercialisation and engagement activities. There is a small but growing body of research in the academic entrepreneurship literature that focuses on individual academic behaviours being influenced by the social context of the university or department (Kenney & Goe, 2004; Bercovitz & Feldman, 2008; Stuart & Ding, 2006; Tartari, et al., 2014; Rasmussen, Mosey & Wright, 2014). This thesis contributes to this body of work through adopting a multi-level approach which shows how local contextual factors influence academic behaviours, in relation to intended participation in commercialisation and engagement activities. Finally, authors have identified that leader behaviours (Bercovitz & Feldman, 2008; Rasmussen, Mosey & Wright, 2014) can positively influence other academics, however, there has been little theoretical development in understanding this process in the academic entrepreneurship literature. This thesis contributes to this gap by providing a conceptual framework for understanding how academic leaders can positively and negatively, and directly and indirectly, affect academics’ intentions to participate in commercialisation and/or engagement activities.

8.4 Multi-level analysis of the STEM and non-STEM Academic Population

The final section of the discussion will address the third research objective of the thesis:

Objective 3: *To explore if contextual factors impact the intentions of academics to participate in commercialisation and engagement activities differently, between STEM and non-STEM academics.*

The third main objective of this study was to look at academic intentions and local contextual factors for STEM and non-STEM disciplines. As found in the whole Scottish academic population study, independent to an individual academic's chronic regulatory focus, their leaders' and colleagues' behaviour can strengthen or weaken their intention to participate in commercialisation and/or engagement activities. However, researchers have identified that opportunities to behave entrepreneurially in STEM related disciplines are much higher when compared to non-STEM disciplines (Laukkanen, 2003; Fini et al., 2010; Abreu & Grinevich, 2013). This increased level of opportunity for STEM academics to participate in entrepreneurial activities may lead to STEM academics being exposed to local contextual factors (leaders and colleagues) at increased intensity levels, compared to their non-STEM colleagues. Having a greater understanding of whether these local contextual factors relate to the creation of entrepreneurial norms and by understanding if differences exist between these two academic groups, this can assist university management teams. Firstly, by determining possible training interventions, aimed at supporting academic entrepreneurship and secondly, by providing an increased understanding of enhancing positive and mitigating adverse local contextual factors, which can impact an academic's commercialisation and engagement intentions. In addition, there is a paucity of research in this area (Abreu & Grinevich, 2013; Perkmann et al., 2013), the main findings (set out in table 70 below) contribute to providing a better understanding regarding whether academic entrepreneurship is, at the cognitive level, a conceptually different type of phenomenon that needs to be treated separately by researchers and university policymakers for STEM and non-STEM disciplines.

Table 70. Summary of Significant STEM and Non-STEM Findings

	STEM Commercialisation Intentions	Non-STEM Commercialisation Intentions	STEM Engagement Intentions	Non-STEM Engagement Intentions
Chronic Promotion Focus	+ ***	+**	+ ***	+***
Chronic Prevention Focus	-	+	- **	-**
Leader Promotion Focus	+	+	+ *	+**
Leader promotion focus x individual chronic promotion focus	+**	+	+	-
Leader prevention focus x individual chronic promotion focus	-	-***	-	-*
Level of colleague participation in commercialisation activities	+ ***	+***	+	+
Level of colleague participation in engagement activities	-	-	+ ***	+***
Level of colleague participation in commercialisation activities x individual chronic promotion focus	+*	+		
Level of colleague participation in engagement activities x individual chronic prevention focus			+ ***	+
	STEM Commercialisation Activity Levels	Non-STEM Commercialisation Activity Levels	STEM Engagement Activity Levels	Non-STEM Engagement Activity Levels
Leader promotion focus	+ ***	+**	+ *	+*

+ positive relationship found; - negative relationship found; *p<0.05; **p<0.01; ***p<0.001

At the individual level, in relation to an academic's intentions towards participating in commercialisation activities, the findings, are again in line with the academic literature (e.g. McMullen & Shepherd, 2002) and Scottish academic population results. STEM and non-STEM academics who are high in chronic promotion focus are likely to display the highest motivation to participate in commercialisation and engagement activities and as a result display strong commercialisation intent. However, the results from this analysis also identified that the stronger an academic's chronic prevention focus, the lower both STEM and non-STEM academics' motivation to participate in engagement activities. This means these academics will be more likely to direct their attention (Higgins, 1998) towards participating in core academic activities and be less motivated to participate in engagement activities.

It is clear from the results of the quantitative studies that academics from STEM and non-STEM disciplines, who are high in promotion focus, are the most likely to be motivated to participate in both commercialisation and/or engagement activities. These results are unsurprising, as regulatory focus is a fundamental motivational principle which influences human activities (Higgins, 1998) and should therefore be consistent throughout the academic population, regardless of whether academic's work in STEM or non-STEM disciplines. If universities wish to increase revenues from academic entrepreneurship, then they should give serious consideration to increasing the number of promotion focused academics they employ. One way to achieve this would be to screen candidates during the recruitment process, where a regulatory focus informed questionnaire could be used, in order to identify suitable candidates.

8.4.1 Academic Leader effects on STEM and non-STEM Academics

Turning to the local contextual factors, and the direct effects academic leaders working in STEM and non-STEM disciplines have on their academics. While the findings identified the actions and behaviours of promotion focused leaders have positive direct effects in strengthening both STEM and non-STEM academics' intentions to participate in commercialisation activities, no significant result was found.

Academics' leaders were found to have a significant and positive direct effect on both STEM and non-STEM academics motivation (with the effect slight stronger in non-STEM academics) to participate in engagement activities, over and above the individual's chronic regulatory focus. This significantly strengthens both STEM and non-STEM academic's intention to participate in engagement activities. This in part validates the findings from the qualitative study, where it was suggested that academic leaders have the ability to direct an academic's attention towards or away from participating in engagement activities. There are many more opportunities to participate in engagement activities, when compared to commercialisation activities (Perkmann et al., 2013) and academics from both STEM and non-STEM disciplines can participate (Abreu & Grinevich, 2013). This significant finding suggests that promotion focused academic leaders either through widespread role modelling or through their actions and behaviours are signalling that participation in engagement activities, is particularly valued in both STEM and non-STEM disciplines.

Again, some of the individual and leader regulatory focus interactions were found to be factors that can significantly affect STEM and non-STEM academics motivation and subsequent commercialisation and engagement intent. A positive and significant interaction between promotion focused leaders and STEM chronic promotion focused academics was found. When regulatory congruence between academic leaders and individual academics (e.g. high leader promotion x high individual chronic promotion) is found, there is a strengthening of STEM academics' intention to participate in commercialisation activities. This is likely to be due to the fact that there are a greater number of opportunities for STEM academics to participate in commercialisation activities, when compared to their non-STEM colleagues. This suggests that academics working in STEM disciplines are either exposed to a greater number of leaders who are participating in commercialisation activities who are acting as role models (Bercovitz & Feldman, 2008), or that due to the long history of participation in commercialisation activities within STEM disciplines they are generally more supportive of their academics attempting to commercialise their research or knowledge.

The results also identified that for academics high in promotion focus working in the non-STEM disciplines, leaders higher in prevention focus have a significant negative impact on these academic's intentions to participate in commercialisation and engagement activities. As a result of this interaction, the behaviour and actions of their academic leader is signalling to non-STEM academics, working in their group, that they should focus their attention towards other academic activities, as participation in commercialisation activities is either not valued or expected.

8.4.2 STEM and non-STEM Work Group Colleague Effects

Turning to the next main effect contextual-level factors, which is the level of colleague participation in commercialisation and engagement activities in an academic's work group and the role their work group colleagues play in the entrepreneurial process. As displayed in table 70 above, both STEM and non-STEM academics display significant intentions to participate in commercialisation and engagement activities, through observing other academics in their work group participating in these activities. Interestingly, the level of colleague participation in engagement activities has no motivational impact at all on an academic's intention to participate in commercialisation activities. The main effect findings for both STEM and non-STEM academics was that their intention to participate in engagement activities increases in line with the level of colleague participation in engagement activities within their work group. Observing colleagues participate in commercialisation activities is a positive, but not significant factor.

These findings suggest that it is the influence of colleagues and the type of entrepreneurial activities they focus on that is a major factor in motivating others. These direct local contextual factor results suggest that the level of colleague participation in commercialisation and/or engagement activities are very important factors and academics use them as two very separate reference points. This in turn legitimises participation in commercialisation or engagement activities. As a result, this has the ability to modify an academics motivation to participate (or not) in commercialisation

and/or engagement activities. The results suggest that both STEM and non-STEM academics appear to be strongly influenced by the entrepreneurial behaviour and choices of their work group colleagues. Academics might be motivated to participate in commercialisation activities but are not able to observe colleagues (role models) successfully participating in commercialisation activities and this could negatively impact their ability or willingness to exploit commercialisation opportunities when they arise. As identified in the qualitative study, some universities are reducing the number of spin-out companies they will back or are choosing to withdraw from participating in commercialisation all together. Over time this is going to have a negative effect on academic intentions. This highlights the importance of maintaining favourable commercialisation norms in a work group (van Berg et al., 2008; Nicolaou & Souitaris, 2015).

The next section will review the level of colleague participation and individual regulatory focus interaction effects (regulatory reference). The results set out in the table above, show that the motivation of promotion focused STEM and non-STEM academics is strengthened by observing an increased level of colleagues participate in commercialisation activities. However, only strong significant support was found for the interaction between the level of colleague participation in commercialisation activities and an individual's chronic promotion focus, for STEM academics. Drawing on regulatory focus theory, these findings suggest that STEM academics high in promotion focus, who already view participation in commercialisation activities as a desired end state (Higgins, 1998), have their motivation to do so strengthened by observing colleagues participating in commercialisation activities.

Turning to the level of colleague participation in engagement activities and prevention focused individuals. The results show that again despite previous results indicating that prevention focused STEM and non-STEM academics display significant negative intentions to participate in engagement activities when contextual factors, such as increased levels of colleague participation in engagement activities in their work group, this in turn affects their motivation to participate in engagement activities. The significant result found for prevention focused STEM academics and the level of

colleague participation leads to significantly increased intentions to participate in engagement activities. A similar interaction, but non-significant effect, is also found for non-STEM academics as witnessed through the simple slopes interaction diagrams (Figure 23 and Figure 27) these diagrams both suggest, that for higher levels of colleague participation in engagement activities, this intensifies the value of group membership. The interaction indicates that, as the level of colleague participation in engagement activities increases, this leads to individuals high in prevention focus to sustain their intentions participate in engagement activities. This suggests that chronic prevention focused STEM and non-STEM academics are sensitive to the level of colleague participation in engagement activities within their groups and use it as a key reference point. In turn, this motivates academics to match the participation level of their colleagues, in order to maintain group membership or norms.

8.4.3 Academic Leader and Group Entrepreneurial Norms

Finally, there is the consideration of whether STEM and non-STEM leaders and their actions and behaviours (when viewed through their regulatory focus), determine the level of colleague participation in commercialisation and/or engagement activities, within their work groups. The results, suggest that promotion focused leaders and their actions and behaviours, significantly lead to increased levels of participation in commercialisation and engagement activities by academics within their work groups. These findings along with the evidence from the qualitative study consistently identify that the actions and behaviour of academic leaders assists in the creation of entrepreneurial group norms for both STEM and non-STEM disciplines. These results highlight that academic leaders play very important roles in the adoption of the academic entrepreneurship process and in turn, organisations achieving their outcome agreements.

8.4.4 Summary

A review of the literature might lead people to conclude that there are likely to be difference between these disciplines, however this was not found to be the case. The local contextual factors identified and analysed in this study that can impact academic entrepreneurship are very similar for both STEM and non-STEM disciplines. The main deviation between the two academic disciplines is in relation to STEM academic's and leader interactions in relation to participating in commercialisation activities. This is likely to be due to the fact that there has been greater potential to exploit research and knowledge within these disciplines and there is a long history of STEM academics commercialising their research. As a result, there is a perhaps a larger number of leaders who have the experience when compared to leaders in non-STEM disciplines and who are able to act as role models. However, the ongoing evolution of digital technologies can act as an enabler to allow a greater level of knowledge to be exploited from the non-STEM disciplines in the years to come. Future research in this area should therefore not neglect the non-STEM academic disciplines, nor engagement activities. The findings contribute to academic entrepreneurship literature highlighting that universities do not need to create different strategies for academics in non-STEM disciplines as the individual and local contextual factors that promote or prevent academic entrepreneurship are likely to be similar across disciplines.

8.5 Evaluation of the Conceptual Model

The conceptual model was developed as a result of the qualitative analysis and draws upon regulatory focus theory, in order to explain how individual and local-contextual factors can affect an academics intention to participate in commercialisation and/or engagement activities. All the scales used were taken from prior research and each of the hierarchical regression analysis conducted (Whole Scottish population, STEM and non-STEM academics) comprised seven models. Models 1 - 7 looked at commercialisation intentions and models 8 - 14 looked at engagement intentions within

each study. It should be noted that conceptual models and theories that study human behaviour are limited in their explanatory powers. For example, Armitage and Conner (2001) conducted a meta-analysis on 185 studies that used the Theory of Planned Behaviour and on average found that the model typically accounted for 39% of the total variance in relation to an individual's intentions. The total variance explained from the conceptual model developed in this thesis (in relation to commercialisation and engagement intentions) is comparable to the Lee et al. (2011) multi-level study of Singaporean IT professionals and the influence of organisational factors and individual factors on their entrepreneurial intentions. The total variance explained from their model was .34 (34%) meaning this model has similar explanatory power.

In relation to commercialisation intentions the conceptual model developed was able to explain between .297 (29.7%) of the total variance for non-STEM academics and .341 (34.1%) for STEM academics as shown in table 71 below.

Table 71. Conceptual Model – Total Variance Commercialisation Intentions

	Whole Academic Population	STEM	Non-STEM
Model 7 Total variance explained	.317	.341	.297

The hierarchical regression analysis sought to understand if each direct and indirect effect model explains a significant variance over and above the comprehensive list of control variables (models 1 & 8) and the percentage of variance each of the individual and local contextual direct and indirect effect explains over and above the previous model. The subsequent R² increase of each model is set out below (Table 72).

Table 72. Conceptual Model – Variance Breakdown of Commercialisation Intentions

	Whole Academic Population	STEM	Non-STEM
Model 1 – Base Model	.206	.203	.185
Model 2 - Individual	.026	.042	.020
Model 3 – Leader Direct Effects	.002	.004	.003
Model 4 – Leader/Individual Interaction Effects	.021	.029	.033
Model 5 – Colleague Direct Effects	.089	.103	.081
Model 6 – Colleague/Individual Interaction Effects	.007	.008	.006
Total Increase over Base Model	.111	.138	.112

It can be seen from the table that the control variables (model 1) account for between .185 (18.5%) and .206 (20.6%) of the total variance in the studies. It can also be seen that in relation to the local contextual factors the level of colleague participation in commercialisation activities explained a large amount of variance over and above the base model. This provides support to the findings set out in the qualitative analysis summary above (Figure 28) which suggested that within the organisational level work group colleagues would have the strongest effect on an academic’s intentions.

Turning to how the conceptual model performed in relation to engagement intentions. The model was able to explain between .361 (36.1%) of the total variance for the whole academic population and .403 (40.3%) for academics working in STEM disciplines as shown in table 73 below.

Table 73. Conceptual Model – Total Variance of Engagement Intentions

	Whole Academic Population	STEM	Non-STEM
Model 14 Total Variance Explained	.361	.403	.362

It can be seen from the table that the control variables (model 1) account for between .193 (19.3%) and .230 (23.0%) of the total variance in the engagement intention studies. Again, it can also be seen that in relation to the local contextual factors, the level of colleague participation in engagement activities explained a large amount in the increase of variance over and above the base model (Table 74).

Table 74. Conceptual Model – Breakdown of Variance of Engagement Intentions

	Whole Academic Population	STEM	Non-STEM
Model 8 – Base Model	.207	.230	.193
Model 9 - Individual	.049	.042	.054
Model 10 – Leader Direct Effects	.015	.012	.020
Model 11 – Leader/Individual Interaction Effects	.005	.003	.011
Model 12 – Colleague Direct Effects	.142	.145	.141
Model 13 – Colleague/Individual Interaction Effects	.010	.019	.005
Total Increase over Base Model	.154	.173	.169

Overall, the conceptual model was slightly stronger at being able to explain a greater amount of variance for an academic’s intention to participate in engagement activities in comparison to commercialisation activities. This is not surprising, as the participation in commercialisation activities (e.g. spin-off or spin-out a company) and

successful outcomes is much more uncertain and complex than participation in engagement activities and it is often dependent on additional factors that are found beyond an academic's local context such as an individual's social networks (Rasmussen, Mosey & Wright, 2015).

8.6 Implications for Practice

The discussion above highlights that at the individual level, the motivational factors that affect STEM and non-STEM academics' motivation to participate (or not) in commercialisation and/or engagement activities based on their regulatory focus, are extremely similar. Academics who are high in chronic promotion focus are much more likely to display strong motivations to participate in commercialisation and/or engagement activities when compared to chronic prevention focused colleagues. As a result, if universities wish to increase their income from commercialisation and/or engagement activities, then as a first step, leaders in STEM and non-STEM disciplines should consider recruiting a greater number of promotion focused academics. This could be achieved through asking shortlisted candidates to complete a regulatory focus questionnaire in order to ascertain their chronic regulatory focus. Secondly, in order to increase academic motivation to participate in commercialisation and engagement activities, academics need to be rewarded, preferably through promotion, which will send a clear signal that these activities are valued and in turn may also modify the behaviour of peers.

In relation to academic's intentions towards participating in commercialisation activities, the chances of obtaining the financial backing from universities and venture capitalists to start a spin-out venture are reducing. The many highly chronic promotion focused academics within this research, who are displaying strong intentions to participate in commercialisation and engagement activities, should be nurtured and retained within universities. Wright, Mosey and Noke (2012) suggest that the aspirations and behaviours of academics with higher entrepreneurial intentions change over time and are context dependent. As a result of not being able to satisfy their entrepreneurial

ambitions it has been identified that a greater number of these academics leave academia, than do academics with weaker or no entrepreneurial intent. As universities are dependent on those with strong entrepreneurial intentions to participate in both commercialisation and engagement activities, they need to increase their emphasis towards creating policies regarding retaining a greater number of these individuals within academia, if they wish to increase the revenues from academic entrepreneurship in general.

It should also be acknowledged that within the academics' local context, attention directors (leaders and colleagues) can strengthen and weaken an academic's intention to participate in engagement and commercialisation activities (Rasmussen, Mosey & Wright, 2014). Academic leaders and the actions and behaviours they display, play a very important role in the academic entrepreneurial process in both STEM and non-STEM disciplines. The findings within this thesis have implications for academic leaders, as the evidence suggests that direct effect and interactions between a leader's and an academic's regulatory focus have the ability to significantly affect an academics commercialisation and/or engagement intention and create group norms. As such, going forward, universities should consider the evaluation criteria for those in leadership roles, if they wish to increase revenues from entrepreneurial activities. Universities focused on academic entrepreneurship should also consider the appointment of leaders who are strong role models and have a track record of success in commercialisation and/or engagement activities. Such individuals are likely to be viewed as innovation or entrepreneurial champions which would help in assisting in stimulating entrepreneurial behaviour amongst their subordinates. As different leadership behaviours and actions (as viewed through their regulatory focus) are not only able to moderate an individual's commercialisation and engagement intentions, but also create the culture of work groups. It may therefore be beneficial for senior management teams to implement entrepreneurial leadership training courses specifically aimed at academic leaders, as prior research suggests that entrepreneurship training helps with self-regulatory skill development (e.g. Bryant, 2007; Tumasjan & Braun, 2011).

The effects of colleague's behaviour in relation to participation in commercialisation and/or engagement activities also appears to impact STEM and non-STEM academics in a similar manner. This direct contextual factor results suggest that the level of colleague participation in commercialisation and/or engagement activities are very important factors and academics (whether promotion or prevention focused) use them as two very separate reference points. This in turn legitimises participation in commercialisation or engagement activities and helps build entrepreneurial competencies within a group (Rasmussen, Mosey & Wright, 2014). As a result, this has the potential to modify an academics motivation to participate (or not) in commercialisation and/or engagement activities.

The results suggest that both STEM and non-STEM academics appear to be strongly influenced by the entrepreneurial behaviour and choices of their work group colleagues. This highlights the importance of maintaining favourable commercialisation norms in a work group (van Berg et al., 2008; Nicolaou & Souitaris, 2015). Universities should therefore recognise these entrepreneurial colleagues within STEM and non-STEM academic departments/groups and hold them up as entrepreneurial champions, as this may further strengthen the influence of peer performance in commercialisation and engagement activities.

8.7 Limitations

This study has some limitations that could be addressed by further research. First, the data collected is limited to a single country, Scotland. In order to improve the generality of the findings, studies within other geographical locations are required, in order to more robustly validate the findings of this study. Second, the colleague participation level measures used in this study are single item Likert scale measures and hence, their reliability is difficult to evaluate. Therefore, future research could concentrate on developing these measures, so that these impacts could be more objectively measured. Third, limited attentional capacity as a perception of risk within academia remains underexplored in the academic entrepreneurship literature. A focus on

a single country offers limited opportunity for theory development and future research could adopt a multi-national approach to understand whether this phenomenon exists, in other national contexts. Fourth, a longitudinal study with two or more data collection points could provide enhanced evidence of the development of entrepreneurial universities, however due to time constraints this was not feasible within this study. Fifth, the results of the quantitative studies suggest that academic participation in commercialisation and/or engagement is formed through individual motives and contextual influences. However, the local contextual effects used in the quantitative studies does not categorically exclude the presence of other contextual factors which may impact an academic's commercialisation and/or engagement intentions. Finally, given the overall response rate represented 11.6% of the sample population, biases may exist. A survey that had a greater number of responses would have allowed for an even stronger test of the conceptual model.

8.8 Future Research

Future research can use a multi-level approach to consider whether other mediators, such as the relationship between academic leaders and the university strategies, allow for a more comprehensive understanding of why academic leaders behave the way they do. For example, organisational and school/department/work-group specific incentive mechanisms have not been included in the study. This could be done through longitudinal research to evaluate the impact of training programs for academic leaders in academic entrepreneurship, looking specifically at effectiveness, or changes in entrepreneurial intent over time. Further multi-level studies could potentially advance our understanding in relation to identity. An academics entrepreneurial identity is likely to comprise organisational, social, dyadic and individual identities and this might help further explain how academic identity is formed. It would also be helpful to understand if any particular leadership style elicits a situational promotion or prevention focus. Future research could also address factors such as whether the hierarchical system within universities leads to different context and individual interactions. For example,

are junior academics more or less affected by contextual factors than more senior academics and is there a difference between male and female academics in relation to academic entrepreneurship? Finally, the qualitative study provided some evidence that universities have taken different approaches towards supporting academic participation in commercialisation and/or engagement activities. As organisations are capable of exhibiting regulatory focus (McMullen & Zahra, 2009) this may suggest that universities are adopting a promotion or prevention focus when it comes to how they exploit research and knowledge within their boundaries. Future research therefore could evaluate whether the level of commercialisation and/or engagement within universities is impacted by a particular regulatory orientation that university senior management adopt, when they set knowledge exchange strategies through evaluating their internal and external environments.

8.9 Summary of the Main Contributions of the Thesis

The final section of the thesis has highlighted the main contributions to knowledge that have come from the qualitative and quantitative studies within this thesis.

The overarching aim of the thesis was to investigate the individual and contextual factors that encourage or discourage academics in Scotland to participate in commercialisation and/or engagement activities.

8.9.1 Contributions to the Academic Entrepreneurship Literature

This thesis makes contributions to the wider academic entrepreneurship literature. There is consensus amongst researchers that some contextual aspects of academic entrepreneurship are not well understood (Bercovitz & Feldman, 2008; Stuart & Ding, 2006; Tartari et al., 2014; Rasmussen, Mosey and Wright, 2014, Perkmann et al., 2013; Johnson, Monsen & MacKenzie, 2017). Firstly, Bercovitz and Feldman (2008) found that leader behaviours have the potential to influence other academic participation

in commercialisation activities, but to date there has been little theoretical development in understanding this process. This thesis contributes to this gap by providing a conceptual model in order to better understand how academic leader's effect academics entrepreneurial cognitive behaviours, resulting in increased or decreased motivation of academics in their work group to engage. The formation of an academic's entrepreneurial intent, particularly in relation to participation in commercialisation activities, is influenced by regulatory congruence, or a regulatory fit, between academics and their leaders. The opposite is true if there is incongruence between academic entrepreneurial motivations and the behaviour and actions of leaders. The actions and behaviours these leaders display (acting as attention directors) whether directly or indirectly, can influence the entrepreneurial intent of academics. This in turn either increases or decreases the legitimacy of participation in commercialisation and/or engagement activities and which overtime can create different group norms. This is important, as both STEM and non-STEM academics are strongly influenced by the entrepreneurial behaviour of their work group colleagues. This highlights the importance of maintaining favourable commercialisation norms in a work group (van Berg et al., 2008; (Rasmussen, Mosey & Wright, 2014; Nicolaou & Souitaris, 2015). Finally, by acknowledging that the regulatory focus leaders adopt affects an academic's entrepreneurial motivational and creates group norms, this in turn is likely to influence the evolution and trajectories of the entrepreneurial universities. Thus, this thesis contributes to literature surrounding the academics local context and mechanisms by which leaders' behaviours and the regulatory focus they elicit, influence an academics motivation to participate (or not) in certain forms of academic entrepreneurship. It provides a theoretical understanding of how these factors subsequently affect the acceptance of the entrepreneurial university ideal, within research groups and departments.

Secondly, academic entrepreneurship has evolved along two distinct research streams; the methods adopted provide an integrated approach to academic entrepreneurship. Much of the research on academic entrepreneurship has focused on commercialisation activities (Di Gregorio & Shane, 2003; Rothaermel et al., 2007; van

Berg et al., 2008; Fini et al., 2010; Siegel & Wright, 2015). While these are important means of transferring university technology, they account for only small part of the knowledge that is actually transferred from universities to non-academic organisations (Hughes & Kitson, 2012). Through splitting these activities into commercialisation and engagement activities, this allowed a richer understanding of the different individual and local contextual factors that can impact an academics entrepreneurial intent. Within the academic spectrum considered within this thesis, it has been identified that commercialisation outputs are often developed from academics first participating in engagement activities (Perkmann et al., 2013). This thesis contributes to bringing a greater understanding of the individual and contextual drivers of academic participation, in relation to commercialisation and engagement activities. Therefore, the importance of academic participation in engagement activities should not be dismissed by researchers, academic leaders, or university senior management teams.

Thirdly, this thesis contributes to the understanding of academic entrepreneurship taking in place in STEM and non-STEM disciplines. As it has been acknowledged that research into academic entrepreneurship has tended to focus on outputs from STEM disciplines at the expense of non-STEM academics (Abreu and Grinevich, 2013). Including academics in non-STEM disciplines in this study extends and broadens our understanding of academic entrepreneurship.

8.9.2 Contributions to Multi-level Research

This thesis also contributes to the academic entrepreneurship and wider entrepreneurship literature, as there is a paucity of studies which have adopted a multi-level approach to understanding the context–entrepreneurship phenomenon, as the majority of studies have tended to focus solely on the individual. As a result, the effect of these contextual influences on individuals represents a major gap in the academic entrepreneurship literature. The findings from the qualitative and quantitative studies suggest that studies which have looked solely at which individual-level factors predict academic entrepreneurship are ultimately unlikely to provide a complete picture. The

researcher argues that because academic entrepreneurship does not exist in a vacuum, research which has sought to understand what individual level factors lead to academic entrepreneurship, may have unwittingly mixed what is in part a contextual phenomenon (e.g., effects of leaders and peers) with individual-level behaviours (i.e., academic entrepreneurship). Through studies not adopting a multi-level approach, and not accounting for context (i.e., cross, lower or higher levels), their findings in relation to understanding the individual factors which drive the academic entrepreneurship processes are likely to be distorted. For example, prior entrepreneurial experience was found to be a significant predictor of participation in engagement activities when viewed as a control variable but once the academic leader variable is included it is no longer significant. This work contributes towards bringing a greater understanding of academic entrepreneurship and how factors in their local context can moderate, at a cognitive level, academics' commercialisation and engagement intentions. The approach taken supports proposals by other scholars (e.g., Gartner, 2001; Davidsson & Wiklund, 2001; Brannback & Carsrud, 2016), that more multi-level research is required to better understand different forms of entrepreneurship. This study provides an innovative theoretical and empirical model for how researchers can study multilevel interactions between the individuals, and cross, lower and higher level university contexts, and in turn better explain how these contexts interact to enhance, or diminish, an academic's behaviours. As a results, this thesis has presented what the researcher believes is a novel, multi-level test of the relationship between local contextual factors and the academics entrepreneurial intentions, thereby contributing towards a methodologically and theoretically appropriate approach to the study of entrepreneurship.

8.9.3 Contributions to Regulatory Focus Theory

This thesis contributes to the regulatory focus theory literature as studies using regulatory focus theory in the academic setting are extremely rare. This thesis also provides new perspectives in the academic entrepreneurship and regulatory focus literature by demonstrating how at, the cognitive level, contextual factors (situational

cues - academic leaders and peers) can both directly and indirectly affect an academic's commercialisation intentions which allows for the incorporation of multi-level factors in studies. By integrating concepts of limited attentional capacity and regulatory focus theory into the academic entrepreneurship domain, whilst drawing on findings from the wider entrepreneurship research, enabled new insights in the fields of regulatory focus and academic entrepreneurship domain to be discovered.

These findings support Higgins (1997) argument that like all individuals, academics are likely to experience positive and negative motivational states which are triggered by situational factors. Despite the growing body of research on regulatory focus theory most studies of the moderating effects of promotion prevention focus have studied desired end states while neglecting the role these regulatory foci in understanding undesired end states. This thesis does this through highlighting the negative affect an academic leader's actions and behaviour can have on academics who are individually motivated to participate in commercialisation activities.

Foo et al., (2016) in their study of Norwegian scientists' intention to spin-out a company, use only promotion focus to explain this phenomenon. The findings of this research confirm that prevention focused individuals are actually capable of participating in academic entrepreneurship when context is considered. It is therefore methodologically important that both promotion and prevention focused scale items should be used in studies to help bring greater understanding, as to why academics behave the way they do.

Finally, the findings in relation to the individual and situational interactions within the quantitative analysis found evidence to support Kark & Van Dijk's (2007) theory, where they suggested that a leader's regulatory focus should interact with an individual's chronic regulatory focus and when there is congruence or incongruence between situation and chronic promotion foci, an individual's motivation to take entrepreneurial action will either be strengthened or weakened as a result.

This novel study has taken a multi-level approach by drawing on regulatory focus theory in order to bring greater understanding to the antecedents of academic entrepreneurship. Findings from this study confirm that both leaders and academic

colleagues play a major role regarding, if and how, an academic participates in entrepreneurial activities. Recognition of the importance of the academic's local context by universities is critical in encouraging more entrepreneurial behaviour amongst academics.

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Appendices

Appendix 1: Participant Information Sheet

Participant Information Sheet

Name of department: Hunter Centre for Entrepreneurship

Title of the study: Why do academics make more or less entrepreneurial exploitation decisions?

My name is Mark Johnson and I am a PhD student from the Hunter Centre for Entrepreneurship at the University of Strathclyde. I am undertaking a research project for my PhD which is focusing on: Why academics make more or less entrepreneurial decisions?

The purpose of this study is to better understand the individual and environmental factors that impact academics and university researchers in Scottish universities when exploiting their research through participating in knowledge exchange activities.

I am looking for volunteers to participate in the project. There are no criteria for being included or excluded – every academic or researcher employed in a Scottish University is eligible. If you agree to participate in the study, you will be asked to take part in a semi-structured interview where the answers will help with the construction of a questionnaire and used to provide a richer understanding of the results.

The researcher is not aware of any risks associated with this investigation. The whole procedure should take approximately 30 minutes. You will be free to withdraw from the study at any stage and you would not have to give a reason. All data will be anonymised, your name will be replaced with a participant number, and it will not be possible for you to be identified in any reporting of the data gathered. You will be given the opportunity to review the transcript of the interview and make amendments if you wish.

If you have any questions please feel free to contact my supervisors:

Dr. Erik Monsen (Senior Lecturer & Director of Research, Hunter Centre for Entrepreneurship, University of Strathclyde) at erik.monsen@strath.ac.uk or via phone 0141 548 3157 (ext. 3157).

Professor Jonathan Levie (Professor & Director of Knowledge Exchange, Hunter Centre for Entrepreneurship, University of Strathclyde) at j.levie@strath.ac.uk or via phone 0141 548 3502 (ext. 3502).

Appendix 2: Interview Guides

Interview Guide – Senior Managers

Thank you for agreeing to meet with me today

The purpose of this interview is to explore the concept of academic entrepreneurship (participation in knowledge exchange activities) from the university standpoint and the environmental and organisational factors that may affect academic participation. Your answers will help with the construction of a questionnaire and used to provide a richer understanding of the results.

Do you mind if I record this interview? I can assure you both you and your university will be anonymised.

Step 1

Show spectrum of entrepreneurial activities to the interviewees.

Answer any questions they have about the spectrum.

Step 2

General Prompts

1. What are your perceptions of these activities from the university standpoint?
2. Has the introduction of outcome agreements changed how the university thinks about participating in these activities?
3. How do you consider the risk element to this spectrum in terms of the resources the university capable of providing?
4. How is the university getting the message to academics about their role in this process?
5. How do you reward academics for participating?
6. What are the main issues you are experiencing?

Thank you very much for taking the time to meet with me.

Do you have any questions? Would you like to review a copy of the transcript once I have typed it up?

Interview Guide - Academics

Thank you for agreeing to meet with me today

The purpose of this interview is to better understand the individual and environmental factors that impact academics and university researchers in Scottish universities when exploiting their research through participating in knowledge exchange activities. Your answers will help with the construction of a questionnaire and used to provide a richer understanding of the results.

Do you mind if I record this interview? I can assure you both you and your university will be anonymised.

Step 1

Show spectrum of entrepreneurial activities to the interviewees.

Answer any questions they have about the spectrum.

Step 2

General Prompts

1. What is your experience (if you have any) of participating in these activities?
2. What was your motivation to do so? What would be your motivation for doing so?
3. What are factors that would impact you participating in these activities (e.g. feasibility or desirability)
4. What do you consider are the risks of participating in these activities?
5. What impact does university policy have on your decision to participate in these activities?
6. Turning more generally to your department. How do your fellow academics recognise and have the confidence to be able to exploit these opportunities?
7. How influential is your academic leader in terms of academics within your group participating in these activities? (Line managers) What influence do you have over your academics in relation to the activities they do?

Thank you very much for taking the time to meet with me.

Do you have any questions? Would you like to review a copy of the transcript once I have typed it up?

Appendix 3: Sample Transcript

Example interview transcript

SM/INS2

How does your university view and consider participation in this particular spectrum of knowledge exchange channels?

Before it has always been that these activities were driven by the enthusiasm of individual researchers rather than necessary institutional priorities. It is now seen as very important, in fact increasingly so. Now for the first time just in May last year we established a knowledge exchange and impact strategy at the university which incorporates these activities [points to spectrum] of these in a different guise which is around building partnerships which is around the collaborative element developing leaders in terms of the knowledge exchange strategies and agendas and how we interact in the commercialisation of technologies and realising that it is not just about income generation it is about getting technologies out there getting them into use and create an impact. So, it is about a pragmatic approach it is not for us about an income stream necessarily for the university as a driver.

How are academics rewarded and measured in terms of participation?

It is worth saying that I'm not aware that any of our academics or research groups have specific objectives around income generation for these type of activities (points to spectrum) it tends not to get categorised to that type of level. They have research income targets and publication targets not necessarily collaborative research income that type of thing. We build it into our performance and development review with all our academics they have KE as a key part of that and impact and also into the reward and recognition process so you can get promoted on the back of your KE activity just like you could on your teaching and research. [Laughs] It is not well used! I'm not sure that the academic managers understand yet what is how they measure the quality it is a difficult concept in what things are often quite driven by the narrative rather than hard numbers such as income so it is how do you benchmark this in the same way. Where is this compared to that activity and it should be rewarded. All the words are there to do it in our framework but it is not really embedded yet and that is what we are working hard at. I'm sure we are not the only institution that is finding this difficult.

Measuring these activities is difficult across many universities then?

Yes, it is because we can count research income, you can count publications and you can count what you do in teaching and developing new programs. It is more about how well we are engaging with external bodies now and likelihood of us generating external impact. If you look at an impact case study now a good one could be worth the same as four, four-star research papers in the REF exercise. So, we monetise this in a different

way and encourage that kind of behaviour as I say the words are all impeded in our approach, but we are not seeing great use of it yet as a community. So, we have not had anybody yet promoted through knowledge exchange.

That is interesting that you have not had anyone promoted. How important do you think these various leaders are then in the adoption of KE throughout the university?

They are essential because they set the tone and the environment that people work in so you see your professors, leaders, line managers whatever you want to call, them engaging in business development activities engaging with the outside community and encouraging it then that rubs off on people particularly in their early career path. If you come in as an early career researcher or even PhD students if they are not solely focused on tradition outputs such as research papers and funding council income, then it drives a different culture. So, it is about the culture of the institution, so those leaders are vital. They are not necessarily heads of school they don't follow the hierarchical lead in the university, it is really who do people look up to and will support them, their department head or a research group lead usually, rather than the actual formal structure within the university.

We have structures which are typically where you have the head of school who have all their challenges they have in life. Making sure people turn up to the lectures and teach, developing international students which is a big challenge these days and then you have got in our science and engineering faculty all our colleges are slightly different in their structure so they have seven schools in the college then divisional leaders so we have systems power and energy and they have an academic need which is usually a senior professor and even then they will have lots of sub research groups depending on the size of them and typical they would be split down into smaller themes so people have lots of line managers and that is the structure we have. They all tend to set their own focus and priorities so one may say we are going to do small scale engagement with industry others say they would not like to encourage that so it is really down to the leader of each group to establish the priorities it is not up to the head of school to get involved in the setting of the agendas.

The head of school might get involved at higher level vision and tends to be around teaching, they can tell them what and when to teach, but not around research or knowledge exchange, because when you go in people respond to teaching requests but shaping research agendas is another thing, it is very difficult. So, it is a complicated structure with lots of agendas and individuals and strategy flowing from the top to the bottom rarely happens.

Like many institutions when it comes to the research agenda we find we are aligned well with that and the teaching activities have to be coordinated and managed and you have students that need that level of service that you give them. The research is driven by

their own individual passions and they have their own funding expertise and their own preferred ways of working it is very hard to influence that. You can change the culture by addressing who are the leaders and how are they approaching it.

The academic literature is suggesting that that research funding through traditional channels is reducing and academics are having to look at other sources such as KE, is that happening at your university?

We see that we need to open up new funding streams often it is not necessarily income from businesses although contract research and consultancy can be a starter. For us it is about building relationships with external organisations and leveraging that. So yes, we see that we need to use our contacts to open up new funding streams. It is okay to go for European money or technology strategy board so the business doesn't pay us but another funder is but we need that relationship to get the money so it is about how do we work in partnership with these organisations. You have to remember that these projects still have to be mutually beneficial it has to be interesting to the academic and has to add value to the organisation it has got to be fundable. So, we are having to think about getting people to think a bit more creatively about where you go for funding opportunities it is not all about research council money. Our engineering faculty might say it is not all about BBSRC.

Are all disciplines at your university generating income from this spectrum?

Yes. The social science faculty does a lot more CPD than other areas of the university and quite a lot more consultancy. Medical does a lot of collaborative engagement with pharmaceutical companies, the clinicians do contract research and consultancy so all the disciplines do it to different degrees. The science and engineering areas focus more on collaborative and contract research type activities. It is more about research driven relationship rather than lots of CPD and it is something that we are looking at how we grow that as we are seeing an increasing interest from companies looking at executive training courses, masters programs for example a bit like an executive MBA there is much more demand for this.

You mentioned your strategic focus is around collaboration and leveraging these relationships, why is that a preferred strategy?

That is where we are more likely to create the impact that we need but most of it is around research so we get publication outcomes, so we are getting that, and we are engaging with industry which is something that the funding council wants to see us to do and it leads us into an international playing field, so it aligns with the strategic needs of the university rather than just ticking one box. CPD tends to be down to the individual discipline area and what is right there our school of education does a massive amount of CPD so does our school of law but that is what their sector is driven by, CPD credits.

You have got the start-up and licensing technologies here. Our focus areas is not about income generation we do do licensing but we tend to focus our efforts into the start-up activity only on high value propositions that we go and receive external VC investment in a relatively short time frame, typically a 3-4 year time frame where we can see real traction from the start. We don't tend to just spin out lots and lots of businesses we now focus on 2 to 3 per year. We have got a relationship with [REDACTED] a UK VC firm that provides seed funding to us and to our ventures and we work very closely with them. We are not trying to nurture lots of spin out activity, it is resource intensive, it doesn't generate massive income streams occasionally you get nice really good income streams but you can't account or plan for it, the timescales are all over the place. It is when academics are willing to, to do it and it is usually down to the academic the academic has to be passionate the technology has got to be right there have to be so many factors that gel together that say let's do it. So we do that and as I day we tend to manage 2-3 per year. We have other people who want to do it but we don't feel that they quite have the return or potential for return for VC investment that enables to do something more quickly then we will usually assign the IP to the academic and say yes there are other networks in Scotland that will support you and we will tap you into them but we won't give you in-depth support. If it is something that you want to do we will make the IP available to you with an easy access or free a license from the university to the academic and we will not take any activity. We are willing to encourage that and the same with student start-ups.

What happens to the academics who start these companies with university support?

Most stay as academics within the university we second them for a period of time but they still remain as an employee at the university. In most cases they don't take a senior role in the business, they step back and take a technical or advisory role or external consultant. By and large they stay in the university and we encourage that. There are different models we have one where the academic is the senior founder that is what he wanted to do and is doing a great job and it depends on the skills of the academic.

Do these departments where these entrepreneurs originate from become more productive in terms of the number of opportunities that academics bring to your department?

We see more disclosures coming through it does rub off because typically the people doing this are typically the research group leaders or line managers, the ones with the big research incomes. They are the ones developing the most disruptive technologies that may be spin out they have huge research portfolios. It is projects that are aligned with industry such as collaborative projects where we see very little licensing going on off the back of those it is a softer transfer of knowledge normally we don't see IP transfer out of these projects so it is the ones where we have government funding research essentially which is very creative research which generally forms our IP portfolio that

we license or create spin outs with. But we do see higher numbers of disclosures coming from those groups because it has been flagged up. You need the people who are seeing the research day in day out to be able to recognise an opportunity when it comes along and it comes from those groups because it is in all their mind-sets.

Why do you think this is the case, is it because these people have better research networks than others for example?

That is a difficult one to answer. By and large I would say they tend to be more outward facing, more entrepreneurial, I guess. They tend to have a better understanding of the industry needs and opportunity that therefore creates for exploiting or they come in from a commercial background to academia they have spent time working in industry and recognise the opportunity for commercial ventures. Their history has a lot to say in what the outcomes are and the culture that they create so if somebody has always come from an academic background and stays in there, they don't consider these as opportunities. If you have come in from industry or have had your own business and spent significant time with industry you are going to think a lot more about opportunities and that rubs off on the group.

What do you think are the other key motivations for academics to participate in these activities?

Money drives academics very rarely usually the overarching driver is that it is something interesting in it for them. In terms of contract research we don't see massive amounts of that here because it is usually about solving a defined problem and that typically doesn't excite our academics who want something a bit more speculative and a bit more long term. So we have pushed the collaborative research because they have a larger input into the development of the programs that they then work on. So it is really about things that interest them academic rather than just solving a company's problem. They will do that to some extent but it is not a very big part of our portfolio.

We have got funding to support industry collaboration and more often than not the actual driver if you dig down is they have a good person and they want to keep them on. It is a challenge of the way that academia is funded we have no core researchers.

Do you think that KE strategy is well understood in your university?

No, I'd say not, and we have got to work harder because academics struggle to see how that is relevant to them. Which is a problem. We have a high-level mission and vision statements and they are unable to understand what does that mean to me as a worker. So we are doing more work to translate it as to what it means as fundamentally we want more academics getting out there building those networks building relationships with industry and creating the opportunities that arises. They like the freedom to explore research in a more explorative manner, what we don't want is to be a contract research organisation because we will lose our academic output. Different universities operate in

different parts of the spectrum. We know that a lot of post-92 organisations will do a lot more direct industry engagement than we will do short term work and that suits them because they don't have the big research portfolios and what interests their staff is different to what interests staff here and you need that mix within the spectrum. The smaller universities are great at doing the small jobs for industry it just wouldn't interest them here. If doesn't mean we couldn't do it we are just interested in the million pound projects not the 10k pieces of work.

Do you think that most academic know that the SFC strategy and the outcome agreements are understood by academics?

They don't care, the institutional level agreements and policies does not matter to them at all it doesn't filter down to the individual. You know heads of colleges and senior members of staff it does affect them as to what we commit to in the outcome agreements that does have an affect but it tends not to filter down most people will not even know there is an outcome agreement on KE. You know that is there activities that stimulate our return and what we agree to deliver for them research funding council, but we are not asking them to do anything different because of them directly anyway. That would not be our driver internally that is just high-level policy. Some people are aware of the single knowledge exchange organisation or innovation Scotland I think they are calling it now and there is a risk for an institution such as ours where we are very international in our focus where it becomes too parochial. We have to make a decision about where we operate we do support the local region but we have also got to work internationally. They are asking us (the SFC) to work with Scottish SME's, but actually if you look at our licensed technologies we licence very little to Scottish businesses, in fact we licence very little to the UK business sector, it is mainly international. When you drill down the technologies are very specialist and you have got to go where there are a handful of companies that are able to take the licences on. In Scotland you get people saying that SME's should get it for free there is a big culture of that in Scotland actually.

So, we have established easy access IP, this is something we launched in 2010 which is licensed technology which is a commercial deal, but with no royalty payment, no upfront payment, it is a very simple license with simplified terms. Everybody tells us we are overvaluing our IP and we are over negotiating, these are criticisms. So, we now have a situation where we say here you go, it is free and there is a very simple license, we still don't license any of that technology to Scottish companies. We have done two Scottish start-up which is two members of our academic staff who went on to start-up companies of the back of it but now other Scottish business. We have the USA taking it up, some in Germany a couple in the rest of the UK so you need to ask the question is the money for licenses really the barrier or is it their absorptive capacity to take that technology and turn it into something more.

We are trying to create an environment on this campus which is more entrepreneurial where people feel supported to do it because a lot of people will say here that frankly I

want to follow up the opportunity but it is just too much hassle. Or I don't know where to go or I get passed around internally and we are trying to correct that, so people feel supported and rewarded for what they do. Hence, we have embedded that into the [workload plan] and we have now to make sure that it is used. Again, this comes down to the culture of the line-managers, if they don't recognise it then it's difficult. They are now paying more attention with the focus on impact and I can talk until I'm blue in the face, but unless somebody externally says that you have to do this, for this reason. Then I can't get them to respond. A lot of them will say that they work in [this university], they think [this university] just houses them.

To all intense and purposes, they go out and win all their research funding and yes we provide infrastructure. But they are the ones with the ideas and selling those ideas to their peer group to win that funding. They could do that at any university they choose, certain universities can make that job easier or harder. We are seeing increasingly the way to win larger grants is to be more institutionalised you know the university has to support them more heavily than we have done and they are the ones where you start to get that corporate relationship you know where going to pay for 10 PhD students and invest in infrastructure and we are seeing more of that where we have to co-invest with the other funder and that is where it becomes a [this universities] initiative rather than an individual academic.

Appendix 4: Questionnaire Email Request

Dear xxxx

My name is Mark Johnson from the Hunter Centre for Entrepreneurship at the University of Strathclyde and as part of my PhD I'm running a study to better understand the individual and organisational factors that impact academics and university researchers in Scottish universities when exploiting their research through participating in knowledge exchange activities.

The outcomes from this study will bring a greater understanding of the diverse motivational factors which encourage academics within Scottish universities to participate, or not, across a spectrum of knowledge exchange activities (i.e. contract research, collaborative research, continuous professional development, contract consultancy, licensed technologies and company formation). The questionnaire is being circulated across Scottish universities and I would be grateful for your assistance in completing the questionnaire.

Follow this link to the Survey:

The questionnaire is anonymous, has ethical approval and takes around 15 minutes to complete. If you have any questions relating to this questionnaire please address them to Mark Johnson mark.johnson@strath.ac.uk and my supervisor, Dr Erik Monsen erik.monsen@strath.ac.uk

Many thanks for your assistance.

Kind regards,

Mark Johnson

Appendix 5: Questionnaire

PhD Questionnaire

Thank you for helping me with my PhD research by completing this questionnaire. The purpose of the study is to attempt to bring greater understanding of the individual and organisational factors that may influence academics to participate, or not, in a range of entrepreneurial (knowledge exchange) activities. In this questionnaire knowledge exchange is broadly defined to include activities where research and knowledge are converted into market-products, processes, and services for non-academic institutions. This includes:

Contract research, collaborative research, continuous professional development (CPD), contract consultancy, patenting and licensing technologies and company formation (spin-outs or start-ups).

The questionnaire takes around 15 minutes to complete. **Please attempt all the questions** by selecting either the number or choice on the scale provided that best describes your opinion. You do not have to answer any questions you are not comfortable answering and you can leave the survey at any time. Some of the questions may appear to be similar, but they do address somewhat different issues. Your answers are confidential, and results will only be released as summaries in which no individual answers can be tracked. By completing this questionnaire, you agree to participate in this study.

Q1 Please indicate your gender:

- Male
- Female

Q2 Please indicate your age group:

- Under 30
- 30 - 39
- 40 - 49
- 50 - 59
- Over 60

Q3 What is your academic rank within your institution?

- Professor
- Reader, Senior lecturer, Principal lecturer or Senior research fellow
- Lecturer
- Research fellow, teaching fellow or research associate
- Research assistant or teaching assistant
- Other - please specify _____

Q4 Employment status:

- Fixed term Contract
- Tenured (Permanent Position)

Q5

Have you at any time in the past started your own company?

- Yes
- No

Q6 Do you have line management responsibilities where subordinates report directly to you?

Yes

No

Q7 Please indicate if your research is typically.....

Applied Research

Basic Research

Q8

Please indicate your main subject area

- Health Sciences
- Biological Sciences
- Chemistry
- Veterinary Science & Agricultural Studies
- Physics & Astronomy
- Mathematics & Computing
- Engineering
- Materials Science
- Architecture, Building & Planning
- Law, Social Sciences & Economics
- Business & Financial Studies
- Languages
- Creative Arts & Media
- Education
- Other Humanities
- Other _____

Q9 Resources for innovation at your university.

Please indicate how strongly you agree or disagree with each statement.

	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
There are adequate resources devoted to innovation in this organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is adequate time available to pursue creative ideas here.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assistance in developing new ideas is readily available	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of funding to investigate creative ideas is a problem in this organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Personnel shortages inhibit innovation in this organisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This organisation gives me free time to pursue creative ideas during the workday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q10 Participating in Entrepreneurial Activities

Please indicate on the scale below, how likely is it that you will participate in each of the following activities in the next 2 years?

	Very Unlikely (1)	Unlikely (2)	Somewhat Unlikely (3)	Undecided (4)	Somewhat Likely (5)	Likely (6)	Very Likely (7)
How likely is it that you will attempt to license technology based on your research in the next 2 years?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How likely is it that you will attempt to start a company based on your research in the next two years?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How likely is it that you will participate in contract consultancy in the next 2 years?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How likely is it that you will participate in delivering continuous professional development to external organisations in the next two years?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How likely is it that you will participate in contact research in the next 2 years?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How likely is it that you will participate in collaborative research in the next 2 years?

Q11

The following section covers questions about your self-regulatory orientation
Please indicate how strongly you agree or disagree with each of the following statements.

	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
In general, I am focused on preventing negative events in my life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am anxious that I will fall short of my responsibilities and obligations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I frequently imagine how I will achieve my hopes and aspirations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often think about the person I am afraid I might become in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often think about the person I would ideally like to be in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I typically focus on the success I	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

hope to achieve in the future.							
I often worry that I will fail to accomplish my academic goals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often think about how I will achieve academic success.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often imagine myself experiencing bad things that I fear might happen to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q12 Self-regulation continued

Please indicate how strongly you agree or disagree with each of the following statements.

	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
I frequently think about how I can prevent failures in my life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am more oriented toward preventing losses than I am toward achieving gains.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My major goal right now is to achieve my academic ambitions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My major goal right now is to avoid becoming an academic failure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I see myself as someone who is primarily striving to reach my “ideal self”—to fulfill my hopes, wishes, and aspirations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see myself as someone who is primarily striving to become the self I “ought” to be - to fulfil my duties, responsibilities, and obligations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In general, I am focused on achieving positive outcomes in my life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often imagine myself experiencing good things that I hope will happen to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I am more oriented toward achieving success than preventing failure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q13 Line manager self-regulation

Please indicate how strongly you agree or disagree with the following statements about your line manager (the person you report directly to)

	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
My line manager is good at many different things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My line manager sets improvement goals for my department/group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My line manager prefers innovative approaches to traditional approaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My line manager frequently gets on senior managements nerves	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My line manager crosses the line by doing things senior management would not formally approve of	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Not being careful enough has gotten my line manager in trouble at times	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My line manager acts in ways that senior management thinks are objectionable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q14 Please indicate the level of colleague participation in your work group for the following activities?

	Nobody (1)	About a quarter of the group (2)	About half the group (3)	About three quarters of the group (4)	Everybody (5)
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Within your work group, colleagues have already participated in the formation of a company and/or have licensed technologies in order to commercialise their research

Within your work group, colleagues have already participated in any of the following activities: continuous professional development, contract research, contract consultancy or collaborative research