BECOMING PARTNERS: A PROCESSUAL APPROACH TO THE FORMATION AND DEVELOPMENT OF UNIVERSITY-INDUSTRY RESEARCH PARTNERSHIPS

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Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor in Philosophy

April 2019

ABSTRACT

University-Industry interaction has become an increasingly important priority for organisations and policy-makers as a source of innovation. Organisations are increasingly engaging with universities to enhance innovation efforts and drive productivity in R&D. Policy-makers are increasingly looking to university-industry interaction as a means of stimulating innovation-based economic development. Whilst there is a substantial body of research that has examined the transfer of technology from academic to industrial contexts, there is comparatively limited research related to university-industry research collaboration. Recently, the concept of university-industry research partnerships has been advanced to characterise enduring collaborative arrangements between firms and universities. However, despite this conceptual advancement, we still have little understanding of the evolutionary dynamics of such collaborative arrangements. Thus, the primary research question posed here is "How do university-industry research partnerships emerge and develop over time?". To answer this research question, I draw upon recent advancements in process theories of organisation as well as the process metaphysics of A.N Whitehead. These theoretical insights are integrated with existing approaches to alliance dynamics to elaborate a processual model of partnership development. I draw upon a single longitudinal case study of the strategic research partnership between Unilever and the University of Liverpool to demonstrate how processual approaches to organisation advance our understanding of alliance dynamics in general and the dynamics of university-industry research partnerships in particular. I show that the emergence and development of partnerships is underpinned by the relationality and activity of events and advocate an 'unowned' process of partnership development driven by the dispersed forces of choice, chance and determinism. I also demonstrate how a Whiteheadian events-based theory of organisation can be mobilized to resolve the 'being-becoming' dualism inherent in existing process theory.

Acknowledgements

First, I would like to thank my Mum and Dad. Without your encouragement and support I would never have attempted a PhD, let alone seen it through to submission. I will be eternally grateful for your belief, care and love that has allowed me to undertake this challenge. I hope it makes you proud. I would also like to thank my sisters, Rosie and Katie, for supporting me along the way. Thank you for the belief you have shown in me and for keeping me smiling when it got tough.

I also owe a debt of gratitude to Mary and Ray Mellon, who have had the good grace to accept me into their home over the course of this journey. When I began this PhD, I could never have imagined living with another family in another home. Thank you for looking after me.

Academically, I am indebted to my supervisor Prof. Oswald Jones, who has guided me and supported me through the drafting of this thesis. The patience and encouragement you have demonstrated towards me cultivated an intellectual curiosity that I didn't know I had, thank you. Also, you completely changed my perception of Manchester United fans, I am glad we experienced 'the Mourinho years' together. Benito, thank you for giving me the opportunity to pursue a PhD, I am glad we had that Skype call over the summer of 2013. I will not forget the time and patience you have afforded me, or that weekend in Chicago.

I also owe thanks to my fellow PhD students at the University of Liverpool Management School, for the intellectual stimulation and sustained encouragement throughout the PhD. I am truly lucky to have been here at the same time as some of my peers who made this such an enjoyable and intense experience. In particular I would like to thank Leighann, Kizzy, Claire, Roland and Scott.

This thesis would also have not been possible without the support of Dr. Matt Reed and Dr. Simon Longden. Matt, your enthusiasm, patience and insight has provided a continued source of encouragement, thank you. Simon, the warmth and encouragement you afforded me extended beyond the call of duty. I will be eternally grateful for your help, guidance and friendship.

This thesis focuses on how partnerships become, drawing attention to how seemingly peripheral occurrences can grow into occasions of extreme significance. Over the course of this PhD, I met Yvonne, a PhD student at the School of Law one day outside the gym. This seemingly innocuous meeting altered the course of my life entirely and Yvonne, has grown to be the most important person in my life. Evie, without your support, patience and love I would not have completed this thesis. This is for you.

Table of Contents

Chapter One: Introduction- Research topic and thesis outline	6
Chapter 2: Perspectives on University-Industry Interaction	12
2.1 Introduction: Chapter Overview	12
2.2 University-Industry Interaction: Mechanisms and Perspectives	13
2.3 Commercialisation	17
2.3.1 Commercialisation: Conceptual Overview	17
2.3.2 Organisational Antecedents of Patenting and Licensing	19
2.3.3 Institutional Heterogeneity: The critical variable	
2.3.4 Organisational Antecedents to Spin-Off Activity	
2.3.5 Academic Entrepreneurs: individual antecedent factors	
2.3.6 Commercialisation Review: Shifting Sands?	
2.4 Research Collaboration	
2.4.1 Defining Collaborative Research	
2.4.2 Conceptualising University-Industry Partnerships	41
2.4.3 Individual-Level Analysis of research collaboration	44
2.4.4 Context and collaboration- the role of geography and policy	51
2.4.5 Organisational Antecedents: Formation	
2.4.6 Successful collaboration: Organisational and managerial factors	61
2.4.7 Emerging perspectives on organisational collaboration: Practices and Process	66
2.5 Conclusions and Next Steps	72
Chapter 3: Theoretical approaches to the alliance development process	75
3.1 Introduction	
3 7 The emergence and Development of Organisation: Process Theorising	76
5.2 The emergence and Development of Organisation. Process meetising	
3.2.1 Process Ontologies	
 3.2.1 Process Ontologies	
 3.2 The energence and Development of Organisation. Process Theorising	ional 88
 3.2 The energence and Development of Organisation. Process Theorising	ional
 3.2 The energence and Development of Organisation. Process Theorising	ional 80 ional 82
 3.2 The energence and Development of Organisation. Process Theorising	ional 82
 3.2 The energence and Development of Organisation. Process Theorising	, 77 80 ional 82 84 88 93 96 rocess
 3.2 The energence and Development of Organisation. Process Theorising	, 77 80 ional 82 84 88 93 96 rocess
 3.2 The energence and Development of Organisation. Process Theorising	
 3.2 The energence and Development of Organisation: Process Theorising. 3.3 Inter-Organisational Relationships. 3.4 Process Perspectives on the Formation and Development of Inter-organisat relationships	,
 3.2 The energence and Development of Organisation. Process Theorising. 3.3 Inter-Organisational Relationships. 3.4 Process Perspectives on the Formation and Development of Inter-organisat relationships	
 3.2 The energence and Development of Organisation. Process Theorising. 3.3 Inter-Organisational Relationships. 3.4 Process Perspectives on the Formation and Development of Inter-organisat relationships	, 70 , 77 , 80 ional , 82 , 84 , 88 , 93 , 96 rocess , 100 , 101 , 103 , 109 , 109 , 109 , 109 , 112 , 116
 3.2 The energence and Development of Organisation: Process Theorising. 3.3 Inter-Organisational Relationships. 3.4 Process Perspectives on the Formation and Development of Inter-organisat relationships 3.4.1 Life-Cycle Models of Inter-Organisational Relationships 3.4.2 Teleological models of Strategic Alliance Development	<pre></pre>
 3.2 The energence and bevelopment of Organisation. Process Metorising. 3.3 Inter-Organisational Relationships. 3.4 Process Perspectives on the Formation and Development of Inter-organisat relationships	<pre></pre>
3.2 Interentergence and beverlopment of Organisation. Process Theorising 3.2.1 Process Ontologies	<pre></pre>
 3.2 The entregence and overlopinent of Organisation. Process Theorising	<pre> 70 77 80 ional 82 84 88 93 96 rocess 100 101 103 103 109 109 109 112 116 119 111 131 </pre>
 3.2 The energence and beetopprient of organisation: Process Theorising	<pre></pre>
 3.2 The energence and bevelopment of Organisation. Process mechanism. 3.2.1 Process Ontologies 3.3 Inter-Organisational Relationships 3.4 Process Perspectives on the Formation and Development of Inter-organisat relationships 3.4.1 Life-Cycle Models of Inter-Organisational Relationships 3.4.2 Teleological models of Strategic Alliance Development 3.4.3 Evolutionary perspectives on the Development of IORs 3.4.4 Dialectical Perspectives on the Development of IORs 3.5 Limitations of existing theoretical approaches: Problems with substantive p theories 3.5.2 Problems with Representationalist Epistemology 3.5.2 Problems with Representationalist approaches Chapter 4: Process Metaphysics and Methodology 4.1 Ontology, Epistemology and Theory 4.1.2 Towards Organisational Process Theory 4.1.3 An Events-Based Theory of Organisation (and Change) 4.2 Research Design and Methods 4.2.1 Research Aims and Objectives 4.2.3 Data Collection 	76 77 80 ional 82 84 83 93 96 rocess 100 101 109 109 109 109 109 112 109 112 109 112 116 119 111 131 131 135

	4.2.5 Case Overview: The University of Liverpool-Unilever Strategic Partnership	3
С	hapter 6: A Whiteheadian analysis of strategic partnership development: events,	
р	rehensions and organisational meaning structures	l
	6.1 Introduction151	L
	6.2.1 Concrescence of events into a Formation creates an Organisational Meaning Structure: 'Becoming' of the UoL-Unilever Strategic Partnership156	5
	6.3 Organisational Meaning Structure reconfigured through Relationality and Activity.	2
	6.3.1 Activity: Events reconfigure Meaning Structure Elements	2
	6.3.2 Relationality: Events preserve Organisational Meaning Structure Elements and define developmental trajectory	7
	6.4 Organisational Meaning Structure 'fixed' in the establishment of the MIF	L
	6.4.1 Activity: Events reconfigure Organisational Meaning Structure Elements	L
	6.4.2 Relationality: Events Define Meaning Structure Elements and developmental trajectory174	1
	6.5 Organisational Meaning Structure reconfigured again through Relationality and	
	Activity of Events	5
	6.5.2 Relationality: Events stabilise actors, concepts and materials)
	6.6 Conclusion 181	1
~		-
C d	evelopment and university-industry partnerships	2
	7.1 Introduction	2
	7.2 Towards the integration of 'Being' and 'Becoming': Events as the agents of process	
		5
	7.3 Reconceptualising Strategic Alliance Development: An 'Unowned' perspective 203	3
	7.4 On the Emergence and Development of University-Industry Research Partnerships: A processual perspective	2
	7.5 Conclusion)
С	hapter 8: Concluding Comments222	2
	8.1 Introduction	2
	8.2 Scope of Research225	5
	8.3 Main Findings and Theoretical Contributions228	3
	8.3.1 Reconceptualising organisation and change: Towards a Whiteheadian perspective	z
		,
	8.3.2 Reconsidering alliance development: Towards an unowned process perspective)
	8.3.3 Becoming partners: Towards a conjunctive theory of university-industry partnership development	3
	8.4 Theoretical limitations and considerations for future research	7
R		1
•	leferences	ι
^ ^	eferences	2

Appendix 1a- Documentary Data Overview	258
Appendix 1b- Overview of Interviews	262
Appendix 3a- Relationality and Activity- CMD Established	264
Appendix 3b- Relationality and Activity- Relationship Expands	273
Appendix 3c- Relationality and Activity- MIF Project Established	286
Appendix 3d- Relationality and Activity- MIF Redefined	309

Chapter One: Introduction- Research topic and thesis outline

The interactions between universities and organisations have become increasingly significant over the past thirty years, as the transition to a 'knowledge-based economy' has taken root (Dowling, 2015). Within this time, policy-makers have sought to foster university-industry interaction as a means of stimulating innovation and economic development (Grimaldi et al., 2011; Hughes and Kitson, 2012). An indication of the significance of university-industry interaction to policy-makers is provided by the number of public reviews that have focused on fostering these interactions over the past ten years, starting with the Lambert Review on Business-University Collaboration in 2003 through the Sainsbury Review in 2007, the Wilson Review in 2012, the Heseletine Report in 2013, the Hauser Review in 2014 and the Dowling Review in 2015. All of these policy reviews emphasise the importance of universityindustry interaction to firm innovation and the economic prosperity of the UK. Alongside policy interest, there is evidence to suggest that firms are increasingly looking to universities to bolster their own R&D efforts, in an attempt to enhance their innovation performance and market competitiveness (D'Este and Patel, 2007; Fabrizio, 2006; Hughes and Kitson, 2012). Despite the increased policy and industry interest in university-industry collaboration, the frequency of these reviews suggests that there is still a lot that we don't understand about the management and organisation of such interactions.

This is not to say that we are ignorant of course. The past 20 years has seen the development of a burgeoning academic literature focused on explaining the factors that impact the development and success of university-industry interaction. Most of this research has focused on the 'entrepreneurial' activities of universities (Etzkowitz, 2003; Siegel and Wright, 2015a) examining factors that influence the ability of the university to commercialise its knowledge stocks (Grimaldi et al., 2011; Perkmann et al., 2013). Although this entrepreneurial activity is important, it has been highlighted that firms generally are less interested in licencing technology from universities and more interested in developing research collaborations that can add to their ongoing R&D efforts (Bercovitz and Feldman, 2007; Bishop et al., 2011; Cohen et al., 2002; Perkmann et al., 2013; Salter et al., 2010). Similarly, recent policy reviews have

highlighted that firms derive more benefits from engagement in strategic, long-term research partnerships with universities (Dowling, 2015). This was echoed in a recent review of UK Universities knowledge transfer strategies, which concluded that "on balance, institutions across the sector clearly value having a small number of significant collaborations, as opposed to casting a wide reach where engagement is less substantial" (RSMPACEC, 2017, p. 5). Despite the apparent significance of strategic research partnerships, there has been limited academic research on this particular form of university-industry interaction.

Research that has focused on strategic research partnerships has primarily been concerned with definition and conceptual clarification (Boardman and Bozeman, 2015; Perkmann and Walsh, 2007; Perkmann and West, 2015). There is an emerging stream of research that examines how these research partnerships function to deliver benefits for participants (Perkmann and Schildt, 2015) and there is a nascent stream of research that has explored how research partnerships develop over time (Ankrah and AL-Tabbaa, 2015; Philbin, 2008; Thune and Gulbrandsen, 2014). Although these recent attempts are useful for providing conceptual clarification, they are largely devoid of management theory, which means they offer a limited understanding of the dynamics of university-industry partnership development (Thune and Gulbrandsen, 2014 provide a notable exception). The overarching aim of the current research is to enhance our understanding of university-industry partnership development. Therefore, the primary research question guiding the research is:

"How do university-industry research partnerships emerge and develop over time?"

In order to develop an enriched understanding of university-industry partnership development, it became necessary to engage with the wider literature related to the two main concerns of the question, namely partnership dynamics (Majchrzak et al., 2015) and organisational emergence and development. The issue of organisational emergence, development and termination is the principal concern of a body of research broadly termed 'process research' (Langley et al., 2013). Therefore, to address the primary research question requires engagement with questions related to the nature of organisational emergence and development (process research) and the development of partnerships as a particular form of organisation. To establish a coherent theoretical basis from which the emergence and development of universityindustry partnerships can be understood, I first address the issue of alliance development processes. The development of strategic alliances has long been a focus of academic research, with a well-developed theoretical basis offering a good platform for investigating the emergence and development of university-industry partnerships. However, some have highlighted that theories of alliance development are underpinned by particular conceptions of organisational change that limit the utility of these theoretical models (de Rond and Bouchikhi, 2004), suggesting alternative assumptions about the nature of organisational change are required for more holistic theories. More recently, research has indicated that existing theories of alliance dynamics (Doz, 1996; Ring and Van de Ven, 1994) are insufficient for the analysis of university-industry partnership development (Thune & Gulbrandsen, 2014).

To address the limitations of existing theoretical approaches to alliance development, I engage directly with questions concerned with the nature of organisational change. To do this I draw upon recent advances in 'organisational process theory' (Helin et al., 2014; Hernes, 2014a; Hussenot and Missonier, 2015; Weik, 2011) and on the process philosophy of Alfred North Whitehead (1929) in particular. Organisational process theory represents an emerging school of thought that attempts to reframe established understandings of organisational change, suggesting an ontological reorientation from the primacy of 'entities' toward the primacy of 'process'. In other words, organisational process theory encourages a shift in focus from the being of organisation to the becoming of organisation (Hernes, 2014a; Tsoukas and Chia, 2002). In this thesis, I build on recent advancements in process theory, incorporating elements of Whitehead's metaphysical system to develop a novel framework for understanding organisation and change. I then build upon these insights to develop a novel approach to the analysis of alliance dynamics, which is more attentive to the empirical complexity that characterises university-industry partnerships. Finally, I draw upon this novel approach to alliance dynamics to elucidate novel theoretical insights into the university-industry partnership development process.

8

To generate these insights, I conduct a longitudinal case study focusing on the emergence and development of the strategic research partnership between Unilever and the University of Liverpool. Collaboration began in late 1997 and continues to this day. The analysis focuses on the period from the beginning of collaboration in 1999 to the opening of the 'Materials Innovation Factory' (MIF), a flagship collaborative project in April 2017. To unpack the complex dynamics at play I rely on qualitative data collected via documents, interviews and observations. The participants of the research, including senior management from both the University of Liverpool and Unilever, are of the opinion that this particular partnership is unique in terms of the scale and depth of collaboration. Over the period covered in this thesis, Unilever twice made record-breaking investments in university research with the University of Liverpool. The investment in the MIF in particular reflects Unilever's largest global investment in external R&D, which is a significant milestone given Unilever's annual R&D budget of over €1bn. Having spent a substantial amount of time examining the literature related to university-industry collaboration and having spoken to other researchers, practitioners and policy-makers over the duration of the study, I am inclined to agree on the distinctiveness of this particular partnership. Therefore, the study of this case provided a unique opportunity to develop insights into the dynamics of university-industry partnership development, as well as insights more broadly relevant to organisational process research. The rest of the thesis is structured as follows:

Chapter Two: Perspectives on University-Industry interaction

This chapter provides a comprehensive overview of existing research concerned with university-industry interaction. The chapter distinguishes between 'commercialisation' and 'engagement' forms of interaction and provides a review of research pertaining to each form. The chapter highlights the relative paucity of research concerned with university-industry research partnerships and in particular with their evolutionary dynamics. The chapter finishes by distinguishing universityindustry research partnerships as a distinct mode of university-industry interaction and by suggesting a potential avenue for theoretical development, namely the dynamics of strategic alliances.

Chapter Three: Theoretical approaches to the development of strategic alliances

This chapter first outlines different approaches to process theorising, distinguishing 'weak' and 'strong' perspectives. I then provide an overview of the existing theoretical models of strategic alliance development, distinguishing between Life-Cycle models, Teleological models, Evolutionary models and Dialectical models. The chapter concludes by highlighting the limitations of existing models that are largely rooted in their underpinning ontological and epistemological assumptions. I suggest that to overcome these limitations, an alternative conceptualisation of organisation and change, based on an alternative metaphysical foundation is required.

Chapter Four: Process Metaphysics and Methodology

This chapter is structured in two parts. The first part of the chapter outlines process metaphysics with particular reference to the process philosophy of Alfred North Whitehead. The first part concludes by defining an alternative metaphysical foundation from which a new perspective on alliance development can be developed, overcoming some of the limitations of existing approaches outlined in the previous chapter. The second part of the chapter provides a detailed overview of the empirical research, articulating the research questions and detailing the data collection techniques and analytical procedures.

Chapter Five: The emergence and development of university-industry partnerships: An 'unowned' analysis

This chapter synthesises the primary data collected and presents processual narrative of the emergence and development of the strategic partnership between Unilever and the University of Liverpool. The narrative is structured around four event-formations that constitute the partnership and outlines how these event-formations were brought about through the interacting forces of choice, chance and determinism.

Chapter Six: A Whiteheadian analysis of strategic partnership development: events, prehensions and organisational meaning structures

This chapter provides detailed analysis of how events worked to produce and reproduce organisational meaning structures. It draws explicitly on the Whiteheadian frame articulated in Chapter Four and demonstrates how organisation and change can be reconceptualised through a Whiteheadian approach. The chapter focuses on how prehensions between events created a provisional, perceptible whole that was 'the partnership'. It shows how the work of events (prehensions) reconfigured elements of the organisational whole (bringing novelty) and how it also located the organisation in spatio-temporal terms, affording a degree of stability. These two modes of prehension are identified as important theoretical mechanisms that underline organisation and change.

Chapter Seven: Discussion: Implications for theorising organisational change, strategic alliance development and university-industry partnerships

This chapter first provides a recap of my research questions and then proceeds to provide answers to each research question, drawing on the insights from the empirical analysis presented in Chapters Five and Six. The chapter first outlines the implications of Whiteheadian process philosophy for theorising organisational change based on the analysis presented in Chapter Six. The second section of the chapter outlines the implications of my 'unowned' process analysis, presented in Chapter Five, for theorising the development of strategic alliances. The third section of the chapter then outlines the implications of an 'unowned' theory of strategic alliance development for theorising the development of university-industry partnerships. The chapter concludes with a summary of my theoretical model for university-industry partnership development.

Chapter Eight: Concluding Comments

This chapter provides an overview of research, highlighting the main research findings and key theoretical contributions. I also highlight the limitations of the study and reflect on the implications for practice and future research.

Chapter 2: Perspectives on University-Industry Interaction 2.1 Introduction: Chapter Overview

This chapter provides an overview of the existing literature pertaining to University-Industry interaction. The first section provides an overview of the modes of universityindustry interaction, drawing conceptual distinctions between commercialisation mechanisms and engagement mechanisms (Perkmann et al., 2013). The second section focuses on commercialisation modes of interaction that have been widely examined in the existing literature. It explores the individual, organisational and environmental perspectives on commercialisation. The section concludes by highlighting the limitations of commercialisation modes of interaction for firm innovation and economic development. The second half of this literature review focuses on research collaboration between firms and universities. Again, a conceptual definition is provided, and summaries of individual, environmental and organisational perspectives are presented. The issue of how research partnerships emerge and develop over time is then discussed, drawing attention to existing empirical work and highlighting the main concern of this thesis. The chapter concludes by suggesting that the field of university-industry collaboration is characterised by theoretical underdevelopment and that there remains little evidence on the partnership establishment and development process. Furthermore, I suggest that analytical distinctions within the existing research between individual, organisational and environmental levels of analysis only serve to obscure our understanding of the emergence and development of collaborative research partnerships, since they encourage an analytical focus on the static aspects of collaboration rather than the dynamic interactions that propel collaborative activity. It is concluded that in order to better understand the emergence and development of collaborative research partnerships, the literature requires greater theoretical grounding in the dynamics of inter-organisational relations (Majchrzak et al., 2015) and necessitates the development of a theoretical framework that facilitates analysis of the mutual shaping of partnerships as connections are made between individuals, organisations and environments. A schematic overview of the current literature review is outlined in Fig 1.0





2.2 University-Industry Interaction: Mechanisms and Perspectives

The interaction that occurs between universities and commercial organisations has become an increasingly important phenomena within academic and policy circles (Hayter et al., 2018; Perkmann et al., 2013; Siegel and Wright, 2015b). There are two main drivers behind the interest in this phenomenon, first is the proliferation and widespread adoption of the open innovation paradigm (Chesbrough & Bogers, 2014), which has precipitated a shift in the role of universities in industrial R&D (Perkmann and West, 2015). Second is the increased policy emphasis on technology-based economic development, which again has precipitated a shift the role that universities play in regional and national innovation systems (Etzkowitz, 2003; Etzkowitz and Leydesdorff, 2000). Both of the open innovation and triple-helix perspectives position the modern 'entrepreneurial' university more centrally in analysis, emphasising that universities are increasingly important sources of innovation (and therefore competitive advantage) and also increasingly important 'engines' of technology-based economic development. Consequently, academic interest in university-industry interaction has burgeoned (Bozeman et al., 2013; Hayter et al., 2018). This chapter provides an overview of the literature concerned with university-industry interaction.

To structure the analysis of the literature concerned with university-industry interaction, I draw upon Perkmann & Walsh (2007) who offer a continuum of university-industry interactions based on the degree of relational involvement (Fig 1.1)

Extent of relational involvement					
High: relationships	Medium: mobility	Low: transfer			
Research partnerships Research services	Academic entrepreneurship Human resource transfer	Commercialization of IP (e.g. licensing)			
Use of scient	ific publications, conferences and networ	king (can accompany all forms)			

Fig 1.1 Typology of University-Industry interaction based on relationality

(Perkmann & Walsh, 2007)

More recent literature has categorised university-industry interactions through conceptualising 'commercialisation' and 'engagement' mechanisms (Perkmann et al., 2013). Commercialisation refers to those channels of interaction involving the "patenting and licensing of academic inventions as well as academic entrepreneurship" (Perkmann et al., 2013, p. 423). Commercialisation focuses explicitly on those forms of interaction underpinned by codified intellectual property that are aimed at generating pecuniary benefits for the organisations involved (Perkmann et al., 2013; Phan and Siegel, 2006; Rothaermel et al., 2007; Siegel et al., 2007a; Siegel and Wright, 2015b, 2015a). Engagement on the other hand refers to the broader subset of interaction channels that represent inter-organisational collaboration. The key distinction from the 'commercialisation' channels is in the shift in emphasis between exploitation to exploration (O'Reilly and Tushman, 2013). In other words, the objectives of interaction for both parties, when interacting through commercialisation channels is exploitation. For the university, this means exploiting codified inventions for licensing revenue. For the industry partner, it means exploiting codified inventions for innovation pipeline projects, such inventions may provide direct solutions to immediate technological problems. Conversely, when interacting through engagement channels, the emphasis shifts to exploration. For example, the university academic may engage in collaborative research to gain access to new datasets or equipment and the industrial partner may gain access to new know-how that can provide new perspectives on technological problems. The key point is that the objectives in 'engagement' interactions are not solely related to pecuniary outcomes and they are not solely based on codified IP. The key distinctions between 'Engagement' and 'Commercialisation' forms of interaction are outlined in Table 1.0

	Commercialisation	Engagement
Logic	Exploitation	Exploration
Type of	Explicit knowledge essential for all	Explicit knowledge not
knowledge	interaction	essential for interaction but
		can be drawn upon. Greater
		emphasis on tacit knowledge
Motivation	Transactional- parties engage in a	Collaborative- parties work
	transaction to maximise pecuniary	together to maximise the
	returns	value of joint research efforts
Organisation	Formal- Spin-Off is incorporated	Formal and Informal-
	or licence agreement signed.	Contracts are used as a form
	Contracts are the principle	of governance in some
	governance mechanism	interactions but not always.
Example	Academic Spin-Off firm with	Large Scale Collaborative
Channels	corporate backing	Research- Co-creation of
		research infrastructure and
	Industry licensing of University-	research programmes.
	owned IP	Co-publication
		Academic Consulting
		Contract Research

Table 1.0 Overview of Engagement and Commercialisation (based on Perkmann etal (2013)).

Whilst the binary conceptual distinction offered by the concepts 'academic commercialisation' and 'academic engagement' is useful, it is important to recognise that in reality, these distinctions (for example between formality and informality) are not always so neat and defined. Therefore, by adopting the logics of the two frameworks and combing them together, I propose a framework for universityindustry interaction that reflects a richer continuum operating along two dimensions. The first dimension on this continuum is the degree of relational involvement. Again, it is important to recognise that within the domain of university-industry interaction there is no purely transactional interaction (low relational involvement) just as there is no purely collaborative interaction devoid of any transactional elements (high relational involvement). The second dimension of the framework for channels of university-industry interaction is the degree of emphasis on exploitation and exploration. Theorists of organisational ambidexterity, that is "the ability to simultaneously pursue both incremental and discontinuous innovation...from hosting multiple contradictory structures, processes and cultures within the same firm" (Tushman and O'Reilly, 1996, p. 24), have emphasised the relationality of exploration and exploitation, advocating that neither exists in isolation. I categorise channels of university-industry interaction based along these two dimensions (relational involvement/ strategic logic). The reason for doing so is to provide a sense of structure and coherence to the rather amorphous literature concerned with interactions between universities and organisations. In the subsequent sections, I will address the key channels that have been subject to academic research, highlighting studies pertinent to each channel, drawing attention to key research findings and the theoretical perspectives adopted in the analysis of each channel. My organising framework is illustrated in Figure 1.1





Perkmann & Walsh, 2007 and Perkmann et al (2013)).

2.3 Commercialisation

2.3.1 Commercialisation: Conceptual Overview

Following (Perkmann et al., 2013) this chapter considers 'technology transfer' as analogous to research commercialisation that primarily occurs through academic entrepreneurship. Academic entrepreneurship manifests in two distinct ways, first it represents the founding of a firm with the expressed objective of commercially exploit a patented invention or unpatented collective expertise (Perkmann et al., 2013, p. 424). Second, protected IP may be licenced out against the receipt of royalties (Perkmann et al., 2013; Rothaermel et al., 2007). In both of these channels, the preliminary step of interaction involves the codification and protection of university generated intellectual property, which is one of the defining characteristics of technology transfer. The other defining characteristic is the objective to generate revenue, either for the inventors, the university, or the organisation that licenses the

technology (Bozeman et al., 2015; Perkmann et al., 2013). Technology transfer is sometimes considered as the most important way in which universities interact with their wider stakeholders (Bozeman et al., 2015), consequently there have been a plethora of reviews of academic literature that has investigated IP based universityindustry interaction (Bozeman et al., 2015; Phan and Siegel, 2006; Rothaermel et al., 2007; Siegel et al., 2007a; Donald Siegel and Wright, 2015b, 2015a; Wright, 2014). The primary focus of this thesis remains on collaborative arrangements rather than the commercialisation of university-generated IP, however, given the significance of such interactions within the broader scope of university-industry interaction and also in acknowledgement of the role that IP-based interaction may play multi-faceted cooperative partnerships, I provide a brief overview of the literature pertinent to technology transfer here drawing largely on the previously conducted systematic reviews.

Siegel, Waldman, & Link (2003) assert that there are three primary agents involved in the commercialisation of university technology; the academic scientist(s), the Technology Transfer Office (TTO) or other university administrative function and the corporate managers or entrepreneurs that are commercialising the technology. Bozeman et al. (2015) in their contingency model of technology transfer effectiveness similarly draw attention to the characteristics of the transfer agent (university) and the transfer recipient (commercialising entity) as factors determining the effectiveness of technology transfer. Commercialisation research generally makes several assumptions about the motivations and objectives of these three primary actors. First, academic scientists are assumed to be motivated by peer recognition and securing funding for the education and training of students (Dasgupta and David, 1994). These objectives are to be achieved through the widespread dissemination of their work and ideas via peer-reviewed publications, presentations at academic conferences and writing grant proposals (Siegel and Wright, 2015a). Second, TTOs and more broadly university administrators are characterised as "guardians of university IP" which has the capacity to generate revenue. The motivation for these actors is to secure the most equitable and profitable terms for IP, so as to avoid the perception that they are 'giving away' the assets of the university (Siegel and Wright, 2015a, p.

9). Third, corporate R&D managers or entrepreneurs are motivated to acquire technology from universities to enhance the competitiveness of the organisation that they work for. This assumes that technology-based innovation is a major source of competitive advantage for firms and the capability to deliver technological innovations quicker than rival firms enhances this competitive advantage (Siegel and Wright, 2015a).

Typically, the commercialisation process begins when a faculty member discloses an invention to the TTO, the TTO will then consult faculty experts and potential interested parties from industry to assess the viability of filing a patent. If the invention demonstrates early commercial viability, the TTO will file a patent and will then look to 'market' the IP to potential external users. Should external users be interested in the invention, the TTO (sometimes with the involvement of the inventing academic) will then proceed to negotiate a licensing arrangement (Rothaermel et al., 2007; Siegel and Wright, 2015a). While much of the existing research in commercialisation remains theory-deficient (Bozeman et al., 2015; Donald Siegel and Wright, 2015b), clear analytical perspectives have been adopted. For example, (Rothaermel et al., 2007) categorise literature according to; papers concerned with the organisational (university) level issues and commercialisation, papers concerned with the practices of the TTO and papers concerned with academic scientists and commercialisation. Here I follow this structure for providing a brief overview of existing literature on commercialisation but I will also consider papers that are concerned with the environmental or institutional characteristics and commercialisation (Phan and Siegel, 2006).

2.3.2 Organisational Antecedents of Patenting and Licensing

Organisational level analysis explores the relationships between organisational (university-level) characteristics or process and commercialisation activity. Organisational-level research is underpinned by the notion of the 'Entrepreneurial University' that forms one component of the 'Triple-Helix' of university-industry-government innovation systems (Etzkowitz, 2003). The core of this framework is the increased interaction between university, industry and government partners in

innovation strategies and practices. It is suggested that through closer interaction with industry and government partners, the 'entrepreneurial university' becomes a key driver of innovation, enhancing social and economic development (Etzkowitz, 2003). In order to become 'entrepreneurial' the university must be independent from the state and industry, having autonomy over its own strategic direction. It also must have close interaction with other institutional spheres such that it is not isolated from the wider socio-economic milieu. Taken together, this means that the university must adopt a strategic view of itself and its relations to others (Etzkowitz, 2013, 2003). Entrepreneurial universities still operate within conventional academic frameworks insofar as they are principally concerned with fundamental research that is undertaken by discrete research groups, but they are characterised by a greater degree of sensitivity to the social and economic implications of fundamental research activity (Etzkowitz, 2003). This enhanced socio-economic sensitivity is manifest in the establishment of organisational structures and mechanisms that facilitate the dissemination of fundamental research beyond the boundaries of the university, for example: the establishment of a TTO, formation of a spin-off firm and the provision of incentives to staff to engage in technology transfer activity would all be considered organisational hallmarks of an entrepreneurial university (Etzkowitz, 2003). Consequently, the existing organisational-level literature has sought to examine these organisational arrangements and the implications of them for the entrepreneurial activity of the university.

One of the key concerns at the organisational level of research is how universities reconcile the 'third mission' of entrepreneurship with the traditional academic functions of teaching and research in terms of their strategic and structural arrangements (Ambos, Mäkelä, Birkinshaw, & D'Este, 2008; Colyvas, 2007; D'Este & Patel, 2007; Etzkowitz, 2003; Etzkowitz & Leydesdorff, 2000; Feldman & Desrochers, 2003; Horowitz Gassol, 2007; Lockett, 2003; Lockett, Wright, & Wild, 2015; Sánchez-Barrioluengo, 2014; Sengupta & Ray, 2017a, 2017b). Another major concern is the factors that cause variations in the degree of entrepreneurial activity within universities (Anderson et al., 2007; Bozeman et al., 2015; Chapple et al., 2005; DiGregorio and Shane, 2003; Horner et al., 2019; Phan and Siegel, 2006; Rasmussen

20

et al., 2006; Siegel and Wright, 2015a; Thursby et al., 2001; Van Looy et al., 2011; Wright et al., 2008, 2004). A third major topic within this stream of research is concerned with the barriers that prevent universities becoming more entrepreneurial (Grimaldi et al., 2011; Hughes and Kitson, 2012; Lee, 1996; Salter et al., 2010).

Organisational level research has explored how different university characteristics influence entrepreneurial activity (Phan and Siegel, 2006). For example, Ambos et al (2008) suggest that the ability of a university to commercialise research is contingent upon the degree of organisational ambidexterity achieved. Drawing on data collected from 207 EPSRC funded projects, they illustrate that it is possible to achieve ambidexterity at organisational level through the combination of scientific excellence in research (as indicated by 2001 RAE performance) and the establishment of a 'dual structure' for commercialisation (as indicated by the establishment of a TTO). It was found that the breadth of TTO activity, in terms of the support mechanisms offered, such as incubation space, science-park accommodation and seed-corn investment, had no impact on commercialisation efforts. In considering the organisational determinants of technology transfer activity, they conclude that the formation of dual structures are critical in enabling universities in commercialisation efforts since they enable different groups of people to work single-mindedly towards divergent goals, leaving the issue of reconciliation to a small group of senior administrators (Ambos et al., 2008).

Building on Ambos et al (2008), Hewitt-Dundas (2012) examines the relationship between research intensity and commercialisation activity. Previous evidence from the US had indicated that the quality of a university's research creates a demand-pull effect, resulting in higher average licensing revenues (Miyata, 2000). Similarly, Hewitt-Dundas (2012) suggests that more research-intensive universities will demonstrate greater levels of commercial activity than less research-intensive universities. Drawing on the 2005-6 round of the Higher Education-Business Community Interaction (HE-BCI) survey and the 2001 RAE return, Hewitt-Dundas (2012) conducts a k-means cluster analysis to examine the linkages between research performance, organisational support structures for commercialisation and commercialisation performance. Based on this analysis she concludes that high research-intensive universities are more likely to place strategic emphasis on commercialisation than low research-intensive universities (and highlights the low strategic attention to spin-off activity among UK HEIs). The paper highlights that commercialisation capabilities are largely the same across low research-intensive universities and high researchintensive universities but there was a slight difference in the patenting and licensing capabilities between the two types of universities. Specifically, it is highlighted that high-research intensive institutions are more likely to have more developed internal patenting and licensing capabilities whereas low research-intensive institutions are more likely to outsource these activities. Interestingly the results indicate that the structural supports play a limited role in directly determining the commercialisation performance of the university, suggesting that the major determinant of interinstitutional variation is the degree to which organisational capabilities are aligned with university strategic priorities (Hewitt-Dundas, 2012). The paper concludes by highlighting that there are significant differences in the performance of commercialisation activities between high research-intensive universities and low research-intensive universities, drawing attention to the role that organisational strategy plays in producing this heterogeneity.

Sánchez-Barrioluengo (2014) also highlights the significance of university level strategy in the context of commercialisation activity. Drawing on TTO, patent and national statistics data in Spain, he shows that the three university missions of teaching, research and entrepreneurship are distinct. Furthermore, through structural equation modelling, the paper shows that while the missions of research and entrepreneurship appear to be complementary, they are both in conflict with the teaching mission of the university, again drawing attention to the strategic tensions that need to be resolved for commercialisation to be effective. The emphasis on university missions also suggests that not all universities will be able to engage in commercialisation in the same way, thus other ways in which to make wider socio-economic contributions need to be considered.

More recently, Sengupta and Ray (2017a) have examined how the practice of ambidexterity within universities impacts its performance on its core missions, namely research and entrepreneurship. Like Hewitt-Dundas (2012) and Ambos et al (2008) they suggest that universities should be able to build capabilities that contribute to commercialisation activity whilst simultaneously maintaining a focus on fundamental research. Furthermore, they suggest that these 'two pillars' are related, assuming that the research pillar reinforces the commercialisation pillar since past research outputs impact future knowledge transfer activities. Thirdly, they account for the path dependent nature of 'research excellence' and 'commercialisation activity' by including university size and reputation in their analysis. The key argument is that, as university capabilities in research and knowledge transfer mature and develop, they become self-reinforcing and structurally independent of one another. Using three years of HE-BCI data combined with two rounds of REF returns, they show that the two pillars of research and commercialisation are interrelated and that past research performance has a net positive effect on commercial outcomes at organisational level. Interestingly, they find that the commercialisation activity of a university could yield negative impacts on the research performance of the university, suggesting that universities in the UK may have developed patent portfolios that are useful neither for commercialisation nor research.

The relationship between research activity and commercialisation activity is also explored by (Van Looy et al., 2011) who conduct a systematic evaluation of the antecedent factors that underpin university commercialisation success. Their empirical study focuses specifically on the relationships between university characteristics, the economic context in which the university is embedded and the entrepreneurial performance of the university. They suggest that research productivity of the university will have a direct effect on the level of patenting activity. This link is proposed on the basis that both activities are informed by the same underlying motivation, namely the generation of new scientific and technical knowledge. Using data collected from 105 universities in 14 European countries, they find evidence to support the link between research productivity and patenting activity. In line with findings articulated above, Van Looy et al (2011) also find evidence

23

to support positive links between the size of the university and patenting activity. Furthermore, there were significant links found between the presence of an engineering department and patenting activity, suggesting that the scope of university research (in terms of basic or applied) has an impact on entrepreneurial performance. The relationship between research productivity and entrepreneurial performance was depressed when the channel examined was spin-off establishment but was still positive and significant.

Moving away from the research-commercialisation links, some have examined the role that organisational support structures play in enhancing university commercialisation efforts. Based on a qualitative case study of Chalmers University of Technology, the Norwegian University of Science and Technology, the University of Oulu and Trinity College Dublin, Rasmussen et al., (2006) explored how universities respond to increasing demands for entrepreneurship through specific initiatives and policies. They identified a range of support mechanisms adopted across their case universities including; research support, the establishment of incubator facilities to provide physical and material support to new firms, access to seed-corn venture capital to fund development of ideas and prototypes before sales channels were established and royalty sharing structures for academic inventors. As this list suggests, there was generally more support for spin-off activity than there was for licensing but the key factor underpinning support for both mechanisms was the access to funding.

Others have focused more on the linkages between incentives and academic entrepreneurship, showing evidence to support the links between rewarding faculty for entrepreneurial activity and the level of university entrepreneurial activity particularly in terms of spin-off creation (Debackere and Veugelers, 2005; Henrekson and Rosenberg, 2001; Rothaermel et al., 2007; Thursby et al., 2001). Link & Siegel (2005) focus explicitly on the 'royalty distribution formula' showing that those universities that provide a higher proportion of royalties to academic inventors are more productive in terms of disclosures, patents and licences, although more recent research has suggested that the effects of royalty sharing may be overestimated (Arqué-Castells et al., 2016). In total, this research suggests that the provision of pecuniary and other incentives, such as professional advancement opportunities, facilitates the development of an 'entrepreneurial culture' within universities which has elsewhere been highlighted as a critical determinant of university entrepreneurial performance (Rasmussen et al., 2006).

As the previous section demonstrates, there is a well-developed literature on the support organisational support structures in their relation to commercialisation activity. One particularly rich seam in this literature is that which explores how the key organisational support structure, the TTO, impacts the productivity of commercialisation efforts (Bercovitz et al., 2001; Chapple et al., 2005; Miller et al., 2016; Siegel et al., 2007b; Siegel and Wright, 2015a). Several studies have shown that the increased scale of TTOs in terms of staff size is reflected in the productivity of commercialisation activity in terms of patents and licences (Siegel et al., 2003; Thursby and Kemp, 2002). However, this finding was contested in the UK context, where decreasing returns to scale were found (Chapple et al., 2005). This is possibly explained by the general lower level of productivity exhibited by UK TTOs and relative lack of experience in relation to more institutionalised US counterparts.

One of the largest studies of TTO productivity was produced by Siegel et al (2003) who utilised extensive qualitative and quantitative data from US TTOs to explain relative variations in performance. Their study was instrumental in highlighting the roles that TTOs play in determining inter-organisational variation in commercialisation activity, drawing attention to the impact of TTO organisational practices. Based on their qualitative analysis they suggest that there are three principle organisational barriers that inhibit commercialisation activity. First, they suggest that cultural differences between universities and firms, particularly small firms, in terms of their time-horizons, communication styles and valuations of IP present a significant barrier to commercialisation. The second major impediment to commercialisation they identify is the insufficient rewards (both pecuniary and non-pecuniary) to faculty, which has been covered in more depth above. Third, they highlight that the staffing and compensation practices for TTOs are also relevant in determining the levels of university commercialisation. They find that there is often misalignment between TTO

officer's remuneration and the objectives of the TTO. In later research Belenzon & Schankerman, (2009) also find evidence to support the link between incentives for TTO managers and levels of commercial activity in terms of patenting and licensing. Importantly, Siegel et al (2003) suggest that, due to the high turnover of staff at TTOs, there are often skills and knowledge gaps with regards to entrepreneurship and commercial experience, which was also highlighted as an impediment in more recent research (Siegel & Wright, 2015).

2.3.3 Institutional Heterogeneity: The critical variable

Although existing research on the organisational characteristics that influence commercialisation efforts has been illuminating in revealing important organisational characteristics and policies, it is increasingly recognised that the heterogeneity that characterises universities needs to be recognised within analysis (Guerrero et al., 2014; Sengupta and Ray, 2017b; Siegel and Wright, 2015a; Wright et al., 2008). However, the existing research assumes, somewhat problematically, that technology transfer 'best practices' and policies can be easily adopted across different universities (McAdam et al., 2005; Resende et al., 2013). Yet others have shown that the establishment of technology transfer practices and policies is far from straightforward (Colyvas, 2007).

Through an exploration of the institutionalisation of Stanford University's successful life science technology transfer programme, Colyvas (2007) argues that the normative order of science is fluid rather than fixed, allowing for multiple possible interpretations of what actions are possible, how credit is applied and how careers are pursued. Through the lens of institutional theory, Colyvas (2007) shows that technology transfer policy emerged through the interactions between senior faculty, research teams and the Office for Technology Licensing (Stanford's TTO). Social, technological and organisational factors (such as status, career structure, technology transfer, where scientists explored new forms of interaction with industry. The same factors and the experiences of scientists in these new forms of interaction established feedback processes that contributed to the formation and reconsideration of technology

transfer models. There were five models of technology transfer that were identified as being adopted during the time-period under study, all within the same institutional environment. Furthermore, none of these models were solely dictated by each underpinning factor (faculty authority, career structure, technological impact, funding) but through the interplay of these factors. This study is important since it highlights that 'best practice' in technology transfer is not easily identifiable let alone transferable across institutions. It also serves to highlight again the importance of organisational variation in university-industry interaction, particularly in commercialisation interactions which are commonly viewed as objective and transactional in nature.

More recently, Sengupta and Ray (2017b) examined how the organisational characteristics of TTOs are shaped by the contextual characteristics of the universities in which they are embedded. Specifically, they focus on three aspects of TTO activity including; the structure of the TTO, the business model of the TTO and their strategic preference for different interaction channels. Using factor analytic techniques on the HE-BCI dataset, they identify four distinct types of TTO within the UK context. The cases of Oxford, Cranfield, Durham and Essex are used to show that universities have evolved different TTO models based on local (organisational rather than geographical) conditions, again emphasising the organisational heterogeneity of TTOs (Wright et al., 2008). Based on their case-study analysis they offer four generic TTO models which vary by degree of centrality and whether they are internal to the university or external organisational entities. These are characterised as; absentee Knowledge Transfer Organisations (KTOs), Co-ordinating KTOs, Traditional KTOs and Outward-Facing KTOs. Sengupta and Ray (2017b) also offer propositions based on their case insights, suggesting that those universities that place a greater degree of emphasis on applied research are more likely to adopt TTO structures that decentralise decision making and outsource some core functions (for example licensing and patenting). Furthermore, more specialist institutions with a narrower research focus, such as Cranfield, are less likely to emphasise commercialisation, preferring to emphasise engagement mechanisms such as contract research, consulting and collaborative research (see section 2.4).

Other research on the organisational aspects of TTOs has focused on learning processes and their outcomes in terms of commercialisation (Weckowska, 2015). Drawing on qualitative data collected from six UK TTOs, Weckowska (2015) firstly identified entrenched commercialisation practices that they term the 'relations-based approach' and the 'transactions based' approach. TTOs characterised by the relationsbased approach to commercialisation emphasise practices related to the building of relationships and networks, connecting external organisations with university stakeholders (including technology transfer managers and academics). The transactions-based approach to commercialisation emphasises practices related to the commodification and sale of scientific research in the form of IP. Following crosscase analysis, Weckowska (2015) suggests that informal interactions across TTOs and external stakeholders helps to evolve existing practices and competencies but that changing the approach to an existing activity in order to achieve different objectives is more challenging. They highlighted that those TTOs that adopt a relations-based approach can develop transactions-based competencies through interactions with external organisations. Conversely, learning in TTOs that are characterised by a transactions-based commercialisation approach is much more difficult and only possible when there is strong strategic support at university level (Weckowska, 2015).

Related to university level strategic support, recent attempts have been made to explore how TTOs attempt to gain legitimacy with both academic inventors and university management (O'Kane et al., 2015). Based on interviews with TTO managers in the US, Ireland and New Zealand, O'Kane et al (2015) show that TTO managers use identity-conformance and identity-manipulation tactics to shape a dual 'scientificbusiness' identity with academics and university management. Following their analysis, they suggest that the identity-conformance and identity-manipulation approaches are ineffective mechanisms of establishing legitimacy and propose that TTO managers should adopt both approaches sequentially to craft a discrete identity is distinctive from scientific identity and business identity within the university context. It is proposed that the crafting and articulation of a distinctive 'TTO' identity will enhance the effectiveness of legitimation efforts (O'Kane et al., 2015).

2.3.4 Organisational Antecedents to Spin-Off Activity

It is no surprise that the role of the TTO has received such significant attention in the academic literature concerned with commercialisation, since it reflects the primary organisational arrangement through which patenting and licensing functions, particularly in the US and UK contexts. While the sections above explore organisational issues in relation to patenting and licensing activity, there is also a welldeveloped literature on the relationships between organisational characteristics and university spin-off activity (Siegel and Wright, 2015a, 2015b). Briefly, research has demonstrated that, in a similar way to licensing, the research performance or 'intellectual eminence' of the university is positively related to the rates of spin-off formation (DiGregorio and Shane, 2003). This research also suggests that university policy has a significant effect on spin-off formation rates, particularly policies related to royalty shares from inventions and policies concerned with university equity stakes in spin-off firms. Regarding royalties, it has been shown that higher royalty shares form academic licences are negatively related to the establishment of spin-off firms since they reflect the opportunity cost of firm creation (DiGregorio and Shane, 2003). Furthermore, those universities that offered the option of taking an equity stake in a new venture in exchange for up-front patenting and licensing demonstrated significantly higher start-up rates than those universities that did not adopt this policy (DiGregorio and Shane, 2003). Interestingly, there are no links between the nature of research (applied or basic) and spin-off establishment rates, again suggesting it is research depth rather than breadth that underpins entrepreneurial activity at the university level (Hewitt-Dundas, 2012). The links between research quality and spinoff activity are also confirmed by O'Shea, Allen, Chevalier, & Roche (2005), who suggest that the scale of the TTO and organisational experience in spin-off activity are important determinants of spin-off establishment. Contrary to DiGregorio et al (2003) they find that the more 'applied' the nature of the research (i.e. the proportion of research that is industry funded) the greater the propensity for spin-off activity.

Aside from university characteristics, research has explored the linkages between university strategy, structure and resources in relation to the establishment of academic spin-out firms (Clarysse et al., 2005; Degroof and Roberts, 2004a;

29

Fernández-Alles et al., 2014; O'Shea et al., 2005; Rasmussen et al., 2011). For example, Degroof & Roberts (2004) explore the different strategic approaches adopted by universities in spin-off activity, showing those universities that are highly selective in terms of deciding which potential firms to offer support to are more likely to offer better support and achieve more successful rates of spin-off establishment than those that are less selective in their strategic approach. Similarly, Clarysse et al (2005) outline a framework for explaining the relationship between university organisation, university resources and spin-off success. Specifically, they outline three optimal models of resource allocation that are contingent upon the strategic objectives for spin-out activity, whether it be to provide local employment, to generate an income stream or to provide a return through the sale of the spin-off shares (Clarysse et al., 2005). While spin-off activity is an interesting and important aspect of University-Industry interaction as well as a key commercialisation mechanism, it is only of tangential relevance to this thesis. More comprehensive reviews of the factors affecting spin-off formation and spin-off activity can be found elsewhere (Phan and Siegel, 2006; Rasmussen et al., 2011; Rothaermel et al., 2007; Siegel and Wright, 2015b; Wright et al., 2004).

In summary, organisational level research on commercialisation has concentrated primarily on around three themes. First, a stream of research has developed around this effectiveness criterion, exploring how university characteristics and organisational supports impact the effectiveness of patenting and licensing activity, drawing attention to organisational structures, resources and strategy. The second strand of literature directly focuses on the nature of organisational strategy, structure and resources, drawing upon institutional theory, practice-based learning and ambidexterity to show how different organisational configurations are achieved. The third stream of research has considered these factors in the development of alternative commercialisation channels, namely the establishment of spin off-firms. This organisational-level analysis is of particular importance to this thesis, since the current research focuses on inter-organisational relationships, however further research in commercialisation has focused more explicitly on individual-levels of analysis and broader institutional levels of analysis. Whilst these perspectives are not

30

the primary focus of this research, they are still useful to consider, to give an insight into the full spectrum of the literature. Synoptic overviews of these perspectives are provided below.

2.3.5 Academic Entrepreneurs: individual antecedent factors

The literature reviewed above demonstrates that there is ample research on how organisational factors and arrangements impact university commercialisation activity. However, some have argued that organisational arrangements are not sufficient in accounting for inter-institutional variations in academic entrepreneurship (Bercovitz and Feldman, 2008; Clarysse et al., 2011; D'Este et al., 2012; Lam, 2011; Wu et al., 2015). Instead, they argue that the most important actor in commercialisation is not the university or the TTO but the academic entrepreneur who undertakes the commercial activity. Consequently, the individual skills and characteristics that contribute towards increased levels of commercialisation (Clarysse et al., 2011; D'Este et al., 2012; Haeussler and Colyvas, 2011; Krabel and Mueller, 2009; Moog et al., 2015; Wu et al., 2015), the motivations of academic entrepreneurs (D'Este and Perkmann, 2011; Göktepe-Hulten and Mahagaonkar, 2010; Hayter, 2015; Iorio et al., 2017; Lam, 2011), and the identity implications of commercialisation (Jain et al., 2009) have all been examined within existing research.

Individual-level research has sought to identify those characteristics and skills that are related to commercialisation activity. D'Este et al (2012) examine the attributes of academic researchers that influence their capacity to interact with industry thorough both engagement and commercialisation channels. They draw attention to five factors that influence this capacity namely; marketplace knowledge through engagement with users, prior experience with innovation activity, knowledge of multiple fields of research (breadth of knowledge), research excellence and breadth of research network. Drawing upon survey data from EPSRC-funded scientists combined with REF data, they find significant linkages between individual characteristics and commercialisation activity. They find that academics with particular research profiles and collaboration experience are more likely to engage in commercialisation, irrespective of discipline or organisational characteristics. For commercialisation,

results indicate that those academics that have the capacity to combine multiple fields of research and who have experience in collaborating with research users (i.e. firms) are more likely to engage in entrepreneurial activity. Research excellence or quality, is highlighted as necessary but not sufficient to explain involvement in commercialisation activity. Clarysse et al (2011) focus on the skills associated with academic entrepreneurship, emphasising the critical role of the individual scientist's 'opportunity recognition capacity'. They refer to this as 'entrepreneurial capacity' as it refers to the individual's "ability to spot, recognize and absorb opportunities" (Clarysse et al., 2011, p. 1087). Others have drawn attention to the importance of previous commercialisation experience in determining entrepreneurial intentions in academic scientists, suggesting that a class of 'repeat commercialisers' exists and that these individuals have distinctive abilities and aspirations with respect to commercialisation (Hoye and Pries, 2009).

In another investigation of the skills and characteristics of academic entrepreneurs, Haeussler & Colyvas (2011) draw upon survey data of 2200 life scientists in Germany and the UK. Their study focuses on how the attributes, attitudes, social and material resources of academic scientists impact their propensity to engage in commercialisation. They conclude that one of the most important factors regarding commercialisation involvement is the career stage of the individual, suggesting that more secure 'tenured' academics are more likely to engage in commercialisation than their more junior colleagues. Similarly, age is also highlighted as a significant factor in determining involvement in commercialisation, since it is suggested that older academics have greater stocks of knowledge and human capital to draw upon, both of which facilitate the commercialisation process. There are also significant relationships between gender and commercial activity, number of publications and commercial activity and the size of the lab and commercial activity (up to a certain point). Importantly, they find that academics have different value perceptions of patenting, showing that the level of reputational importance placed on patenting and scientific output by peers is associated with different channels of interaction including commercialisation.

More recent research has explored the interactions between these value perceptions and commercialisation (Moog et al., 2015; Wu et al., 2015). Wu et al (2015) show that there are two types of academic inventors; opportunity driven, where commercial activity is not anticipated at the outset of research and invention-driven, where commercial activity is anticipated from the out of research. They show that positive attitudes towards proprietary science, engagement in follow-up research after disclosure and collaboration with industry scientists are all related to intentional commercial activity. Similarly, Moog et al (2015) show that the peer-environment of academic scientists is important in conditioning the relationship between commercial intention and commercial activity. Kalar & Antoncic (2015) focus on individual perceptions of the entrepreneurial orientation of their department. They demonstrate that there are substantial differences in the perception of entrepreneurial orientation between natural and social science departments and suggest that the perception of entrepreneurial orientation of the department partially accounts for the variation in levels of commercialisation activity. The role of individual attitudes towards commercialisation and previous commercialisation experience in explaining entrepreneurial intentions among scientists has also been supported through analysis of Max Planck scientist's entrepreneurial activity (Krabel and Mueller, 2009).

The prominence of peer-effects outlined above suggests that there is substantial variation in individual motivations for engagement in commercial activity, several studies have sought to enhance our understandings of what motivates academics to pursue commercialisation. For example, Lam (2011) operationalises constructs from self-determination theory to explore the intrinsic and extrinsic motivations of academic entrepreneurs. In a mixed-method study consisting of 706 survey responses and 36 semi-structured interviews, she finds that there is a diversity of motivations for engagement in commercial activity. According to Lam (2011) there are three motivational configurations: 'traditional scientists' who are predominantly extrinsically motivated and view commercialisation as a means to access resources to further research ambitions; 'hybrid scientists' who are intrinsically motivated by the puzzle of commercial application as well extrinsically motivated by pecuniary rewards;

and 'entrepreneurial scientists' who are extrinsically motivated by the pecuniary rewards offered by commercialisation, although it is highlighted that these types of individuals are rare in academia. Others have found evidence to support the suggestion that the primary motivation for academics to engage in commercial activity is to enhance their research capabilities, and thus their academic reputation (D'Este and Perkmann, 2011; Göktepe-Hulten and Mahagaonkar, 2010). Lam's (2011) regression analysis supports previously established links between individual characteristics and propensity to pursue commercialisation including age, gender and the applied nature of research. Building on Lam (2011), lorio et al (2017) propose that as well as the 'learning' and 'funding' motivations previously identified, academics are also motivated to engage in commercial activity by 'pro-social' motivations which relate to the possibility to contribute to local economic well-being and development.

The motivational configurations above suggest that there is a degree of dissonance between academic and commercial motivations, research as sought to explore how these different role-identity conflicts can be reconciled. For example, Jain et al (2009) explore the sensemaking of academic inventors as they attempt to embrace new commercial demands. They highlight how engaging in commercialisation entails identity-modification and show how academics utilise 'delegating' and 'buffering' techniques to ensure that academic identity is preserved as commercial activities force identity modification. In other words, they suggest that academics take active steps, by delegating the commercialisation aspects of their activity to other actors (e.g. the TTO) or by emphasising the prominence of their academic concerns in relation to commercialisation activity, to ensure coherence between their academic role and their identity as an academic entrepreneur.

The research outlined above shows that individual-level analysis as well as organisational-level analysis has been instrumental in enhancing existing understandings of university research commercialisation. This research draws more explicitly on theoretical arguments from entrepreneurship literature, such as human capital, social capital and identity rather than the concepts borrowed from strategy at the organisational level of analysis (e.g. resources, capabilities, ambidexterity). In

34

combination, both of these levels of analysis provide a good understanding of what drives university commercialisation activity and why this activity occurs. Others have drawn attention to the role of institutional heterogeneity, emphasising that different regulatory environments may contribute to variations in commercialisation activity (Geuna and Nesta, 2006; Grimaldi et al., 2011; Taylor Aldridge and Audretsch, 2011a). However, whilst there is some research on the role that local conditions play on the commercialisation activity of university research (Broström, 2010; Crescenzi et al., 2017; Decter et al., 2007; Petruzzelli, 2011; Wright et al., 2008), the volume of literature that explicitly focuses on institutional factors that influence commercialisation is relatively thin. This can partly be explained by the widespread adoption of Bayh-Dole type legislation, which has ensured a degree of institutional homogeneity across national and regional boundaries (Geuna and Nesta, 2006; Lockett et al., 2015). Consequently, Much of the institutional level research instead has adopted a 'supply-side' perspective, whereby analysis focus on how the patenting and entrepreneurship activity of a university impacts on environmental conditions, through so-called 'spillover effects' including local entrepreneurship and innovation activity (Abramovsky et al., 2007; Bonaccorsi, 2017; Guerrero et al., 2015; Jaffe et al., 1993; Mueller, 2006). There is however, a well-developed literature on the geographical aspects of university-industry interaction, but this literature tends to adopt a focus on collaboration rather than commercialisation activity (D'Este et al., 2013; Laursen et al., 2011) and will therefore be covered in the relevant section below.

2.3.6 Commercialisation Review: Shifting Sands?

Section 2.3 and all the subsections above provide a synoptic overview of some of the core issues that characterise university-industry technology transfer research. Although this thesis does not focus explicitly on commercialisation, the commercialisation literature reflects the most substantial stream of research within the broader university-industry interaction corpus (Perkmann et al., 2013). Furthermore, within policy debates, the commercial activity of universities is frequently cited as one of the most important ways in which academic institutions can interact with the private sector (Guerrero et al., 2015; Hughes and Kitson, 2012) therefore it is important to address this literature in any discussion of university-
industry interaction. The literature reviewed above highlights a number of key issues; first, that the common perceptions of the role of the university in society have shifted from being centres of education and research to centres of innovation and economic growth. Second, that what constitutes as 'effective' university entrepreneurship is contested, although the most common operationalisation of effectiveness is the capacity to engage in revenue generating commercial activity through the sale of IP. Third, that the organisational strategy, structure and resources are important determinants of the effectiveness of commercialisation activity. Fourth, individual characteristics and capabilities of the academic entrepreneur are equally important in determining the commercialisation effectiveness of universities. Finally, that institutional variation in terms of different regulatory, economic and social conditions have some effect on the effectiveness of commercialisation efforts but these effects are increasingly marginal as commercialisation has become institutionalised as a policy priority and an academic norm. As research on commercialisation has proliferated, there has been increasing dissent about the narrow focus on this subset of university-industry interactions (Hughes and Kitson, 2012; Langford et al., 2006; Perkmann et al., 2013; Rossi and Rosli, 2014; Siegel and Wright, 2015a). Specifically, it is recognised that these formal mechanisms of interaction with industry reflect only a subset of all interactions that may take place between academic institutions and private organisations (Hughes and Kitson, 2012; Perkmann et al., 2013; Taylor Aldridge and Audretsch, 2011b), such activities include collaborative research, contract research, academic consultancy and sharing of research facilities (or 'Collaborative Research Centres' (Boardman and Corley, 2008)). In fact, it has recently been suggested that the levels of university-industry interaction based on IP exchange are underestimated since a substantial amount of IP based interaction occurs outside of the scope of formal IP systems (Fini et al., 2010). Researchers have also highlighted that the formal IP-based mechanisms of university-industry interaction are often of the least importance to firms in their innovation activities (Agrawal and Henderson, 2002; Cohen et al., 2002; D'Este and Patel, 2007; Perkmann et al., 2013; Phan and Siegel, 2006). Just as the significance of commercialisation appears to be peripheral to firm innovation activity, it is also seen as increasingly peripheral to regional development objectives (Bonaccorsi, 2017a; Siegel and Wright, 2015b), since very

little evidence has emerged to suggest university entrepreneurship has a significant regional impact (Bonaccorsi, 2017).

With the increasing dissatisfaction with conventional academic entrepreneurship, increased attention has focused on the other forms of university-industry interaction. The next section of this literature review and the remainder of this thesis focuses on these non-IP based interactions. The literature on so-called 'engagement' mechanisms is much less developed than the commercialisation literature (Perkmann et al., 2013) since these mechanisms are much more difficult to examine empirically. However, since the primary aim of this thesis is to explore an emerging form of engagement, namely strategic research partnerships, the next section will provide an overview of what is known currently about different engagement interactions. Most of this section will focus on what is broadly termed 'collaborative research', since this is the largest stream of engagement literature. Replicating the structure of Section 2.3, this section will examine the individual level, institutional level and organisational level perspectives on university-industry collaboration. The section is structured in this way since the intention is to narrow down the focus of the review to the issue that is of primary concern for the current research, namely the temporal dynamics of collaborative research partnerships.

2.4 Research Collaboration

In this section I first provide an overview of the various conceptualisations of 'research collaboration' within the existing literature. I then offer an outline of research that has examined the phenomena of university-industry research collaboration, providing a framework that delineates the individual, organisational and environmental approaches. I then move towards a definition of 'collaborative research partnerships', drawing attention to recent conceptualisations of 'open' and 'closed' research partnerships (Perkmann & West, 2015). Based on this review, I suggest that much of the existing research regarding university-industry research collaboration focuses on the identification of antecedent factors to collaboration formation and, to a lesser extent, collaborative success. Only recently have theoretical conceptualisations of

university-industry partnerships begun to emerge. I then present details of the few studies that have examined the process of partnership formation and development.

2.4.1 Defining Collaborative Research

A recent review of research collaboration highlights the ambiguity surrounding the term 'research collaboration' (Bozeman et al., 2013). The ambiguity in the term stems from the multiple levels of analysis that studies of research collaboration have adopted, with some providing an analysis of organisational research collaboration and others providing an analysis of individual research collaboration. Bozeman et al (2013) note that these levels of analysis are often difficult to discern in practice, since all collaborative research fundamentally takes place between individuals, noting that 'organisations' are useful social constructs that enable us to talk about certain groups of individuals. Another issue they address concerning the definition of collaborative research is the depth of interaction, showing that academic studies of collaboration tend to focus narrowly on co-publication as a proxy for collaboration (Bozeman et al., 2013; Katz and Martin, 1997). Bozeman et al (2013) suggest that not only is copublication a partial indicator of collaboration, but also it is just one of many possible outcomes of the social process of collaboration. Consequently, research collaboration is conceptualised rather broadly as " a social process whereby human beings pool their human capital for the objective of producing knowledge" (Bozeman et al., 2013, p. 3). This particular definition emphasises that research collaboration is solely concerned with the publication of academic papers but can be reflected in other 'knowledge outputs' such as software and technological developments (they also highlight patents as a knowledge output but here academic entrepreneurship is conceptually distinct from research collaboration). Furthermore, this definition suggests that research collaboration does not necessarily require person-to-person contact since multiple individuals can work together to achieve the same outcome without necessarily meeting or interacting (as is increasingly observed in scientific publication). Since this definition of research collaboration emphasises the pooling of human capital resources for the common objective of knowledge production, there are no normative assumptions made about success or failure. For example, many collaborations (pooling of resources) do not result in the production of a publication and under normative assumptions would be considered 'unsuccessful'. By focusing on the pooling of resources rather than the production of outputs, such a conceptualisation of research collaboration draws attention to the fact that these arrangements are inherently risky and unpredictable. Another important point about the definition of collaborative research is the distinction between 'human capital' and 'resources'. Bozeman et al (2013) emphasise that an individual may provide resources, for example finance or materials but may not be considered a collaborator if there is no pooling of human capital for combined research aims. For example, if an individual (or organisation) provides finance to fund research but nothing else, then they may be considered a patron rather than a collaborator. However, if they provide finance and some individual knowhow, even if this is related to the operation of the equipment rather than the research challenge at hand, then this constitutes research collaboration (Bozeman et al., 2013).

Elsewhere, research collaboration has been defined as "an R&D-based relationship involving a private firm and a university that are mutually committed to reaching a common R&D goal by pooling their resources or co-ordinating specific research activities" (Bstieler et al., 2015, p. 112). This definition similarly emphasises the pooling of broadly defined resources and co-ordination of activities to achieve a common research goal. It differs from the definition offered by Bozeman et al (2013) in that it explicitly relies on the conceptual units of 'the university' and 'the firm'. Here, I draw upon an amalgamation of these definitions to limit the scope of the review. Since this research is particularly concerned with collaborative research efforts between individuals working in a university and individuals working in a private organisation, I offer a specific definition of university-industry collaborative research as the social process where individuals working within the context of university research and private research and development, pool their resources and co-ordinate their activities in order to realise a mutually defined research ambition.

The review of collaborative research by Bozeman et al (2013) is incredibly helpful in delineating clear conceptual boundaries for collaborative research. However, in their

review distinctions are made between what they term 'knowledge-focused' collaboration and 'property-focused' collaboration. Knowledge-based collaboration refers to situations where human capital resources are pooled to expand the base of knowledge or enhance academic reputation whereas property-based collaboration refers to situations where the objective is economic gain for the researchers. More recently, D'Este & Perkmann (2011) distinguished between three types of collaborative research. First, they suggest that collaborative research may simply be 'joint research', which is collaboration on pre-competitive research that is usually subsidised by public funding sources. Second, there is contract research, which refers to a situation where academic scientists work with industry scientists on research that is directly commercially relevant to the organisation and as such is usually funded solely by the firm (D'Este and Perkmann, 2011). The third form of collaborative research, consulting, refers to a situation where an academic scientist works with industry scientists by providing specific research services and/or advice. Again, these collaborations are usually funded solely by the firm (although in some instances may be subsidised i.e. as part of a public-assistance programme) and income generated usually accrues to the participating academic scientist rather than the university they work for (D'Este and Perkmann, 2011). These forms of interaction have been demonstrated to be more widespread and more valuable to firms, yet the academic literature concerned with university-industry collaborative research is much less developed than the academic entrepreneurship literature that is addressed in the previous section (Agrawal & Henderson, 2002; Cohen, Nelson, & Walsh, 2002; D'Este & Perkmann, 2011; D'Este & Patel, 2007; Hughes & Kitson, 2012).

The rest of this section is structured as follows: first, I provide an overview of university-industry research partnerships, offering a conceptualisation based on existing literature. Second, I review literature concerned with the characteristics and motivations of individuals involved in university-industry collaborations. Third, I provide an overview of literature concerned with the environmental factors that condition university-industry collaboration, namely the effects of different dimensions of proximity (Balland et al., 2014; Boschma, 2005). Fourth, I outline the literature concerned with the organisational aspects of university-industry research

collaboration, including the organisational factors associated with the establishment of collaborative activities and the organisational factors associated with their success. The fifth and final section of this literature review focuses on the emerging literature concerned with the organisational practices adopted within collaborative research partnerships and the process of research partnership evolution and development, highlighting the issues of principal concern to this thesis.

2.4.2 Conceptualising University-Industry Partnerships

Strategic alliances are widely recognised as a means through which firms can access knowledge and capabilities that would be otherwise unavailable (Grant and Baden-Fuller, 2004). Strategic alliances are organisational arrangements "characterised by the commitment of two or more firms to reach a common goal, entailing the pooling of resources and activities" (Teece, 1992, p. 19). A large literature has considered the impact that these partnering arrangements have on the innovation capabilities of firms and organisational learning more broadly (Inkpen and Tsang, 2007; Lin et al., 2012). The broad notion of strategic alliance encompasses a range of collaborative forms, such as buyer-supplier relationships, franchises, cross-selling arrangements and research partnerships (Grant and Baden-Fuller, 2004; Hagedoorn, 2002; Hagedoorn et al., 2000; Inkpen and Currall, 2004; Inkpen and Tsang, 2007).

Research partnerships are an important mode of open innovation for science intensive firms (Perkmann and West, 2015), they are broadly defined as "innovation-based relationships that involve, at least partly, a significant effort in R&D" (Hagedoorn et al., 2000, pp. 567–568). Given their obvious relevance for innovation (particularly open innovation), research partnerships have been studied extensively in terms of their antecedent factors, governance arrangements and innovation outcomes. However, it has recently been recognised that university-industry relationships present a particular subset of research partnerships, which most commonly occur amongst transacting firms, since these partnership arrangements are characterised by an intrinsic misalignment in terms of approaches to knowledge production and value appropriation (Perkmann and Schildt, 2015).

University-Industry Research Partnerships have been defined as "partnering arrangements to which both parties bring to bear their assets and competencies" (Perkmann and West, 2015, p. 51). Bercovitz & Feldman (2007, p. 934) conceptualise university-industry research partnerships "as bundles of linked transactions that exist when a firm engages in several activities such as funding multiple sponsored-research projects, hiring graduate students, participating in research centres and providing endowment funding". Perkmann and Walsh (2007, pp. 275–276) suggest "university-industry research partnerships can range from small-scale temporary projects to large scale organisations with hundreds of industrial members" and highlight that "on an organisational level, university-industry relationships vary considerably in terms of contractual arrangements and outputs, which makes them difficult to research... not much is known about the different types and diffusion of such agreements and their organisational morphology."

The emerging concept of university-industry research partnerships is also elaborated by Boardman & Bozeman (2015) who make explicit distinctions between what they term 'university-industry research alliances' and 'non-university-industry alliances'. They propose three distinct characteristics of university-industry research alliances, namely that they are university-based, that they exhibit some degree of organisational structure and that they emphasise joint research. These alliances are also characterised by some degree of organisational structure. Drawing on US examples such as alliances established by the National Science Foundation (NSF) and the National Institute for Health (NIH), Boardman & Bozeman, (2015) suggest that structures include some form of joint governance or decision making body and some degree of managerial hierarchy and centralisation. As well as varying in size, in terms of numbers of individuals involved and depth, in terms of the various modes of interaction utilised, research partnerships may also vary in what Perkmann and West (2015) refer to as openness. Specifically, Perkmann and West (2015) make the distinction between 'open' research partnerships and 'closed' research partnerships. Open research partnerships constitute arrangements whereby participating firms adopt an acceptance that outcomes of the joint endeavour will be openly disseminated, usually via publication, thus IP protections become peripheral to the arrangement (Perkmann and West, 2015). There are three principal reasons why a firm might agree to enter into an open partnership arrangement; first, firms may engage in open partnerships when there is a recognition that the research problem at hand is too complex and challenging to be overcome by a solitary firm effort. For example, a problem that presents a significant challenge to an entire industry, such as CO2 capture would be better addressed through collaborative effort rather than a singular firm effort (Perkmann and West, 2015). Second, firms may engage in open partnership activities to create new markets, since the diffusion rate of knowledge that is not constrained by IP protection is higher than knowledge protected by IP. Therefore, the likelihood of adoption by follow-on users that were not involved in the initial research is greater (Perkmann and West, 2015). Third, firms may engage in open partnership arrangements in an attempt to address societal 'grand challenges' such as poverty reduction, food sustainability, renewable energy (Nilsson, 2017; Perkmann and West, 2015). In summary, firms will pursue these open partnership arrangements when there is limited scope for directly appropriating the returns from research, usually because the technology is at a nascent stage of development or the direct commercial applications remain vague (Panagopoulos, 2003; Perkmann and West, 2015).

The second type of research partnership proposed by Perkmann & West (2015) are 'closed' research partnerships, whereby firms have a greater degree of control over the direction of research and make considerable efforts to appropriate research outputs via IP protection. Universities have become increasingly visible within industrial R&D, as firms have sought to reduce spending on in-house R&D (Chesbrough & Bogers, 2014; Dodgson, Gann, & Salter, 2006). For example, universities represent 'technology partners' within Royal Phillps' R&D network (Vanhaverbeke et al., 2014). Similarly, Rolls Royce have invested in a number of 'University Technology Centres' that conduct sponsored research that is guided and owned by the firm (Perkmann and West, 2015). Firms may be particularly attracted in forming closed partnerships with universities in areas where they possess particular academic expertise and in research areas that benefit from substantial amounts of public research investment (e.g. nuclear energy or defence) (Perkmann and West, 2015), since this funding may be leveraged to support related industrial research. As evidenced by the literature review presented below, 'closed' partnerships are much more widespread than 'open' partnerships since these reflect more conventional firm-university relations, although recent evidence suggests that 'open' partnerships may provide a useful way of facilitating university-industry research collaboration (Perkmann and Schildt, 2015).

The current research is specifically interested in these forms of research collaboration between academic and commercial partners, those that involve repeated interactions over a prolonged period of time, exchange of human and capital resources and are characterised by an identifiable organisational structure. Whilst these research partnerships are of primary interest here, most of the existing literature is not specifically focused on collaborative partnerships per se. Rather, the existing literature has focused on more common forms of university-industry research collaboration such as consulting (Perkmann and Walsh, 2008), participation in collaborative research centres (CRCs) (Acworth, 2008; Boardman and Corley, 2008; Youtie et al., 2006; Youtie and Shapira, 2008) and individual one off collaborative research projects (Bruneel et al., 2010). Consequently, much of the literature outlined below adopts the 'project' as opposed to 'the partnership' as the unit of analysis. Nonetheless, this research is incredibly helpful in illuminating some of the key issues for consideration in terms of research partnership development.

2.4.3 Individual-Level Analysis of research collaboration

Despite much of the individual-level analysis concentrating on the activity of 'academic entrepreneurs', several studies have emphasised the importance of individual level characteristics in the analysis of university-industry research collaboration (Ankrah et al., 2013; Aschhoff and Grimpe, 2014; Azagra-Caro, 2007; Boehm and Hogan, 2014; Craig Boardman and Ponomariov, 2009; D'Este et al., 2012; D'Este and Fontana, 2007; D'Este and Perkmann, 2011; Iorio et al., 2017; Kroll et al., 2016; Lee, 1998; Link et al., 2007; Martinelli et al., 2008; Ponomariov and Craig

Boardman, 2008; Tartari and Breschi, 2012; van Rijnsoever et al., 2008). For example, in their examination of the variety of channels through which university-industry collaboration occurs, D'Este and Patel (2007) highlight that previous experience of collaborative research plays an important role in determining the variety of interactions that academic researchers engage in with industry and the frequency with which they engage in them. They also draw attention to demographic characteristics including the academic seniority of the researcher and the age of the researcher, concluding that more senior academics (i.e. professors) are more likely to engage in a wider variety of interactions with industry and that older academics are more likely to restrict their interactions with industry to a smaller variety of channels.

Similarly, Azagra-Caro (2007) examined the factors that underpin university-industry contract research drawing upon a survey of 380 academic scientists from public universities in the Valencian region of Spain. They conclude that older, male academics are more likely to engage in collaborative research than other academics. They also offer insights into the types of firms these academics are likely to collaborate with, showing that contract research is more common with larger more technically advanced organisations than smaller less technologically advanced firms. Some have suggested that disciplinary effects should be taken into account when considering individual factors that underpin industry collaboration, with several studies showing that those individuals who engage in more basic research are less likely to collaborate with industry than those whose research is more applied in nature (Link et al., 2007; Tartari et al., 2014). In relation to academic excellence, several studies have demonstrated that there is a strong link between scientific productivity, in terms of publication outputs and the level of collaborative engagement with industry (Agrawal and Henderson, 2002; Haeussler and Colyvas, 2011; Tartari et al., 2014).

D'Este and Fontana (2007) explicitly examine the factors that underlie the size of external partner networks established by academic scientists and the types of networks that are established (i.e. academic networks and industrial networks). They suggest that there is substantial heterogeneity in the engagement of research collaborations amongst academic scientists and they explore the factors that

influence what they term 'extremely active' academic researchers. The key contribution of this paper is that it identifies that there are a certain group of academics that are more likely to engage in collaborative research partnerships and suggests that individual reputation and fund-raising ability are characteristics of those active in multiple collaborative research projects. Furthermore, the paper demonstrates that the level of university-industry collaboration for individual academics is strongly related to the level of departmental funding derived from industry sources. van Rijnsoever et al (2008) also focus on the network activity of academics use their contacts for research purposes. While this study takes a broader view, looking at collaboration beyond the university-industry dyad, it offers insights into the characteristics that affect the degree to which researchers use industry contacts for research purposes. This study reports that academics with greater work experience, including experiences of working in multiple institutions and firms, are more likely to draw upon industry networks to support their research.

The individual characteristics related to increased levels of university-industry research collaboration are also examined by D'Este et al (2012), who focus on the skills and experiences of academic researchers that influence the discovery of technological opportunities available to industry. It is argued that academic researchers are important contributors to the pool of opportunities available to industry. The emphasis on technological opportunities is important since this construct is distinguished from the exploitation of opportunities through entrepreneurial mechanisms such as licensing and spin-off formation. The key insight offered by D'Este et al (2012) is that different skills and experiences are required for the generation of industry-relevant technological opportunities and the entrepreneurial exploitation of these opportunities, a conclusion previously presented by Perkmann et al (2011a). Specifically, an academic's research excellence, the breadth of their research activity, their prior experiences of invention, their prior experience with collaborative research with industry and their membership in external research networks are proposed as characteristics that influence an academic's capacity to discover new technological opportunities and exploit those opportunities through entrepreneurship. Academic

excellence and prior invention experience were proposed as key drivers of technological opportunity discovery whereas the capacity to combine multiple fields of research and prior collaborative experiences with industry were more strongly associated with technological exploitation rather than discovery (D'Este et al., 2012).

Similarly, Perkmann et al (2011a) demonstrate that there are clear links between departmental faculty quality and industry involvement in technology-oriented sciences as well as medical and biological sciences but emphasise this relationship only holds up to a point. They show that there no links between 'star scientists' and higher levels of industry involvement, possibly due to the relative resource munificence of star scientists. They also find differences between the social and natural sciences, showing a negative relationship between faculty quality and industry involvement in applied social science disciplines. The significance of this particular study is that is highlights differences in 'research the the quality-industry' between commercialisation and engagement channels.

Boardman and Ponomariov (2009) also focus on individual attitudes and characteristics. They examine how funding received from industry, time supported by government grants, affiliations with research centres, tenure status, support of students, scientific values and demographic characteristics influence the propensity of academic scientists to engage in various forms of collaboration with industry. Drawing on a survey of 1643 tenure-track scientists across 13 academic disciplines in the US, they show that the levels of funding received form industry, affiliations with university research centres, achieving tenure all contribute to higher levels of collaboration with industry. Their most interesting finding centres on the role that scientific values play, they examine the degree to which conventional scientific values of communalism (value citations more than economic returns) and disinterestedness (view engagement with industry problems as detrimental to development of science) impact academic's engagement in collaborative activity. Unsurprisingly, they find that that identification with the norm of disinterestedness generally precludes collaboration with industry, however identification with the norm of communalism only precludes commercialisation activity but not collaborative research. Therefore,

Boardman and Ponomariov (2009) conclude that there is only limited evidence of a conflict of interest between industry norms and traditional academic norms, suggesting that engagement in collaborative research with industry is not necessarily at odds with academic aspirations. Related to the issue of academic aspirations, several studies have explored the motivations that drive academic scientists to collaborative with industry (Ankrah et al., 2013; D'Este and Perkmann, 2011; Kroll et al., 2016; Lee, 1998; Tartari and Breschi, 2012). These studies will be addressed briefly below.

D'Este and Perkmann (2011b) use large scale data collected from a sample of EPSRC funded scientists to examine the motivational drivers of academics engaged in collaborative research with industry partners. In their empirical model, motivations were derived from a factor analysis of 12 items from their survey. This analysis produced four factors or 'motivations' including; commercialisation, learning (using industry engagement to inform academic research), access to funding (using industry funding to complement public funding) and access to in-kind resources (using industry-owned equipment and data). Importantly, they highlight that three factors are research related suggesting most academics engage in collaborative efforts with industry to further their own research agendas either through gaining access to equipment, materials and funding or gaining access to emerging problems that require a more fundamental understanding. Relating motivations to collaborative mechanisms, they suggest that academics driven by learning motivations are more likely to engage in collaborative research, whereas those driven by commercialisation motivations are more likely to engage in patenting, spin-off formation and consulting activities. In contrast to Boardman & Ponomariov (2009) these results suggest that a clear tension exists between academic and commercial motives. However, whilst it's clear that there may be divergence in motivations for purely academic or purely commercial research, Boardman and Ponomariov (20009) show that academics rarely adopt pure academic notions of research. Similarly, D'Este and Perkmann (2011) show that academic learning motivations are not necessarily at odds with engagement in industrial collaborative research.

Further support of the overlap between academic motivations and collaborative efforts with industry is also provided by Tartari, Perkmann, & Salter (2014) who show that intrinsic academic motivation is related to higher levels of engagement in collaborative research efforts with industry. More recently, Iorio et al (2017) examines the motivations of academics for industrial engagement in the Italian context. In contrast to D'Este and Perkmann (2011) they find that learning motivations are not as important as financial motivations, although it is suggested that this could be due to the Italian context of their study, where most academics collaborate with smaller firms outside of industrial districts, thus learning opportunities are lower. Rather than learning motivations, they point to the importance of pro-social 'mission' motivations, relating to the desire to enhance the utility of research and advance the university's capacity for local development as a key driver of academic engagement. This motivation was related to increased activity in terms of the number of channels of interaction (knowledge-transfer breadth) and the frequency of interaction through certain channels (knowledge-transfer depth). This study highlights that higher levels of 'mission' motivation had a stronger effect of the depth of interaction than the breadth of interactions, suggesting that those academics that are motivated to make wider societal contributions seek to do so through building trusting, long-term relationships with a smaller number of firms. This is important in light of the current study, which seeks to understand how such long-term trusting research partnerships emerge and develop.

While much of the literature has focused on individual drivers and motivations for engagement with industry, others have highlighted that localised social contexts are important in underpinning collaborative activity (Bercovitz and Feldman, 2008; Haeussler and Colyvas, 2011; Tartari et al., 2014). One of the most comprehensive studies on local peer effects is offered by Tartari et al (2014), who draw on multiple sources of data to inform a regression analysis on the peer effects and collaboration. They combine data from an EPSRC survey of grant holders over the period 1992- 2006, the 2008 Research Assessment Exercise results, HE-BCI data for the years 2006 and 2007, bibliometric data from ISI Web of Science and regional data from Eurostat. For their analysis, they create an 'engagement index' that denotes the frequency of engagement with industry across multiple channels over time, although analysis is concentrated on joint research, training, research services and networking. They argue that since collaborative engagement with industry is a discretionary activity for academic researchers, they will often compare themselves to their peers to establish a baseline of the level of activity they should be engaging in and the types of activity that they should undertake. Importantly, it is emphasised that the engagement activity of 'star' scientists (i.e. in the top 1% of the cohort in terms of citation counts or in the top 2.5 % for number of publication outputs) and more senior members of staff are less likely to be impacted by peer-effects. This is suggested because these individuals have a greater certainty about their career and role within the scientific community. The results of their regression analysis indicate that individual behaviour is strongly informed by the social context of the university department, supporting the findings of earlier research (Bercovitz and Feldman, 2008). Results also suggest that when pursuing pro-active engagement with industry junior scientists will mimic the average behaviour of their peers. It is also suggested that individuals engage in this mimicking behaviour to match relative departmental performance and therefore enhance their career prospects. Again, these findings suggest that there is potentially an overlap between motivations for academic career development and engagement in collaborative research activity with industry.

Considering these results in totality, a few key insights emerge. First, it is clear that the individual factors that drive involvement in collaborative research are not the same factors that drive involvement in academic entrepreneurship, highlighting that these phenomena are conceptually and empirically discrete. Second, the motivations driving collaborative research are associated with academic ambitions of conducting *better* research, not necessarily commercially valuable research. Third, involvement in collaborative research, whilst largely individualistic, is also conditioned by local environmental conditions. The research described above highlights the impact that social context has in conditioning collaborative research activity and, by the same logic, some have suggested that broader contextual arrangements condition engagement in collaborative research (i.e. local economic conditions). The next section provides an overview of the research that has focused specifically on the role that context has on engagement in collaborative research activity.

2.4.4 Context and collaboration- the role of geography and policy

While a large body of research within the existing literature has explored issues related to collaborative research such as the characteristics and motivations of individual collaborators and increasingly important topic is the role played by proximity in driving university-industry collaborative research (Abramovsky et al., 2007; Arundel and Geuna, 2004; Boschma, 2005; Broström, 2010; Carboni, 2013; D'Este et al., 2013; Jaffe, 1989; Johnston and Huggins, 2016; Muscio, 2013; Ponds et al., 2007; Steinmo and Rasmussen, 2016). Boschma (2005), presents a critical assessment of the role of proximity in innovation identifies five distinct dimensions of proximity namely; cognitive proximity, geographical proximity, organisational proximity, social proximity and institutional proximity. Cognitive proximity refers to the degree to which individuals are proximate in terms of their knowledge base, establishment of cognitive proximity facilitates communication and the development of absorptive capacity (Cohen and Levinthal, 1990). Geographical proximity simply refers to the spatial distance between actors. Organisational proximity is the extent to which relations are shared in an organisational arrangement, either within or between organisations. It is best to imagine it on a continuum that goes from low- no ties between independent actors, to high- hierarchically organised firm or jointventure (Boschma, 2005, p. 65). Social proximity is defined in terms of socially embedded relations between agents at a micro level. Relations between actors are socially embedded when they involve trust based on friendship, kinship and experience. Like the other dimensions of proximity, social proximity operates along a continuum, high degrees of social proximity are required for trust-based relationships since it reduces the risks of opportunism and facilitates the transfer of tacit knowledge. However, if collaborators are too socially proximate then the risk of opportunism resurfaces and the risk of becoming locked-in to existing social networks is exacerbated. Whilst social proximity refers to the issue of social embeddedness at a micro-level, institutional proximity address the social embeddedness of economic activity at a macro-level (Boschma, 2005). The notion of institutional proximity

includes both the idea of economic actors sharing the same 'rules of the game' as well as the same values and habits, for example, a common language, shared habits, a legal system securing ownership & IP rights. Too much institutional proximity is unfavourable for new ideas and innovation due to institutional lock in (obscuring awareness of new possibilities) and inertia (impeding required institutional adjustments). Too little institutional proximity can be detrimental to collective action due to weak formal institutions, lack of social cohesion and lack of common values (Boschma, 2005).

It is widely acknowledged that university research generates knowledge externalities that 'spill-over' into the local surrounding environment (Arundel and Geuna, 2004; Audretsch and Feldman, 1996; Cowan and Zinovyeva, 2013; Jaffe, 1989), the specific role that different dimensions of proximity play in the establishment and functioning of university-industry collaborations has become an increasingly important topic (Broström, 2010; D'Este et al., 2013; D'Este and Iammarino, 2010; Laursen et al., 2011; Muscio, 2013; Ponds et al., 2007; Steinmo and Rasmussen, 2016). The role that geographical proximity plays in driving the development of university-industry collaborative research has been examined by several researchers in different empirical contexts. Broström (2010) uses evidence from a survey of Swedish R&D managers to examine the role that geographic proximity plays on direct collaborative interactions between R&D subunits and universities. Specifically, the impact that geographic proximity has on the content of university collaborations is examined. The study acknowledges that the significance of geographic proximity for the universityindustry collaboration is likely to vary depending on the type of knowledge involved and the phase within the R&D life-cycle that interaction takes place (Broström, 2010). Following analysis of 18 interviews with R&D managers and regression analysis of 425 completed surveys of R&D managers, the research suggests that geographically proximate collaborations differ in the types of benefits they provide to firms than collaborations that occur over distance. Specifically, local collaborations based on a high degree of interaction and trust provide firms with greater learning advantages and are more useful in the delivery of short-term research projects. Conversely, when the objective of collaboration is long-term and exploratory in nature geographic

proximity is not as important since long-term, large scale projects can be modularised. In other words, geographical proximity between firms and universities is important in early phase and late phase R&D projects but for projects in-between early and latephases the significance of geographic proximity dissipates.

Whereas Broström (2010) focuses on the role that geographic proximity plays in the content of university-industry collaboration, D'Este and lammarino (2010) focus on how proximity affects the formation of university-industry collaborations and the factors that affect the significance of geographic proximity, with a focus on university research quality. Drawing on EPSRC project data over the period 1999-2003 and Eurostat regional data, they show that geographical proximity and research quality are both important antecedents of university-industry collaboration but that their significance varies by academic discipline. In particular, they show that for engineering related disciplines, where the research is more applied in nature, geographical proximity is highly relevant for partnership formation whereas for basic science disciplines this is not the case. Furthermore, they highlight the curvilinear character of the relationship between geographic proximity and research quality, suggesting the higher the quality of a department the more likely they are to attract business collaborators but only up to a point, beyond which collaboration is principally driven by the geographical proximity to the partner university. The research also draws attention to possible collaborative learning effects by showing that the more frequently firms collaborate with universities, the more likely they are to pursue geographically distant collaborations.

The interaction between geographical proximity, research quality and universityindustry collaboration was also examined by Laursen et al (2011). They examined UK data based on the UK Innovation Survey, the Research Assessment Exercise and regional data from the UK Office for National Statistics and also conclude that geographic proximity plays a role in shaping university-industry interaction. Similar to D'Este and Iammarino (2010) they find that the significance of geographic proximity is attenuated by university research quality and firm absorptive capacity. In other words, the importance of being close to a university for collaboration depends on the quality

of the university in question, generally firms prefer to collaborate locally with highquality universities but in situations where firms are not located near top-tier institutions, they prefer to collaborate with better quality universities than closer universities. This study is important in highlighting the highly contingent process by which firms enter into collaborative arrangements with universities, which has also been highlighted in more recent research (Hewitt-Dundas, 2013).

One of the most comprehensive examinations of different proximity dimensions in fostering university-industry collaborative research is provided by D'Este et al (2013). Their study differs from those outlined above, which principally focus on one dimension of proximity (geographic), whereas this study considers the interaction between several proximity dimensions on research collaboration. Specifically, they examine the interaction of geographic proximity, cognitive proximity and organisational proximity and the extent to which they impact the establishment of collaborative interactions between industry and academic partners. Echoing the findings regarding geographic proximity in the above sections, they conclude that being spatially close makes collaborations more likely. They also highlight that organisational proximity, operationalised as shared collaborative experience, enhances the likelihood of collaborative interactions. Importantly, the role of geographic proximity in facilitating new partnership development is neither enhanced or attenuated by organisational proximity, suggesting that these proximity dimensions are neither compliments nor substitutes in facilitating university-industry collaboration. Interestingly, they find that cognitive proximity, or shared knowledge bases does have an impact on the effect of geographic proximity by showing that firms located in dense clusters of technological-relatedness are more capable of collaborating with universities irrespective of their location.

More recently, Steinmo and Rasmussen (2016) explore how different dimensions of proximity influence the formation of collaborative relationships but also how proximity dimensions evolve as collaboration develops. Accordingly, their research is based on qualitative case study research, drawing on interview data and supporting documentation from 15 top-performing university-industry collaborative projects in

Norway. Their sample of projects is stratified into engineering-based firms and science-based firms that differ in terms of their underlying knowledge base, their research objectives and aims and their objectives of interaction with external partners. Science-based firms are characteristically research intensive and underpinned by an analytical knowledge that enables the pursuit of new technological opportunities; whereas engineering-based firms are characterised as being marketdriven with lower R&D intensity and a synthetic knowledge base, where existing knowledge is recombined to pursue new market opportunities (Asheim and Coenen, 2005; Steinmo and Rasmussen, 2016). Echoing Laursen et al (2011), they find that importance of geographic proximity in the establishment of research collaboration is contingent upon the organisations involved. In particular, they find that geographical proximity is more important for engineering-based firms that tend to rely on local partners to overcome issues related to cognitive distance and organisational distance. Conversely, science-based firms are more likely to have shared knowledge bases with universities and have a better understanding of university norms, rules and structures, therefore geographic proximity and social proximity are less important in the establishment of collaborative research efforts. This study is one of the few studies to explore the temporal aspect of proximity dimensions and suggests that those collaborations that are initially based on social and geographical proximity are more likely to develop cognitive proximity over time. The development of cognitive proximity is found to reduce the dependence on geographic proximity in future collaborative efforts, again indicating the development of collaborative capabilities (D'Este et al., 2013; Laursen et al., 2011).

To conclude this section, the research on the significance of geographical proximity and local environmental conditions for engagement in research collaboration is ambiguous, with some suggesting geographical proximity is important and others highlighting its irrelevance (Mora-Valentin et al., 2004). However, the research concerned with geographical proximity and research collaboration consistently highlights the interdependence of the different dimensions of proximity with geography. In fact, much of the empirical evidence suggests that the significance of local conditions is heavily mediated by the organisational characteristics of the

collaborating firms (Laursen et al., 2011). Therefore, the next section focuses explicitly on the role that organisational characteristics play in contributing to the formation and success of collaborative research efforts.

2.4.5 Organisational Antecedents: Formation

This section will be split into two, the first section focuses on the research that has examined the characteristics of firms and universities that are affect the engagement in collaborative research for innovation (Arvanitis et al., 2008; Bercovitz and Feldman, 2007; Bishop et al., 2011; Bodas Freitas et al., 2013; Cohen et al., 2002; De Fuentes and Dutrénit, 2012a; Feldman and Desrochers, 2003; Goel et al., 2017; Laursen and Salter, 2004; Mora-Valentin et al., 2004; Santoro and Chakrabarti, 2002).The second section provides an overview of research that explores the linkages between organisational structures practices and policies and the success of collaborative activity (Bruneel et al., 2010; Bstieler et al., 2017; Giuliani and Arza, 2009; Hall et al., 2001; Hemmert et al., 2014; Hughes and Kitson, 2012; Korff et al., 2014; Plewa et al., 2013; Plewa and Quester, 2007; Thune, 2011).

Research on the organisational antecedents to university-industry collaboration is less developed than the literature that explores the linkages between individual antecedents and environmental antecedents. The reason for this could be twofold; first, collaborative research is primarily conceptualised as a highly individualised phenomenon as evidenced by the literature outlined above. Second, the role of the organisational unit (both 'the firm' and 'the university') when considered is largely seen as a mediator for individual antecedents or environment level antecedents. Nonetheless, some research has explored how organisational characteristics (both firm and university) impact the level and success of collaborative research activity. For example, Cohen et al (2002) focus on the relationship between firm size and the propensity of the firm to utilise publicly funded research. Using a sample of 1267 US owned manufacturing firms, they show that larger firms are much more likely to engage in collaborative research activity than smaller firms. Specifically, large firms are more likely to engage in collaborative research in order to generate new avenues

for research as well as to contribute to existing R&D programmes. They also show that start-up firms, i.e. younger firms are much more likely to engage in collaborative research than established or older firms but only for the purposes of completing existing R&D projects. This result indicates that start-ups make up for a lack of internal R&D capacity by engaging with universities.

Santoro and Chakrabarti (2002) also offer a detailed examination of how firm characteristics impact the collaborative activity with universities, with a specific emphasis on how firm characteristics impact the intensity of research collaboration. Adopting a mixed-method approach, they collect data from semi-structured interviews with managers of US Government funded R&D centres and survey data from firms active in the 29 centres. Interview data was used to inform the construction of a survey and the survey formed the basis of regression analysis. Following analysis of the 207 responses, they find that larger firms are more likely to engage in formal collaborative relationships and research support activity (the use of materials and equipment) to contribute to skill and knowledge development in non-core technological domains. They suggest that this is the case since larger firms have greater resource endowments, thus have the capacity to work on enabling technologies that are ancillary to core-business technology (Santoro and Chakrabarti, 2002). Further, emphasising the significance of firm size for types of university collaboration, they show that smaller firms are more likely to engage in IP-based technology transfer (commercialisation) and co-operative R&D with the ambition of enhancing knowledge and skills related to core-technologies. In contrast with large firms, small firms do not have the capacity to engage with universities to work on noncore technologies, so draw upon different collaborative mechanisms to work on more immediate technological solutions. Critically, they also examine the role of 'champion behaviour' in engagement of collaboration, that is a dedicated individual who maintains ongoing relationships with the industry/university partner, monitoring ongoing activity and protecting against internal and external threats to the relationship (Santoro and Chakrabarti, 2002, p. 1172). They find that industry-based 'champions' are more influential in preserving collaboration efforts than universitybased champions, since industry-based champions are more likely to exert a greater

degree of influence over resources and innovation strategy than university-based champions.

The significance of innovation strategy for firm engagement in university research collaboration has been highlighted by a number of studies (Bercovitz and Feldman, 2007; Laursen and Salter, 2004). Bercovitz and Feldman (2007) investigate the links between firm innovation strategy and internal R&D structure with their level of involvement in collaborative university research. They draw upon survey data collected from senior R&D managers in the most research-intensive Canadian organisations in 2004. Again, employing regression analysis they find evidence to support a strong relationship between firm innovation strategy and the level of collaborative research with universities. In particular, those firms that pursue an internal innovation strategy that places a greater degree of emphasis on exploration are more likely to collaborate on a long-term, ongoing basis with universities. They also find evidence to suggest that the more centralised a firm's R&D function is the more likely it is that the firm will engage in exploratory collaborative research with universities. The study highlights that universities are preferred partners when it is perceived that appropriating research results will be problematic. Whilst this initially appears counter-intuitive, this finding suggests that firms that have concerns about the effectiveness of formal IP protection are more likely to conduct exploratory R&D with universities than other firms because universities lack the complementary resources to capitalise on any unprotected knowledge developed in the joint collaboration (e.g. a lack of manufacturing, sales and marketing capabilities).

Similarly, Laursen and Salter (2004) examine what types of firm are most likely to collaborate with universities for innovation. Whereas Bercovitz and Feldman (2007) base their findings on a relatively small scale survey, Larsen and Salter (2004) use UK Community Innovation Survey data based on 2655 responses across 13 industries in the UK manufacturing sector. Similar to Bercovitz and Feldman (2007) they show that firm-level strategy has a significant on the propensity to engage in collaborative research with a university. Specifically, firms that adopt 'open' search strategies are much more likely to draw knowledge form universities than firms who adopt a more

closed approach to innovation. R&D intensity (R&D expenditure as a proportion of sales) is also related to the propensity to collaborate with universities. In contrast with Cohen et al (2002), it is suggested that larger firms are much more likely to engage in collaborative research efforts with universities than smaller firms. This study is significant since it draws attention to the role that managerial agency plays in contributing towards university-industry collaborative research. In particular, this study shows that the likelihood of a firm engaging in collaborative research with a university is not pre-determined by environmental or structural conditions but mainly by the firm's strategy for sourcing innovation which is a consequence of managerial choice. This argument relates to the significance of 'collaboration champions' outlined in the research above (Santoro and Chakrabarti, 2002), in highlighting the important role of agency in university-industry collaboration.

Although research has largely focused on the characteristics of firms that are related to engagement in collaborative research, such as the papers addressed in the previous section, others have examined the characteristics of public research institutions in terms of their effect on levels of collaborative research activity. Notably, Arvanitis et al (2008) explore the factors that determine the propensity of Swiss science institutions to engage in knowledge transfer. Drawing on national data collected from three types of Swiss public science institutions (federal labs, research universities and universities of applied science), they find that those institutes with a stronger orientation to applied research and with lower teaching commitments were more likely engage in collaborative research. As the studies reviewed below elaborate, this research also drew attention to the significance of previous experience in collaboration with industry as a key determinant of higher levels of collaborative research. In contrast to research that has indicated that there are differences in the propensity to collaborate between small and large firms (Bercovitz and Feldman, 2007; Cohen et al., 2002), this study suggested that there were no systematic effects of university size in relation to propensity for collaborative research activity.

More recently, De Fuentes and Dutrénit (2012) examine the impact that collaboration drivers have on the utilisation of specific collaborative channels and the impact that

the adoption of these channels has on the perceived benefits of collaboration for academic and industrial researchers. In-line with previous research (Bercovitz and Feldman, 2007; Laursen and Salter, 2004) they find that 'behavioural factors' including a firm's innovation capability and innovation strategy are more important drivers for all modes of collaboration than structural factors such as size, age and sector. It is concluded that a firm's innovation capability, in terms of the size and formalisation of its R&D operations, is the most important driver of university-industry research. Firms that adopt an open innovation approach to knowledge creation are also more likely to collaborate with universities, confirming the earlier results of Laursen and Salter (2004). The relationship between firm characteristics and benefits of university research collaborations is also examined by Bishop et al (2011) who show that different benefits are influenced by different firm characteristics. Crucially, they show that R&D intensity has limited effect on the benefits derived from collaboration. Instead, they suggest that the firms are most perceptive of the benefits of collaboration are those that maintain continuous involvement in R&D activity, irrespective of R&D intensity. Interestingly, this study draws attention to university characteristics, showing that the extent to which firms perceive benefits of collaboration is not related to the ranking of the academic institution.

Overall, research on the structural organisational antecedents on university-industry collaboration remains relatively underdeveloped (Perkmann et al., 2013), although this may be because the existing research seems to suggest that structural characteristics, aside from firm size and strategy, appear to play a minor role in influencing engagement in collaborative research activity with universities. In fact, this body of research appears to suggest that the more salient issues to consider are related to the organisational and managerial characteristics of the collaboration itself, rather than the characteristics of the collaborating parties (Bercovitz and Feldman, 2007; Bruneel et al., 2010; Mora-Valentin et al., 2004; Morandi, 2013). The next section focuses on these relational and managerial characteristics and their influence on the success of joint collaborative efforts.

2.4.6 Successful collaboration: Organisational and managerial factors

The research outlined above focuses on organisational factors that influence the occurrence of collaborative activities, others have focused on how organisational factors relate to the *success* of collaborative activities. Mora-Valentin et al (2004) define success as the extent to which the collaborative project meets the objectives stated in the initial agreement. Previous links, reputation, proximity and clarity of objectives constitute what Mora-Valentin et al (2004) term 'contextual variables' and commitment, communication, trust, conflict and dependence constitute organisational factors that may contribute to or hamper success. Data was collected from both academic researchers and firm participants so that evaluations included feedback from both partners, the total sample included 150 research organisations and 547 firms. Results of regression analysis showed that, as far as firms were concerned, the most important success factors were the organisational commitment of the research partner, the presence of pre-existing linkages, clarity in the definition of research goals and the capacity to deal with conflict. Interestingly, the research organisations perceived differences in success factors, since they perceived trust, clarity in communication and the firm's reputation as critical success factors. Importantly, this study highlights that both partners emphasise the significance of preexisting linkages as critical to the success of collaborative research efforts, suggesting that repeated interactions over time enable the development of trust and related social capital that enables clarity in communication, commitment and effective dispute resolution. In contrast with the research outlined in Section 2.4.4, geographic proximity was found to have no effect on the success of collaborative research efforts.

Thune (2011) also employs the 'contextual', 'organisational' and 'process' constructs when exploring the success factors associated with university-industry research collaborations. Organisational factors relate to degree of formalisation, organisational commitment and resource involvement whereas process factors include project management, clear communication and social capital. Based on four case studies of university-industry collaborative partnerships in Norway Thune (2011) argues that, formal agreements are often symbolic and it is the operational 'anchoring' of the partnership in people, activities and projects that is most necessary for success. The case material presented also emphasises that collaborative projects are usually driven by a limited number of academic staff who occupy multiple roles (i.e. gatekeeper, boundary spanner). It is suggested that the stability these 'collaboration champions' maintain is crucial for overcoming organisational commitment issues (Santoro and Chakrabarti, 2002) and thus, critical for success. Some process factors can substitute for organisational factors, for example organisational commitment and continuity of staff may reduce the need for formal control and co-ordination mechanisms. Thune (2011) concludes by highlighting that larger, resource intensive collaborations (or strategic partnerships) are often underpinned by pre-existing relationships, again emphasising the significance of experience for success in collaborative partnerships.

One of the most widely cited studies concerned with the organisational success factors of university-industry collaboration is presented by Bruneel et al (2010) who also focus on the relational mechanisms that may diminish barriers to collaboration, namely trust. Their analysis is premised on the assumption that there are two principal barriers that disrupt university-industry research collaboration, these are labelled 'orientation-related' barriers and 'transaction-related barriers'. Differences in research orientation in terms of timescales and research incentives constitute 'orientation-related barriers' whereas difficulties associated with IP concerns and dealing with university administration are 'transaction-related' barriers. The key questions addressed by Bruneel et al (2010) relate to how prior collaborative experience and trust reduce these barriers (thus contributing to 'successful' collaboration). Statistical analysis of survey data collected from 503 UK firms that had been involved in collaborative research with universities is used to address these concerns. Their research demonstrates that organisations that have amassed prior experience in research collaboration with universities will have different perceptions of the barriers to collaboration. Firms with prior experience will perceive lower 'orientation-related' barriers than firms that have had no prior collaboration experience. Thus, it is postulated that firms developed routines for engaging in collaborative research with universities as a result of experiential learning (Bruneel et al., 2010). The importance of experience in collaboration is also elaborated by the studies outlined above, however Bruneel et al (2010) stress that prior collaboration

experience plays only a partial role in diminishing the perceptions of barriers to collaboration, since there is no relationship between prior experience and the perception of transaction related barriers. Similarly, results indicate that adopting multiple channels of collaboration is useful in reducing 'orientation-related barriers' but may have negative consequences for 'transaction-related' barriers, since the administrative burden increases as more collaborative channels are adopted. Unlike prior experience, trust was found to reduce the perceptions of both types of collaboration barriers. Bruneel et al (2010) therefore conclude that trust is the most important mechanism for enhancing the potential for successful collaboration but stress that the establishment of trust requires that that collaborators make mutual effort to understand one another's goals and incentive systems. It is suggested that the resource intensive nature of trust development necessitates face-to-face contact which will enhance contribute towards the development of overlapping personal and professional relationships (Bruneel et al., 2010).

Given the centrality of trust in fostering success from collaborative research efforts, it is no surprise that the mechanisms of trust formation and maintenance have been subject academic scrutiny (Bstieler et al., 2015; Hemmert et al., 2014; Plewa et al., 2013). The role that trust plays in the success of university-industry collaboration and the mechanisms through which trust can be cultivated are examined by Bstieler et al (2015). Drawing on a dataset of 440 US Biotech firms that have been involved in collaborative research with a university for over 3 years, they examine how university IP policy and shared governance structures impact the establishment of trust and consequently, how this trust impacts the success of collaboration. They also examine the extent to which these structural mechanisms are moderated by the behaviour of collaboration champions, whose significance is addressed above. The flexibility and transparency of university IP policies were key in ensuring the development of trust between university and industrial collaborators. Shared governance arrangements, in terms of joint objective setting, decision making and evaluation (Perkmann et al., 2011b), was also a key driver of trust formation between research collaborators. This study also provides an elaboration of the role of collaboration champions, who are able to enhance the development of trust by separating transactional discussions

related to IP from discussions about relationship development and mutually beneficial working arrangements. Furthermore, it is highlighted that because of their seniority within their respective organisations, champions are able to motivate partners to redefine their goals and re-direct their efforts from formal negotiation to partnership development (Bstieler et al., 2015). Most importantly, they conclude that those partnerships that are characterised by higher degrees of trust are perceived as more successful in terms of firm innovation performance.

The foundations of trust within university-industry collaborative research projects are also highlighted by Hemmert et al (2014), who show that that champion activity is a critical determinant of trust in three different national contexts. They also show that prior ties and contractual safeguards are also important drivers of trust development, but that their significance varies by institutional context. For example, in national settings where university-industry research collaboration is still in its relative infancy (in their case South Korea and Japan), champion behaviour and reputation are more fundamental to trust development than prior collaborative ties. A substitution effect between tie-strength and contractual safeguarding is also highlighted, suggesting that too great an emphasis on embedding trust via contractual means may in fact undermine trust development since it could diminish the perceived goodwill of the parties (Hemmert et al., 2014).

Whilst the studies described above are useful in illuminating the antecedents for success in collaborative research efforts, very few studies have examined how the significance of these factors varies over time. One obvious exception is Plewa et al (2013) who examine the interrelationships of trust, communication, mutual understanding and personal relationships and their impact on collaboration performance over time. They break collaborative research efforts into three discrete phases of 'initiation', 'engagement' and 'continued engagement'. Data is collected from recipients of research funding from a programme aimed at establishing links between university and industry partners run by the Australian Research Council from 2002- 2009. Following statistical analysis of 132 survey responses they find that personal relationships are key to the development of trust across all phases of

collaboration. Similarly, clear communication is found to be crucial for the developing mutual understanding and producing successful outcomes across all three collaborative phases. Interestingly, communication is only related to trust development in the engagement phase but not in the initiation phase. In contrast to findings presented above (Bstieler et al., 2015; Hemmert et al., 2014), there is no evidence to support linkages between trust and successful outcomes. Their results suggest that personal relationships are key for the development of collaboration in the initial phases insofar as individuals need to establish relationships with one another to clearly define project aims and scope. The significance of communication remains constant across the life-cycle of collaborative projects since it facilitates clear project definition, underpins monitoring and feedback and enables coherent evaluation. It is concluded that trust, as a relational antecedent of success, is limited in its significance because once it is established in the initiation phase, clear communication becomes a more important factor in ensuring project continuity.

Considering the research on organisational antecedents for success in totality, key mechanisms are commonly highlighted as underpinning success, both in terms of fostering continuity and in contributing to organisational innovation performance. The studies outlined above consistently present collaborative experience as a key driver of collaboration success, other factors such as trust, communication and close personal relationships may all be considered derivatives of collaboration experience. The guestion that then arises is, in what ways does experience contribute towards collaborative relationship development? Those studies outlined above are useful in highlighting that experience is important, yet there remains very little research on how experience, at various different levels of analysis (individual/ organisational) actually functions in the development of collaborative research partnerships. Furthermore, it is clear from the studies reviewed in the preceding two sections that there is a paucity of research that adopts a longitudinal perspective to explore the organisational dynamics of collaborative research partnerships. The exception is Plewa et al (2013) who include an evolutionary aspect to their analysis but even within their study, the dynamics of partnership formation and development are not addressed. In this example, evolutionary 'phases' are used as conceptual anchor

points to examine interrelationships between organisational mechanisms for trust development. Despite the paucity of research exploring the evolutionary dynamics of collaborative research, there is increasing recognition of the significance of understanding how partnerships emerge and change over time (Boardman and Bozeman, 2015; Goel et al., 2017; Perkmann et al., 2013; Perkmann and Schildt, 2015; Perkmann and West, 2015; Thune and Gulbrandsen, 2014). The few studies that have attempted to explore the emergence and evolution of university-industry research collaboration are outlined briefly below, before the principal research concerns of this current research are articulated in relation to the literature presented in this chapter.

2.4.7 Emerging perspectives on organisational collaboration: Practices and Process

The research presented in the previous section demonstrates that there is a wellestablished understanding of the antecedent factors that contribute to both the occurrence and success of university-industry collaborative research. However, issues pertinent to how collaboration is managed and how collaborative partnerships develop over time remain underexplored within existing literature (Thune and Gulbrandsen, 2014). However, there have been some notable efforts in elaborating collaborative practices at an individual level (Nelson, 2016) and organisational level (Morandi, 2013; Perkmann and Schildt, 2015; Youtie and Shapira, 2008). There have also been some notable efforts at elaborating the developmental process of university-industry partnerships based on life-cycle models and path-dependent models (Ankrah and AL-Tabbaa, 2015; Dill, 1990; Philbin, 2008; Thune and Gulbrandsen, 2014; Youtie et al., 2006).

Regarding the establishment of university-industry collaboration, a useful recent contribution is offered by Goel et al (2017). Drawing on a sample of 833 German manufacturing firms that have collaborated with industry, they provide statistical analysis of interaction characteristics and conclude that university scientists are usually responsible for initiating interactions with industry, since they are often searching for resources to further their work, but find that industry scientists usually take over responsibility for project management once collaborations have been initiated. Their analysis also suggests that university researchers find it easier to establish collaborative research projects with smaller firms but that industry scientists based in larger firms are more likely to initiate collaborative projects than their counterparts in smaller firms.

In terms of understanding how multi-partner collaboration is achieved in the university-industry setting, Perkmann and Schildt (2015) offer key insights based on the case of the Structural Genomics Consortium (SGC). This is a consortium of three leading research universities and several multinational pharmaceutical companies that seeks to identify the 3D shape of thousands of human proteins with the potential for drug discovery (Perkmann and Schildt, 2015, p. 1135). Based on 22 semi-structured interviews with key consortium participants, Perkmann & Schildt (2015) describe how the organisational arrangements and collaborative practices in the SGC allowed both firms and universities to mutually benefit. They show how the consortium constituted a 'boundary organisation' that acted as an intermediary between all partners. This boundary organisation enabled collaboration through instilling the practices of 'mediated revealing' and 'enabling multiple goals'. Mediated revealing involved the SCG aggregating and anonymising data that was donated by firms that was then redistributed to all consortium partners. Therefore, all partners had equal access to data but did not know who contributed what. This allowed participating firms, who were in direct completion with one another, to reveal information that they would otherwise be unwilling to disclose and enabled them to shape the direction of scientific enquiry within the consortium. The second key practice that is enabled by the establishment of a boundary organisation is 'enabling multiple goals. While the SCG involved investment from commercial enterprises, it was designed in such a way that it allowed room for academic participants to pursue their own research agendas alongside the targets nominated anonymously by firms. Consequently, academic goals and commercial goals co-existed within the same organisational framework. This enabled the SCG to attract top tier academic scientists who were willing to participate since they could further their own research pursuits. This study is the first and only existing study (to the best of my knowledge) to examine the organisational practices that facilitate open collaborative research partnerships between universities and commercial partners. There is also emerging interest in how such organisational collaborative arrangement are formed and how they change over time.

Early efforts at outlining the development of collaborative research partnerships between universities and firms were provided by Dill (1990) who recognised that collaborative research relationships are not fixed entities but dynamic evolving structures. Dill (1990) suggests that collaborative relationships evolve through negotiations between organisations and antecedent conditions that ensure arrangements develop through predictable and discrete phases. Specifically, Dill articulates three phases of development; the first phase is described as the 'problem setting stage' where organisations recognise mutual interdependence due to shared opportunities and risks. The second phase is termed the 'direction setting stage' in which organisations establish the boundaries for collaboration, negotiate with the relevant stakeholder and define shared values and priorities. The final phase is the 'structuring stage' where collaborations are formalised in legal agreements and formal roles and obligations are defined.

More recently, Philbin (2008) proposes a life-cycle model of university-industry collaboration (Fig 1.2).



Fig 1.2 Life-Cycle model of partnership development (Philbin, 2008).

He suggests that university-industry collaborative projects progress in a linear fashion through stages of terrain mapping, proposition, initiation, delivery and evaluation. Activity in each stage of the model is aligned to technical challenges and a business mission, facilitating a focus on value creation for both parties. The model also emphasises the role played by social capital and by human agency in the delivery of collaboration but offers limited insights as to how to how these constructs are mobilised. Terrain mapping consists of market analysis and the collection of information on potential collaborative partners' technology trajectories. In the proposition stage, a formal proposal or research offering is articulated, potential governance structures are proposed and key personnel are identified. Collaborations then move into the initiation phase, during which contractual negotiations take place and governance mechanisms are established. It is crucial at this stage that the scope and scale of the collaboration are clearly defined. University-industry collaborations then progress into the delivery stage, which is focused on the operational management of the collaboration and the delivery of results. Outputs at this stage may include publications, conference proceedings or intellectual property (Philbin, 2008). This stage is also characterised by systematic and periodic reporting on the progress of the collaboration. Finally, collaborations move into the evaluation stage whereby assessments are made on whether a collaboration should continue or should be dissolved.

Others have proposed more iterative models of collaborative partnership development. For example Ankrah & AL-Tabbaa (2015) suggest that partnerships begin with a formation phase, during which potential partners are identified, collaborative goals are articulated, assessments and evaluations of partners are made and contractual arrangements are negotiated and agreed. The outcomes of the formation phase contribute towards the establishment of specific organisational forms which are then translated into collaborative activities in the 'operational phase'. Their model is more iterative than the model offered by Philbin (2008) since it is recognised that the outcomes of the operational phase may lead the partners into another formation phase (see Fig 1.3)



Fig 1.3 Iterative framework for University-Industry Collaboration (Ankrah and AL-Tabbaa, 2015)

Thune and Gulbrandsen (2014) also offer an iterative perspective on research Theoretically grounded partnership development. in inter-organisational collaboration dynamics (Ring and Van de Ven, 1994), Thune and Gulbrandsen (2014) present a large scale study on the formation dynamics and evolutionary trajectories of multi-party university-industry research consortia. Drawing on 90 interviews with individuals involved in six research consortia they investigate the relationship between the initial conditions of partnership formation and the developmental process of the partnership. In presenting their case material, they propose that partnerships are characterised by three stylised initial conditions, which they term 'engineered', 'emergent' and 'embedded'. Engineered conditions refer to situations where a 'triggering entity' external to the collaborative partners invites co-operation. In this situation, the triggering entity is necessary for initial tie formation as the organisations involved have no prior relationships or mutual research interests (Thune and Gulbrandsen, 2014). Emergent initial conditions are characterised by an environmental interdependence between partners (e.g. they face common threats or are presented with common opportunities) which motivates cooperation. Since these conditions are characterised by environmental mutual dependence, the domain of collaboration and expectations regarding activities and outcomes are already salient

to the potential collaborators. Embedded conditions reflect situations where there is strong inter-personal network connections between individuals in firms and universities but there is little mutual inter-dependence between their respective organisations, consequently, goals and expectations are not immediately apparent to collaborators but cooperation is expected and taken for granted (Thune and Gulbrandsen, 2014). Based upon the cross-case analysis of their empirical material, Thune and Gulbrandsen (2014) conclude that the initial conditions of alliance formation are only relevant for understanding the formation stages of collaboration and that the influence they exert over the developmental trajectory of a partnership dissipates over longer time periods. Regarding the effects of initial conditions on the formation stages, they conclude that partnerships characterised by weaker network ties and greater goal ambiguity are more likely to face problems.

Similarly, they suggest that being embedded in dense personal networks is conducive to stability and development in the initial phases of collaboration but does not ensure success over the longer term. Importantly, they highlight the inadequacy of the three discrete conditions, suggesting that within their case material elements of all three conditions could be observed simultaneously in each partnership. Notably, they only find limited support for partnership learning over time, suggesting that the nature of collaborative interactions is largely contingent upon the alliance conditions. They suggest that when conditions are emergent, partnerships are characterised by 'coordinated efforts' where there are close personal relationships, frequent meetings and communication, higher levels of resource investment and higher levels of trust. Those partnerships characterised by engineered conditions are more likely to interact via 'parallel projects' where there are moderately strong personal relationships, but all interaction takes place in formal arenas and communication occurs mainly through key gatekeepers. Finally, those partnerships operating under embedded conditions are more likely to involve 'symbolic collaboration' where personal relationships between collaborators exist but the actual collaboration that occurs is primarily performed to fulfil funding criteria, there is no formalised personnel exchange and there are low degrees of trust and commitment (Thune and Gulbrandsen, 2014).
This seminal contribution to collaborative partnership dynamics was informed by previous work (Thune and Gulbrandsen, 2011) based on the same underlying data. The earlier paper carries a more specific focus on the formalisation of university-industry collaborations by examining the impact that formal structures have on the institutionalisation of collaboration between academic and industry partners. Echoing previous studies highlighted in Section 2.4.5 results emphasise the importance of pre-existing networks in the establishment of collaborative partnerships. The results from this study highlighted the variation in interaction levels that characterised different university-industry collaborations, suggesting the need for the development of a typology of collaborative arrangements and conditions, which is duly elaborated in the later work (Thune and Gulbrandsen, 2014).

Although the literature investigating the formation and evolution of universityindustry collaborations is thin, there are some very useful insights that provide direction to the current research. First, adoption of models of inter-organisational collaboration from mainstream alliance dynamics literature provides a good theoretical grounding for further work. Second, the existing research clearly highlights the significance of central issues in development such as the relationship between 'context' and 'process' (Pettigrew, 1997). Specifically, it is clear that for any meaningful analysis of process, it would be harmful to exclude individual, organisational and environmental aspects from analysis, since all are clearly important in shaping the collaboration process. The key conclusions of this literature are summarised below.

2.5 Conclusions and Next Steps

This chapter presents a comprehensive review of the literature pertinent to university-industry interaction. The first section focused on the most widely researched channels of interaction within this field, namely patenting, licensing and spin-off formation. These channels are important to consider, given the widespread attention devoted to them within existing literature, however, research has consistently demonstrated their limited utility in both firm innovation efforts and regional development (Bonaccorsi, 2017; Cohen et al., 2002; Perkmann et al., 2013; Perkmann and Walsh, 2007). It is clear that collaborative research based on more relational forms of interaction are of more value to firms. The existing literature on collaborative university-industry research has generated a detailed body of knowledge on the factors that underpin the formation of collaborative interaction and the factors that may contribute to the success of collaborative interactions, both in terms of partner satisfaction and in innovation performance. However, there are a number of issues presented by the literature reviewed above.

First, empirical studies on antecedents to collaborative research are largely underpinned by cross-sectional research designs, that give no insight into the temporal dynamics of collaborative interactions. Second, the research outlined above is largely empirically driven, the field of university-industry interaction is characterised by theoretical under-development. The theoretical development of the field is evidenced by the structure of this current review, since it was very difficult to isolate theoretical schools of thought representing research in university-industry collaborations, with only fleeting reference to theoretical constructs made in most papers discussed. Third, there is limited research on 'research partnerships', a collaborative arrangement that is seen as increasingly important in terms of how firms collaborate with universities (Boardman & Bozeman, 2015; Perkmann et al., 2013; Perkmann & Schildt, 2015; Perkmann & West, 2015). Fourth, there is very little research on the temporal dynamics of university-industry collaboration, even though it is acknowledged that understanding how to create, sustain and manage long-term partnerships is an increasingly important policy objective (Dowling, 2015; Hughes and Kitson, 2012).

Finally, taking all the analytical perspectives in totality, it is clear that analytical distinctions between individual, organisational and environmental influences on collaborative activity are insufficient to account for partnership development. For example, research on individual level factors consistently shows that these are moderated by organisational level characteristics. Similarly, organisational level analysis points to the significance of 'champion behaviour' of individuals as a key

mediator and the macro-environmental perspectives on proximity highlight the importance of firm-level factors such as absorptive capacity and innovation strategy as key mediators of proximity effects. Therefore, on the basis of this review, I propose that neither individual influences, firm influences or macro-environmental influences are sufficient to account for the formation and development of collaborative research partnerships. Although this has been tentatively explored by Thune & Gulbrandsen (2014), this issue requires further theoretical elaboration that will enable more comprehensive theoretical understandings. The next chapter provides an overview of theoretical perspectives that allow for the incorporation of these multiple levels of analysis within a singular theoretical framework, mainly drawn from literature on the dynamics of inter-organisational collaboration (de Rond and Bouchikhi, 2004; Majchrzak et al., 2015).

Chapter 3: Theoretical approaches to the alliance development process

3.1 Introduction

Chapter 2 concluded by highlighting the need for a consideration of theoretical perspectives pertinent to the development of inter-organisational relationships. This chapter first offers an overview of theoretical perspectives on organisational emergence and change, more commonly referred to as 'process theory' (Hernes, 2014a; Langley et al., 2013; Sminia, 2009). Process theories are variously characterised as 'strong' or 'weak', 'endogenous' or 'exogenous' as well as 'substance-based' or 'process-based' (Hernes and Weik, 2007; Langley et al., 2013; Van de Ven and Poole, 2005; Weik, 2011). These different variations in process theories are a consequence of the underlying ontological and epistemological assumptions about organisations and change.

Following this, the processual perspectives on the development of interorganisational relationships are outlined. The core theoretical perspectives that have been adopted in explaining the development of collaborative relationships between organisations include: Life-Cycle models, Teleological models, Evolutionary models and, to a lesser extent, Dialectical models (de Rond and Bouchikhi, 2004; Majchrzak et al., 2015). The second section provides an overview of each of these perspectives and gives examples from the existing literature to illustrate how they aid our understanding of the development of inter-organisational relationships. The second section concludes by highlighting that much of the existing theorising on collaborative partnership development can be characterised as 'exogenous' or 'substance-based' process theory. I argue that while these theoretical perspectives are useful in advancing our understanding of this phenomena, our understanding still remains partial, since these theories make certain assumptions about the nature of organisations and our knowledge of them, that obscures richer alternative understandings. The chapter concludes by suggesting that alternative metaphysical assumptions might yield more realistic insights and more holistic theories of partnership emergence and development

3.2 The emergence and Development of Organisation: Process Theorising In an introduction to an *Academy of Management* special issue on process research, Langley et al (2013, p. 1) describe how:

"Process studies address questions about how and why things emerge, develop, grow and terminate over time, as distinct from variance questions dealing with covariation among dependent and independent variables"

The process/ variance distinction in organisational research is based around the conceptualisation of change according to different ontological and epistemological assumptions (Langley et al., 2013; Poole et al., 2000; Van de Ven and Poole, 2005). The core ontological issue within processual approaches to organisation revolves around the primacy of substances or process. Consequently, the key epistemological question relates to how (organisational) change can be known. Van de Ven and Poole (2005) provide an overview of the principal ontological-epistemological perspectives adopted within organisational process research (Fig. 3.1). Whilst there is a strong variance tradition within alliance research that explores co-variation between alliance characteristics and outcomes (Lioukas et al., 2016; Lioukas and Reuer, 2015; Reuer et al., 2002; Reuer and Ariño, 2007; Zollo et al., 2002), there is much less on the evolutionary dynamics of alliances over time (Majchrzak et al., 2015). The principal interest of the current research is in understanding how partnerships emerge and change over time, thus the current review will focus explicitly on process theoretical perspectives rather than variance studies. The distinctions between different types of process research will now be outlined, followed by a review of processual alliance research, much of which is underpinned by 'substance-based' theorising.

		Ontology- Nature of Organisations and Change			
		Substantive- Nouns, actors, entities as 'beings'	Processual- Verbs, processes, temporary stabilisations, 'becoming'		
Epistemology (how change can be known)		Approach 1- Variance studies			
		of change by causal analysis of	Approach 4- Studies of		
		changes in characteristics of	organising based on dynamic		
	Variance	the entity (dependent	modelling- agent based		
	Method	variables) attributable to other	models and complex-		
		observable characteristics	adaptive systems-		
		(independent variables)-	Newtonian Science		
		Newtonian Science			
		Approach 2- Process studies of	Approach 3- Process studies		
		change in organisational	of organising by narrating		
	Process	entities narrating a sequence	emergent actions and		
	Narratives	of events, cycles or stages in	activities by which collective		
		the development of an entity-	endeavours unfold-		
		'Exogenous Process'	'Endogenous Process'		

Fig 3.1 Process Assumptions and Theoretical Approaches (Adapted from Van de Ven & Poole, 2005, Tsoukas & Chia (2002) and Hernes & Weik (2007)).

3.2.1 Process Ontologies

As suggested in Section 3.1, there are various labels used characterise different types of process theory. Here, I focus on the ontological distinctions that characterise 'substance-based' process theory and 'flux-based' process theory. I will not consider epistemological differences in great depth since I am not attempting to engage in variance-based theorising. The ontological differences are significant for the current research however since the assumptions made about the nature of 'being' and 'becoming' have significant implications for theorising and subsequent knowledge claims (Bakken and Hernes, 2006; Hernes and Weik, 2007; Langley et al., 2013; Tsoukas and Chia, 2002). Substance-based process theory is premised on the assumptions that the world is fundamentally constituted by substances, 'things' or 'entities'. These things or entities that make up the world, such as organisations (or partnerships), are assumed to retain some fundamental character that remains constant over time. Change therefore is ontologically secondary to substance, since under these assumptions change is something that happens to entities as they move from one state to another (Van de Ven and Poole, 2005), varying along some dimensions but retaining their same fundamental character.

Conversely, 'flux-based' process theory gives ontological primacy to process rather than substance. Therefore entities, such as organisations, are reconsidered as temporary instantiations of ongoing processes, in a continuous state of becoming (Langley et al., 2013; Tsoukas and Chia, 2002). Under these assumptions, reality consists not of entities that can be categorised into levels of analysis (e.g. actors, organisations, institutions) but solely of events and experiences, in which process achieves form, that we recognise as actors, organisations and environments (Hernes, 2014a; Hernes and Weik, 2007; Tsoukas and Chia, 2002).

Hernes & Weik (2007) suggest that the entity/process distinction, whilst helpful is too simplistic to fully account for the way in which the notion of 'process' in dealt with in organisation studies. Instead, they recognise the duality of these two constructs by acknowledging that organisational phenomena can be treated both as entity or as process, since actions (process) contribute towards the stabilization of actors into entities, but in actuality they may be always somewhere in between (Bakken and Hernes, 2006). Consequently, process research is characterised as 'exogenous' and 'endogenous' (Hernes & Weik, 2007) based on the degree of stability that is assumed within the analysis. In other words, since 'process' is used within the field of organisation studies to refer to that which moves, it is therefore necessary to make some assumptions about the degree of stability within the analysis of process. Process research can therefore be loosely categorised based on these implicit stability assumptions (Hernes and Weik, 2007). In exogenous research, process is characterised as the 'stuff that changes' (e.g. actions, behaviours) in relation to a more stable set of arrangements around it (i.e. it's context). A good example of exogenous process theory is Pettigrew's contextualism, which assumes that process is the 'stream of analysis' that is shaped by organisational terrain through which it runs (Hernes and Weik, 2007; Pettigrew et al., 2001; Pettigrew, 1987; Sminia, 2009; Sminia and de Rond, 2012). This conception of process advocates that 'context' or stable environmental arrangements are the key determining factor in explaining the development process. Neoinstitutionalism provides another good example of exogenous process theory, since changes in the behaviour and actions of organisations are explained by reference to external forces such as regulatory pressures, competitive pressures, the desire to maintain legitimacy within the market (Di Maggio and Powell, 1991). All of these external 'contextual' factors, are what drive changes and transformation within the organisation (Hernes and Weik, 2007).

In contrast, endogenous process theories are those that relax the assumptions of stability. When 'context' is not considered the driver of change (process), the basis of movement resides in the process itself. Process interacts with its past and is 'carried forward' as the basis of further process. Hernes and Weik (2007) draw attention to Weick's (1979) 'enactment, selection, retention' theory of organisational change as an example of endogenous process theory, since this framework acknowledges that contexts are 'enacted' by organisational members who create and define them and thus give them meaning. In contrast to exogenous theories where entities external to the organisational change process remain stable and drive the change, here there is no objectively stable 'external environment' outside of the process but rather environments are enacted or brought to bear by the organisational actors involved in driving change and are thus endogenous (Hernes and Weik, 2007). Consequently, the focus of analysis shifts from the exogenous perspective, which analyses how contextual changes precipitate organisational responses, to an endogenous analysis of how organisational stability is established through the internal enactment process. In the second type of analysis, organisation is produced by relations between actors,

79

artefacts, communications, materials and technologies which coalesce into a recognisable whole. They are driven by their own process of connecting and 'change' as configurations of connections are altered. Under this conception of process, the analytical focus is squarely on the connecting processes which produce stability rather than the correspondence between entities and contexts (Hernes, 2014a; Hernes and Weik, 2007).

Clearly, from the discussion presented above, there are important nuances that have to be attended to in the consideration of organisational change and development. The next section focuses on the key process-theoretical perspectives that have been adopted within the domain of inter-organisational relationships. Before I provide this overview, I will outline the construct of 'Inter-Organisational Relationships' that is adopted within existing process research on alliance dynamics (Majchrzak et al., 2015) Following the review of process theories of inter-organisational development, I offer a critique of substance-based processual theories of alliance dynamics.

3.3 Inter-Organisational Relationships

Academic literature concerned with inter-organisational collaboration, particularly that which is concerned with dynamics of collaboration, is extremely fragmented (Bell et al., 2006). Terms including "inter-organisational collaboration" "inter-organisational relationship", "strategic alliance", "strategic partnership" and even "joint venture" are used to describe different configurations of collaborative arrangements between organisations (Kale and Singh, 2009). Strategic alliances are defined as "purposive relationships between two or more independent firms that includes the exchange, sharing or co-development of resources to achieve mutually relevant benefits" (Kale and Singh, 2009, p. 46). Furthermore, alliances can span several components of a firm's value chain and can have a variety of organisational configurations based on equity arrangements. Alliances are generally based upon contractual agreements, equity exchanges or a combination of the two (Gulati, 1998; Kale and Singh, 2009; Yoshino and Rangan, 1995). Contract-based relationships include; joint R&D activity, joint marketing, joint manufacturing; arrangements to access mutually complementary assets and skills, standard setting and R&D consortia.

Other configurations are based on equity exchanges whereby partners invest in one another or mutually invest in the establishment of a joint-venture (Kale and Singh, 2009). Figure 3.2 provides an overview of the various organisational arrangements that may be considered a strategic alliance.



Fig 3.2 Defining Strategic Alliances (Source: Kale & Singh, 2009)

The focus of this research is the relationship between publicly funded academic institutions and commercial organisations. As UK academic institutions are autonomous (in statutory terms), publicly funded institutions, relational configurations based on equity exchange are not appropriate in this context (as private organisations cannot take equity stakes in public universities). Although, these two types of partner may engage in some form of equity-based exchanges via the establishment of spin-off firms (Mustar et al., 2006; Rasmussen et al., 2011) this is not the primary focus of this research. This chapter therefore focuses on those interorganisational relationships that facilitate the exchange of assets and resources, which are based upon contractual and relational underpinnings (Kale and Singh, "alliance", "inter-organisational collaboration", 2009). The terms "interorganisational partnership", "strategic partnership" and "strategic alliance" are used interchangeably throughout this chapter to refer to these exchanges between organisations that contribute towards mutual benefit.

3.4 Process Perspectives on the Formation and Development of Interorganisational relationships

The study of alliance formation and development is sometimes referred to as 'alliance dynamics' (Majchrzak et al., 2015). Lumineau et al (2011, p. 11) highlight that "dynamics approaches often view processes in alliances as cycles in which the outcome of collaboration is implemented and assessed." De Rond and Bouchikhi (2004) articulate the pre-eminent theoretical perspectives in literature concerned with the formation and development of inter-organisational relationships. Based on Van de Ven & Poole's (1995) process-theory typology, they comment on the four generic 'theoretical engines' that characterise research in the formation and development of inter-organisational relationships. These include; life cycle theories, teleological theories, evolutionary theories and dialectical theories. Although the emphasis in de Rond and Bouchikhi (2004) is firmly on a dialectical approach, they provide a helpful theoretical review of other process-driven perspectives. This section will follow de Rond and Bouchikhi (2004) in outlining seminal theoretical contributions to process-driven alliance research, offering detailed outlines of key theoretical perspectives and models.

	Life-Cycle	Teleological	Evolutionary	Dialectical
Кеу	Organic Growth	Purposeful Interaction	Competitive Survival	Opposition/ Conflict
Metaphor				
Logic	Prefigured Sequence	Envisioned end-state	Variation, Selection and Adaption	Conflicting forces; Thesis, Antithesis,
	Compliant Adaption	Equifinality (multiple paths to the same		Synthesis
		end)		
		Social Construction		
Event	Linear and irreversible	Recurrent, discontinuous sequence of	Recurrent, probabilistic	Recurrent, discontinuous sequence
Prograssion	Sequence of prescribed stages in	goal-setting, implementation and	cumulative sequence of variation,	of confrontation, conflict and
Progression	unfolding of immanent potentials	adaption of means to reach desired end-	selection and retention events	synthesis between contradictory
	present and visible at the	state.		events
	beginning of the sequence.			
Generative	Pre-figured programme regulated	Goal enactment and consensus on means	Population scarcity, competition	Conflict and confrontation between
Mechanism	by logic/ institutions		and commensalism	opposing classes/ forces
Conception	IORs as a discrete entity that	IORs as purposeful arrangements that	IORs as a product of adaption to	IORs as a product of conflicts
of IORs	progress through pre-determined	develop through enactment of goals by	environmental conditions	between human agents.
-,	states	human agents		

 Table 3.1- Process Theories of Inter-Organisational Relationships (adapted from Van de Ven & Poole, 1995; de Rond & Bouchicki, 2004)

3.4.1 Life-Cycle Models of Inter-Organisational Relationships

Life-cycle approaches to inter-organisational relationships characterise relationship development as a natural growth process whereby organisations proceed through discrete but interlinked stages of development (de Rond and Bouchikhi, 2004). Furthermore, life-cycle process theories assume that the entity under investigation (the alliance) has an underlying form or structure (Van de Ven and Poole, 1995; Van de Ven and Poole, 2005). Life-cycle theories assume a latent and known end-state; therefore, alliances are considered progressive and irreversible. Specifically, characteristics from early stages determine the characteristics of the alliance in subsequent stages. Consequently, it is assumed that interorganisational relationships are linear, predictable and stable. Research informed by life-cycle assumptions seeks to track the development of relationships through various stages from inception to termination. The assumption is that the development and performance of interorganisational relationships can be predicted by characteristics at the formation stage. De Rond and Bouchicki (2004) liken this approach to genetic research, which seeks to predict the functioning of cells based on the underpinning genetic code. In line with this analogy, they suggest that life-cycle approaches assume that inter-organisational relationships "grow up" from formation into the "final structure" through a series of discernible and generic life-cycle stages (Bell et al., 2006; de Rond and Bouchikhi, 2004; Van de ven and Poole, 1995).

Life-Cycle models are employed primarily as a sense-making device by consultants or in teaching contexts because they have the capacity to provide neat explanations for the development of IORs over time. Early studies on the development of IORs made extensive use of life-cycle models, for example, D'Aunno & Zuckerman (1987) propose a life-cycle model for the development of multi-firm federations. This model assumes that federations progress through predictable phases and that occurrences in each phase are influenced by known external conditions. The model proposed illustrates that federations pass through phases of emergence, transition, maturity and crossroads. Key tasks are to be completed in each phase before the federation can develop; for example, to progress from the emergence phase the partners have to define membership criteria and define the objectives of the federation. In the transition phase key tasks include the establishment of organisational structures and the hiring of managers. The maturity phase consists of the fulfilment of objectives and sustained

commitment. In the final 'crossroads' phase the key task to be completed is a decision about future commitment.

More recently, Das and Kumar (2007) outline how alliances between firms progress through three discrete phases of formation, operation and outcome. The formation phase is where prospective alliance partners start to negotiate the alliance and begin implementing the agreement that has been entered into. It is also during this phase that expectations about the perceived risks to partners are also calculated (Das and Kumar, 2007). The 'operation' phase follows formation, during this phase alliance partners implement the contractual agreements that were established in the formation phase. It is also during this phase that partners make judgements about one another in terms of trust and reliability. Learning also occurs in this phase and refers to 'content' learning about the tasks to be completed and also learning about how to effectively manage alliances (Das and Kumar, 2007; Dyer and Singh, 1998; Ranjay, 1995). The final phase that alliances progress through is the 'outcome' phase, in which assessments of the performance of the alliance are made. Das and Kumar (2007) suggest that based on the adjudged success of the collaboration, partners may decide to continue, or they can enter a state of progressive decline and dissolve the relationship.

Jap and Anderson (2007) also draw upon the life-cycle model proposed by Dwyer et al (1987) to explain the characteristics of alliances at various stages. The stages that alliances progress through are termed; 'exploration', 'build-up', 'maturity' and 'decline'. Drawing upon a sample of 1540 buyer-seller relationships they show that relationship characteristics such as goal congruence, information exchange, relationship harmony, mutual dependence, risk propensity, trust and commitment; are highest in the build-up phase. They argue that relationships plateau in the maturity phase as characteristics become routinised. They also illustrate that, as characteristics become routinised, partners become less attentive to the relationship and therefore the partnership can become inefficient in the maturity phase. This decline in managerial attention contributes to the decline and dissolution of the arrangement. Importantly, Jap and Anderson (2007) show that path-dependence and history are important in predicting the performance of alliances, therefore, they argue that life-cycle models have better explanatory capabilities than other forms of process models.

85

Kale and Singh (2009) offer a more elaborate life-cycle model of relationship development (Fig 3.3).



Fig 3.3 Alliance Development Stages (Kale and Singh, 2009)

They delineate the alliance development process into stages of; Alliance planning, alliance formation, alliance design, post-formation/management and evaluation. During the planning and formation phases, partners are selected based on judgements about resource complementarities and perceived interdependence of potential partners (Shah and Swaminathan, 2008). Once an alliance has progressed through the planning and formation phase, they move into the design phase, during which the governance structures are agreed upon and implemented. Governance structures are designed and implemented to lower the transactions costs and risks inherent in any collaborative agreement (Williamson, 1981). Governance structures can be underpinned by contractual provisions or by self-enforcing governance depending on the trust, goodwill and reputation of partnering entities (Gulati, 1998; Ranjay, 1995; Reuer and Ariño, 2007; Ring and Van de Ven, 1994; Uzzi, 1997). Once governance structures have been agreed and implemented the alliance progresses to the post-formation phase. During this phase the primary concerns are the management of the alliance and the co-ordination of resources to fulfil the alliance objectives (Kale and Singh, 2009). It is during this phase that alliance partners begin to develop knowledge about one another, which then informs resource allocation decisions (Gulati, 1998; Gulati et al., 2005; Schreiner et al., 2009). The model of university-industry partnership development proposed by (Philbin, 2008) outlined in Chapter 1 Section 2.4.7 provides a good example of a typical life-cycle model.

Prominent life-cycle models of strategic alliance development discussed above are clearly based upon a common underlying logic. This logic appears in various different guises as 'stages'. The common logic underpinning life-cycle approaches is that alliances can be planned, controlled, assessed and predicted by rational actors with perfect information (Figure 3.4)



Fig 3.4 Generic Life-Cycle perspective on Alliance Development

This logic underpins every stage of the alliance development process. In the first stage the alliance is planned to meet specific goals and objectives for example to access resources, lower transactions costs, access markets, share R&D risks (Faems et al., 2008; Hagedoorn, 2002). Search processes are then undertaken and potential partners are assessed on the probability that they can contribute towards the realisation of desired objectives. The second generic stage is to structure the collaboration accordingly, in light of the previously determined objectives. This involves establishing appropriate governance based on partner characteristics and objectives (Zollo et al., 2002) and establishing working mechanisms that will ensure objectives are effectively realised. The final generic stage involves an objective evaluation of the success of a collaboration in terms of delivering initially envisioned

objectives. This assessment then informs a decision as to whether the alliance is sustained or dissolved.

3.4.2 Teleological models of Strategic Alliance Development

Teleological models provide an alternative perspective on the development of interorganisational relationships (de Rond and Bouchikhi, 2004; Rasmussen, 2011). These approaches advocate more contestable, open-ended and iterative models of developmental processes. They are labelled teleological because they are informed by an Aristotelian conception of process as informed by 'final causes' (de Rond and Bouchicki, 2004). While these models do not fully commit to conceptions of backward causation, or the notion that end-states exert a causal pull on antecedent events, they do place a great emphasis on *telos* as a governing process (de Rond and Bouchicki, 2004). In other words, these models assume that organisations and their relationships are *purposeful* and that these purposes drive action and behaviour. In the context of alliances, these approaches assume that alliances are initiated to achieve a known and desired end and are changed and adapted over time until this end is realised. Therefore, the development of inter-organisational relationships can be understood as a process through observations of repetitive sequences of goal formation, implementation, evaluation and modification based on managerial learning and intervention (de Rond and Bouchikhi, 2004; Doz, 1996; Ring and Van de Ven, 1994).

One of the most influential process models of inter-organisational relationships is offered by Ring and Van de Ven (1994). This model has been critical in shaping the research agenda in trust formation literature, however direct empirical application of the Ring and Van De Ven (1994) model remains scare within the alliance dynamics literature, even more so in the context of relationships between different types of organisations (Kale and Singh, 2009; Majchrzak et al., 2015; Tello-Rozas et al., 2015). Despite this, others have proposed variations of this framework and offered their own empirical applications (Doz & Hamel, 1998;Doz, Olk, & Ring, 2000;Doz, 1996; Ring, Doz, & Olk, 2005).

The Ring and Van de Ven Model (1994) views IORs as proceeding through a repetitive sequence of three clearly identifiable phases labelled 'Negotiations', 'Commitments' and

'Executions'. Iterations between these stages are mediated by a fourth identifiable stage termed 'Assessment'. Figure 3.5 provides an overview of their process model.



Fig 3.5 Developmental *process of Inter-Organisational Relationships* (Source: Ring and Van de Ven (1994))

During the negotiation phase, shared understandings are developed by the parties (not individuals) with regards to motivations, investments and perceived risks of a potential transaction. There is a focus on formal bargaining processes and the choice behaviour of parties as they approach and select potential partners. Underlying formal bargaining procedures are social psychological processes of sense-making (enactment) that leads parties into negotiations with one another. Repeated interaction between informal sense-making and formal bargaining provides parties opportunities to assess the nature of the deal, the nature of each other's role and the other's trustworthiness, their rights and duties and the possible equity and efficiency of the potential transaction.

Within the commitment phase the 'wills of the parties' meet and agreement on the obligations and rules for future action in the relationship are established. Terms and governance structure are established and codified. These are agreed both formally in legal contracts and informally in psychological contracts. Whether agreements are reached

formally or informally depends upon the degree of uncertainty and the willingness of parties to rely on the trustworthiness of one another. It is during this phase that legal agents of each party are called upon to draft legal agreements on key commitments in order to avoid mistake, misrepresentation and undue influence (Ring and Van de Ven, 1994).

Finally, in the 'execution' phase, the formally and informally agreed commitments are carried into effect. It is at this stage that the alliance activity moves from a 'strategic domain' into operationalization. It is suggested that initially, formally designated role-obligatory behaviour reduces the uncertainty between parties, giving interactions a degree of predictability (Ring and Van de Ven, 1994). Following a series of role interactions, partners establish a greater personal familiarity, consequently interpersonal relationships become more prominent than role-relationships. In long-term or 'strategic' partnerships occasions such as misunderstandings, conflicts and changes in expectations are inevitable. These provide recourse for re-thinking terms of the relationships, triggering re-negotiations.

Ring and Van De Ven (1994) argue that if parties can negotiate minimal congruent expectations then they can make commitments to an initial cause of action. If these are executed in an efficient and equitable manner then they will continue with or expand mutual commitments, if not parties may enter into renegotiation or reduce commitments to the relationship. It is argued that these developmental processes are underpinned by social-psychological dynamics that explain how and why co-operative IORs repeat sequences of negotiation, commitment and execution events (Ring & Van De Ven, 1994; de Rond and Bouchicki, 2004).

Building on Ring & Van de Ven (1994), Doz (1996) explores the evolution of strategic alliances between firms. Doz's (1996) contribution is more akin to Pettigrew's contextualism (Pettigrew et al., 2001), since analytical emphasis is on the interplay between context and action. Similar to Ring & Van de Ven (1994), Doz (1996) argues that collaborative relationships between organisations occur through iterative cycles of interaction. The key distinction is the emphasis placed on learning as the key process in alliance development.



Fig 3.6 Development of alliances based on initial conditions (Source: Doz, 1996)

Fig 3.6 illustrates Doz's (1996) model of the evolution of strategic alliances. Context is operationalized as 'initial conditions'. Initial conditions are characterised by the degree of clarity around tasks, routines, interface design and performance expectations. Expectations of performance refer to tangible outputs to be produced as well as behavioural conduct. In this paper and subsequent contributions (Doz et al., 2000;Ring et al., 2005) initial conditions (or context) shape the way in which the alliance develops by either facilitating or inhibiting learning. Specifically, initial conditions moderate learning about the alliance environment and how to more effectively co-operate in the alignment of skills and goals.

Once partners are engaged in an alliance, they have the opportunity to begin learning both cognitively and behaviourally. Cognitive learning within the alliance context refers to learning about the specific nature of the aims and objectives that the alliance is established to achieve. Behavioural learning refers to learning about how to more effectively co-operate and interact

with partner organisations (Ring and Van de Ven, 1994; Doz, 1996; Doz *et al*, 2000). In his original model, Doz (1996) explicates five discrete 'leaning dimensions'. The five learning dimensions consist of learning about the environment, learning about tasks to be completed, learning about collaborative processes, learning about goals and learning about skills. Once an alliance is active, partners not only begin to learn, they also begin to continually assess the equity and efficiency of the arrangement (Ring and Van de Ven, 1994). Doz (1996) builds on this by incorporating the learning dimension. This is evidenced by the 'adaptability' evaluation, whereby partners also make judgements about the ability of their counterparts to adapt, or to learn about the changing alliance context. Once an alliance is established, recurrent cycles of learning and evaluation (action) stimulate changes in the relationship, moving it away from the characteristics observable in the initial conditions (context).

Doz (1996) argues that successful alliances are those that evolve through recurrent sequences of learning, re-evaluation and re-adjustment over time. These evolutionary cycles of learning influence the impact that initial formation conditions have on alliance functioning. Successful alliances, those that are more prolonged, are characterised by high degrees of learning and continual improvement upon initial conditions. Unsuccessful alliances, those that dissolve, are not necessarily characterised by low degrees of learning. Rather, learning can propagate the dissolution of alliances as partners begin to make more informed judgements about the ability of an alliance to deliver value. Learning also allows constituent alliance partners to make more precise evaluations of each other's' behaviour with regards to trustworthiness, openness and flexibility (Doz et al., 2000; Ring et al., 2005).

This model is teleological in the sense that alliances are conceptualised as purposeful relationships between discrete organisational entities. The model builds upon the theory of IORs proposed by Ring and Van de Ven (1994) by explicitly addressing the critical role played by context in the formation and development of relationships. As previously highlighted, Ring and Van de Ven (1994) attribute the formation and development of IORs to agents of organisations, suggesting relationships develop via the same recursive cycle of negotiation, commitment, execution and evaluation without addressing the context in which these processes take place. Doz (1996) on the other hand places great emphasis on the role that context plays, articulating how actions of agents are mediated by alliance conditions. Thus,

suggesting that alliance formation and development cannot be understood as equivocal, rational and periodic. Rather, learning and evaluation occur continuously and in context. Through the proposition of this process model, Doz (1996) suggests that multiple units of analysis should be considered in order to appropriately understand the formation and development of inter-organisational relationships. The individual, the project and the organisation are all considered as important units of analysis in empirical applications of this model (Doz & Hamel, 1998; Doz, 1996; Thune & Gulbrandsen, 2014)

3.4.3 Evolutionary perspectives on the Development of IORs

Evolutionary process approaches are based on biological metaphor (Volberda and Lewin, 2003). The underlying premise is that organisations compete for survival in an environment characterised by scarce resources and chance occasions (variations) (Volberda and Lewin, 2003). Analytical primacy is given to the environment in evolutionary approaches, in which managerial intentionality is secondary to environmental determinism (Van de Ven and Poole, 2005; Volberda and Lewin, 2003). Within this meta-theoretical framework there are various units of analysis, namely firm level theories which focus on strategic adaption, meso-level theories which focus on the links between firms and their institutional environment, finally, macro-level theories which concentrate on firms and their links to their macro-environment (Volberda and Lewin, 2003). Furthermore, the focus on the environmental conditions facilitates the inclusion of stochastic variance into developmental processes (Rasmussen et al., 2011; Van de Ven and Poole, 1995).

Evolutionary process theories conceive change as 'competitive selection' constituted of movement through a cycle of variation, selection and retention (Rasmussen et al., 2011; Van de Ven and Poole, 1995; Volberda and Lewin, 2003). Variations are considered as the emergence of new organisational forms that emerge by chance (Aldrich, 1979; Van de Ven and Poole, 1995). For example, a strategic alliance may be considered a novel organisational form that can emerge through chance. Selection refers to the process through which new organisational forms are aligned with their environment. The selection of organisational forms is performed by the environment which ensures that organisational forms that best fit with environmental resource requirements are functional. The final process, retention, refers to the inheritance and persistence of those selected organisational forms (Van de Ven &

Poole, 1995). This is the final phase of evolutionary change processes as it provides a counterweight to random variation and selection processes. To elaborate, as variation is stimulated by the selection of new organisational forms, retention of previous forms and practices influences the variation and selection mechanisms (Van de Ven & Poole, 1995; Volberda & Lewin, 2003). Change therefore, is a recurrent, cumulative and probabilistic sequence of variation, selection and retention of organisational entities (Van de Ven & Poole, 1995). Based on this evolutionary conception of change, it is assumed that variation, selection and retention can be probabilistically determined provided the demographic characteristics of a population operating in a specific environment can be obtained (Van de Ven & Poole, 1995).

Koza and Lewin (1998) articulated an evolutionary approach to explaining the development of strategic alliances over time. They suggest that alliances should be understood in the context of the strategic adaption choices of the firm. Consequently, alliances are embedded in a firm's historic and strategic context and co-evolve with the firm's organisational, institutional and competitive environment. In outlining a co-evolutionary theory of alliance development Koza and Lewin (1998) highlight how alliance structures (forms) are determined by founding conditions which then frame expectations of joint value creation and the direction of co-evolution. They argue that alliance structures and practices co-evolve with changes in the constituent firms and with broader industrial and societal changes. According to this perspective, the structures and mechanisms of alliances evolves with the strategic orientation of the partner organisations, in particular, whether they are active in the pursuit of explorative or exploitative objectives (Koza and Lewin, 1998; March, 1995). The strategic orientations that determine the evolutionary path of the alliance are underpinned by three primary selection mechanisms; absorptive capacity (Cohen and Levinthal, 1990), 'control' and 'identification'. In short, variations in these characteristics will determine the explorative or exploitative orientation of alliances, which determines their persistence over time.

Building on Koza and Lewin (1998), Das and Teng (2002) offer a fine-grained conceptualisation of the evolutionary dynamics of strategic alliances. Similar to the teleological approaches, they argue that the development of alliances is much more complex than the envisioning and accomplishment of pre-determined stages. Conversely, they suggest that the unfolding of alliances can only be understood if there is a consideration of alliance conditions and the environment over time. In sum, they argue that 'alliance conditions' that characterise the alliance at any given point in time impact the development of an alliance across formation, operation and outcome stages. Furthermore, alliance conditions are determined by the 'alliance environment' which is based on partner-firm characteristics. Their central thesis is that alliance conditions link the alliance environment and the alliance development process (Fig 3.7)



Fig 3.7 Co-Evolutionary theory of Strategic Alliance Development (Das and Teng, 2002)

Figure 3.7 clearly illustrates the mediating role of alliance conditions and the dynamic interplay between the alliance environment and alliance development. In this model firm characteristics include; market commonality, competitive positions, resource diversity and reputation. These firm characteristics determine the alliance conditions which then impact the developmental process of alliances. As the figure highlights, the performance of the alliance changes the characteristics of the engaged firms, thus shaping the alliance environment and alliance conditions (Das and Teng, 2002). Co-evolutionary approaches have also been adopted to study the specific interplay of certain alliance characteristics. For example, Inkpen and Currall (2004) adopted an evolutionary perspective to study the interplay between trust, control and learning process in alliances over time.

Despite the adoption of biological terminology, there is only limited research into the development of dyadic alliances that utilises the conceptual schema of evolutionary theory. This may be because evolutionary approaches to organisation focus attention on environmental selection, therefore are more suited to the study of macro-level phenomena. For example, evolutionary approaches may be more appropriate for the investigation into the development of populations rather than individual collaborative endeavours (Volberda and Lewin, 2003). Although others have adopted evolutionary terminology, there is limited empirical investigation into alliances that explicitly mobilises the variation, selection and retention framework associated with mainstream evolutionary theory (Koza and Lewin, 1998; Nelson and Winter, 1982). One of the primary criticisms of the evolutionary approach to alliance development is its emphasis on environmental determinism (de Rond and Bouchiki, 2004). This approach conceptualises alliances as products of environmental conditions, marginalising the role played by managerial agency. Although this goes some way to addressing the weaknesses of teleological perspectives, which describe alliances solely as products of managerial cognition, there is potentially too little consideration given to the important role that human actors play in the development of alliances. The next section outlines an alternative approach to the development of alliances which articulates alliance development as an outcome of dialectical tensions negotiated by managers.

3.4.4 Dialectical Perspectives on the Development of IORs

Dialectical approaches to alliance development conceptualise development as a process of transformation propelled by the reconciliation of dialectical tensions. Das and Teng (2000) focus on three internal tensions that stimulate alliance development. Specifically, they concentrate on; co-operation/ competition, rigidity/ flexibility, long-term/short term orientation as behavioural, structural and psychological tensions. In elucidating a dialectical theory of alliance development Das and Teng (2000) make three core arguments. First, they argue that alliance stability is contingent upon the resolution of dialectical tensions, equating stability and instability with function and dysfunction. Second, they argue that three types of dialectical tensions are interrelated. For example, the structural and behavioural tensions will be positively or negatively related depending on the psychological tension. Third, it is argued that certain configurations of 'tensions' encourage alliance development along particular trajectories. For example, alliances that are characterised by competition, flexibility and

short-term orientation are more likely to proceed towards dissolution than those that are characterised by co-operation, rigidity and are long-term oriented (Fig 3.8)



Fig 3.8 Dialectical Tensions and Alliance Outcomes (Das & Teng, 2000)

Dialectical approaches to inter-organisational relationships have advanced since Das & Teng's original conception (de Rond and Bouchikhi, 2004; Vlaar et al., 2007). For example, de Rond & Bouchiki (2004) suggest that the dialectical tensions that constitute alliances do not possess the same transformative capacity as Marxist or Hegelian dialectics, as operationalized by Das and Teng (2000). Conversely, they contend that organisational arrangements are not *transformed* through resolution of dialectical tensions but rather *emerge from* the tensions that characterise organisational life (Hargrave and Van de Ven, 2017; Vlaar et al., 2007). The latter dialectical conception of alliances is much broader than Das & Teng's (2000) dialectical conception. This is illustrated in Fig 3.9, which shows the numerous tensions that constitute strategic alliances.



Fig 3.9 Dialectics of Strategic Alliances (de Rond & Bouchiki, 2004)

Through an empirical study of an alliance between a large pharmaceutical firm and a small biotechnology company, de Rond and Bouchicki (2004) argue that different tensions were active in the alliance at different points in time, shaping what the alliance 'is'. Specifically, they show that the alliance was initiated via a serendipitous encounter between two scientists with no formal planning evident prior to the initiation (emergent as opposed to deliberate (Mintzberg and Waters, 1985)). The empirical study also highlighted that co-operation and competition existed simultaneously within the collaboration with shifting emphasis on each aspect over time. Tensions between trust and vigilance were also observed and the recursive nature of these dialectical forces was evident throughout the duration of the alliance. Movement in the tensions between expansion and contraction and between control/ autonomy were also evident. Different configurations of tensions shaped what the alliance was over the course of four years.

Subsequent research has employed a dialectical framework to understand variation in the formalisation of alliances over time (Vlaar et al., 2007; 2006). In their single case study of an alliance between a large global retailer and a European bank, Vlaar *et al* (2007) argue that different degrees of formalisation are produced as managers attempt to reconcile the

inherent tensions between function and dysfunction associated with formal management. This understanding of formalisation runs counter to normative conceptions of formalisation based on transaction cost rationale and agency theory (Foss and Foss, 2005; Gulati and Singh, 1998). Vlaar et al (2007) conclude that managers attempt to cope with the duality of function and dysfunction in alliances by applying semi-structures, formalising behaviour and outcomes. Similar to de Rond & Bouchicki (2004), Vlaar et al (2007) illustrate that formalisation does not exist prior to action, rather it emerges as human agents attempt to resolve the tensions intrinsic to organisational life.

Vlaar et al (2007) provide one of the few empirical applications of a dialectical perspective. Although de Rond and Bouchicki is widely cited¹ empirical contributions are sparse. The primary contribution of the dialectical approach then, is the reconceptualization of alliance development as an emergent entity from the balancing of organisational tensions. The conceptual portrait of alliances as "largely *unintended successions of peaks and valleys with no pre-determined progression towards a desired end-state"* (de Rond and Bouchicki, 2004 p. 66) provides a radically alternative frame of reference for understanding this complex organisational phenomena (Hargrave and Van de Ven, 2017).

To elaborate, this conception of alliances forces us to acknowledge that generic explanations of how alliances emerge and develop (life-cycle and evolutionary approaches) or teleological models underpinned by rationality and clearly defined ends are flawed. Dialectical perspectives force the realisation that no two relationships are the same and therefore direct inquiry towards issues of how alliances 'become' as opposed to 'how alliances ought to be' (de Rond and Bouchiki, 2004). In order to appropriately investigate the becoming of alliances, dialectical proponents advocate the adoption of alternative metaphysical assumptions (de Rond and Bouchiki, 2004; Vlaar et al, 2006; 2007; Van de Ven and Poole, 2005). Specifically, they suggest that alliances are to be approached as "facts" that are neither inherently functional nor dysfunctional (de Rond & Bouchiki, 2004; Vlaar et al, 2007). Therefore, investigations of alliances should not be informed by expectations of order, purpose, constancy or success. Rather, investigations into the formation and development of alliances

¹ 145 citations in ISI Web of Science as of April 2019

should seek to determine how they are 'accomplished' as facts (de Rond and Bouchiki, 2004). Empirically, this necessitates a focus on the fine-grained formation and development dynamics by exploring the events and experiences that constitute the alliance.

Although no direct reference is made by de Rond and Bouchicki (2004) to process ontologies, their call for a metaphysical re-think clearly encourages a 'processual' turn. The next section, elaborates on the critiques of the existing theoretical perspectives offered by de Rond and Bouchikhi (2004) by drawing attention to the assumptions of exogenous process theory and the limitations they impose on analysis of organisational dynamics (Hernes, 2014a).

3.5 Limitations of existing theoretical approaches: Problems with substantive process theories

Having outlined the preeminent theoretical approaches adopted in the study of alliance dynamics, I will now offer a review of the limitations of these models before articulating the requirement for a 'processual' perspective that attempts to address some of these shortcomings. Whilst I could have offered critiques within the individual sections pertaining to each theoretical school, most of the approaches suffer from the same limitations, largely due to the assumptions underpinning 'entitative' process theory. Here, I will return to issues of ontology and epistemology presented in Section 3.2.1, to show how these models are all underpinned by similar conceptions of process (i.e. premised on the same ontological foundations) and thereby are restricted in their analysis to particular conceptions of change (Bakken and Hernes, 2006; Chia, 2002, 1999; Cobb, 2007; Hernes, 2014b, 2014a; Hernes and Weik, 2007; Tsoukas and Chia, 2002).

Three of the four approaches presented in Section 3.4 can be characterised as 'exogenous' process theories, with only de Rond and Bouchikhi (2004) and to a lesser extent Vlaar et al (2007) offering what may be called 'endogenous' theoretical accounts. I draw upon the work of Hernes (2014a) to highlight the assumptions implicit in exogenous process theorising and to elaborate on some of the limitations that are consequently embedded in analysis. In particular, Hernes (2014a) articulates the key assumptions that are implicit within conventional exogenous process theory, namely; correspondence assumptions, misplaced concreteness assumptions, homogeneity assumptions, circumscription assumptions, stability

assumptions and inert temporality assumptions (Hernes, 2014a, pp. 11–38). Collectively, these are the foundations of what may be termed a representationalist epistemology (Tsoukas, 2017; Chia, 1999).

3.5.1 Limitations of Representationalist Epistemology

A central assumption of 'substantive' process theory is that "truth lies in the correspondence between what is experienced or enacted and something else" (Hernes, 2014a p.16). (Chia, 1999, p. 215) refers to this as a *representationalist epistemology,* where "linguistic terms are taken to be accurately representing an external world of discrete and identifiable objects, forces and generative mechanisms...underlying this intellectual attitude is an unshakable assumption that reality is essentially discrete, substantial and enduring." Chia (1999, p. 215) suggests that it is this underlying ontological assumption "which provides the inspiration for the scientific obsession with precision, accuracy and parsimony in representing and explaining social and material phenomena". Based on this conception of reality, "knowledge of organisational phenomena is thought to be possible through a cognitive system which represents the pre-given features of the phenomena" (Tsoukas, 2017, p. 6). Hernes (2014a p.17) suggests that theories of change based on correspondence assumptions are premised on the notion that "processes within organisational boundaries are as they are because they correspond to the state of the external environment of the organisation". Frameworks underpinned by correspondence assumptions therefore usually conceptualise change as the "transitory phase bridging the various stages in an evolutionary process" (Chia, 1999, p. 215). As highlighted in Section 3.2.1, numerous theories of organisational change are underpinned by such correspondence assumptions, most obviously Pettigrew's contextualism (Pettigrew et al., 2001; Pettigrew, 1987) but also neo-institutionalism, resource dependence and organisational evolutionary theory (Hernes, 2014a; Hernes and Weik, 2007).

Correspondence assumptions are clearly identifiable in the process theories of alliance development outlined above. For example, life-cycle models assume that internal and external conditions can be comprehensively analysed, and the results of this analysis will inform the configuration of the partnership. These models also assume that states are stable and objectively comparable at different points in time (i.e. alliance at *t2* corresponds with the

101

characteristics of alliance at *t1*). Furthermore, they suggest that the fixed characteristics at one stage are explained by the fixed characteristics at another stage. Consider Philbin's (2008) model of university-industry partnership development. This model proposes 5 stages of development, with the characteristics of each state being informed by the last. For example, the first state is 'terrain-mapping' in which university managers can perform detached 'industry and market analysis' which will enable an understanding of the 'collaboration landscape'. Once the collaboration landscape has been mapped, it is possible to move into the 'proposition' state, whereby organisations identified as suitable in the 'terrain-mapping' exercise are approached and a proposal is drafted that aligns the technical and strategic missions of both parties. This then informs the 'initiation stage' which is characterised by different organisational and technical arrangements, these arrangements then define the characteristics of the initiation stage for example by determining the type of negotiations that are entered into (Philbin, 2008).

Similarly, these assumptions are observable in Ring and Van De Ven (1994), who delineate between clear 'negotiations' 'commitments' and 'executions' states that are mediated by an 'assessment' state. In the assessment phase, 'the alliance' is analysed by enlightened alliance managers by evaluating the characteristics of the 'negotiation', 'commitment' and 'execution' states. These representations are assumed to accurately reflect 'the alliance'. Managers then make decisions about the development of the alliance by assessing the correspondence between the state of the alliance (characterised by 'negotiation, commitment and execution) and some pre-determined desired end-state. It is the degree of correspondence between the characteristics of the 'negotiation, commitment and execution' states and the objective pre-determined end that defines the development of the alliance.

Correspondence assumptions are even more salient in Doz's (1996) alliance development framework. For example, they state that they "observed a set of initial conditions *that determine* whether and how learning takes place" (Doz, 1996 p.64). These stable configurations of 'initial conditions' are characterised by four dimensions (task definition, partner routines, interface design, performance expectations). This model suggests that the degree of learning that occurs within the alliance will correspond to the configuration of these initial conditions. This is outlined when it is stated that "how each initial condition is set and

102

the interdependencies they create between the various dimension will influence learning" (Doz, 1996 p.64). They also suggest that the learning, characterised by five dimensions (environment, task, process, skills, goals), informs the evaluation of the 'state of the alliance' which is also fixed to three dimensions (adaptability, equity and efficiency). Overall, their model suggests that the 'change' in the alliance relates to variations in these fixed characteristics that all correspond with one another in a cyclical manner.

Correspondence assumptions can also be observed in the theoretical framework proposed by Das and Teng (2002). Specifically, they suggest that "alliance conditions, or the key characteristics of an alliance at any given moment, link the alliance environment (firm characteristics) and the alliance development process" (Das & Teng, 2002 p.725). In sum, they suggest that alliances can be characterised by a set of variables that "capture the essence of alliance conditions across the developmental stages", proposing three characteristics that reflect the 'state of the alliance' (collective strength, inter-partner conflict and interdependencies). Furthermore, they propose that these variables are determined by the 'alliance environment' which is represented through firm characteristics (market commonality, competitive positions, resource profiles and reputation). Their development model assumes that changes in these firm characteristics will change the alliance conditions (state of the alliance) which determine the developmental trajectory of the alliance through the three stages of alliance development (formation, operation and outcome). Similar to both Doz (1996) and Ring and Van de Ven (1994) change is reflected by variations in these observable characteristics which represent the phenomena (the alliance). Having established that most of the theoretical frameworks outlined above are underpinned by correspondence assumptions, it is important to consider why these assumptions may be problematic in terms of circumscribing our understanding of alliance dynamics.

3.5.2 Problems with Representationalist approaches

Clearly, representationalist assumptions are commonly adopted by alliance dynamics scholars. Whilst these approaches are useful in helping us to address the issue of organisational change (emergence and development), scholars have drawn upon process philosophy to argue that such assumptions limit analysis (Bakken and Hernes, 2006; Chia,

1999; Hernes and Weik, 2007; Tsoukas, 2017; Tsoukas and Chia, 2002; Weik, 2011). Hernes (2014a) summarises these limitations, drawing attention to problems of 'misplaced concreteness' and associated issues of homogeneity, circumscription and inert temporality. It is suggested that, as a consequence of these limitations, accounts of change informed by representationalist assumptions are at best idealistic and at worst inadequate for dealing with the empirical complexity of organisational emergence and development (Hernes, 2014a). Specifically, it is highlighted that 'the fallacy of misplaced concreteness' means that these representationalist approaches are inappropriate for addressing change (Hernes, 2014a p.17). The term 'misplaced concreteness' is borrowed from process philosopher Alfred North Whitehead who coined the phrase in his critique of Cartesian rationalism. Whitehead, (1929, p. 7) outlined that the fallacy of misplaced concreteness "consists in neglecting the degree of abstraction involved when the actual entity (empirical reality) is considered merely so far as it exemplifies certain categories of thought." Suggesting that "there are aspects of actualities (empirical reality) which are simply ignored so long as we restrict thought to these categories". By this, Whitehead means that when we rely on abstractions, or representations to describe our experience (i.e. categories of thought) we are limited by the boundaries of these abstractions and thus, experiential richness is surrendered at the expense of descriptive convenience. For example, consider the notion of 'alliance conditions' (Das and Teng, 2002), we are limited in our description of alliance conditions by the extent to which the experienced phenomena exemplifies the category (characteristics) including; market commonality, competitive positions, resource profiles and reputation. When in actuality, the factors and conditions that participate in the formation of alliances is much richer than these four categories. Thus, in focusing on these characteristics, our analysis of the total complexity of the empirical world is restricted.

Whitehead (and latterly Hernes, 2014a) recognise that abstractions are necessary and useful in that they enable us fix and describe complex experiential reality but warn against the common mistake of regarding these abstractions *as* reality rather than considering them as the abstractions that they are. This is what is meant by 'misplaced concreteness', it is essentially the common mistake that is made within representationalist theories of change that regards the abstractions that represent reality *as* the actual reality. Hernes (2014a) considers that this mistaking abstractions for reality is problematic for theorising organisation

104

and change for several reasons, most notably because it forces analysis to focus on stability rather than change.

What organisational process theorists suggest is that these neat, circumscribed entities or states only exist conceptually and are inconsistent with the world as we experience it (Chia, 1999; Bakken and Hernes, 2006; Hernes, 2014). It is because these boundaries are drawn primarily for the purposes of analytical convenience rather than because they resonate with empirical experience that a 'neatness' is imposed which is not reflective of the phenomena as experienced (Hernes, 2014a; Nayak and Chia, 2011; Tsoukas, 2017). This is eluded to by Nayak & Chia (2011) who suggest that the focus on circumscribed abstractions contributes to analytical overemphasis on formal organisation, organisational infrastructure, organisational environments, organisational goals and intentions and rational deliberations and actions (Hernes, 2014a, p. 28). One of the implications of this, is that the circumscribed entities that are delineated by analysts become viewed as internally consistent actors. In delineating entities through representations and assuming these representations are 'actual', they are ascribed agency. For example, in the theoretical approaches outlined above based on these assumptions, abstractions such as 'firms' are ascribed agency. This is evident in Lumineau et al's (2011) description of process theories of alliance development. Specifically, Luineau et al (2011 p.11) characterise process theories of alliance development as "cycles in which the outcome of collaboration is implemented and assessed. Depending on their assessment, firms undertake corrective actions, which lead them to set new conditions of cooperation".

The irony of this approach to change is that, by imposing such conceptual clarity on the complex empirical world, the actual process of emergence and development is obscured. By relying on discrete social entities (organisations, managers, alliances, environments) and focusing on the interactions between their characteristics "we get little to no knowledge of *how a social entity becomes a social entity* with the characteristics that we ascribe to it" (Hernes, 2014a p.25). In other words, we fail to understand how 'things' emerge and develop. Again, consider the process models presented above, the life-cycle, teleological and evolutionary models all rely on 'states' or 'phases', conceptualising change as stable cycles of movement that remain consistent. Thus, change is paradoxically explained in terms of

stability, as stable states/ phases cycle from one to the next in "a series of immobilities" (Hernes, 2014a, p. 30). For example, Das and Teng (2002 p.726) suggest that "alliances go through a developmental process consisting of *three stages* of 'formation, operation and outcome." They also outline that "the evolution of alliances along this process is *directed by* the changing conditions of alliance, *as reflected* in their collective strength, inter-partner conflicts and interdependencies". Thus, by freezing change into stable cycles of activity (formation, operation, execution (Das and Teng, 2002) or negotiation, commitment, execution (Ring and Van de Ven, 1994)) the analysis fails to actually capture *movement* (i.e. how things become) instead focuses on 'motion' (how things move from one position to another) (Tsoukas and Chia, 2002).

A related issue associated with the hypostatisation of change into bounded stabilities, concerns the conception of time. In the processual models above, time is conceptualised as periodic, constituted by discrete sets of 'nows' identified as periods or phases. It is assumed that change happens over time. For example, negotiation is followed by commitment which is in turn followed by execution (Van de Ven and Poole, 1995) or formation is followed by operation which is followed by outcome (Das and Teng, 2002). Here time is conceptualised as 'inert', meaning that events and actions are considered as isolated and separate, they have a beginning and an end, and they may interact (i.e. follow or precede) with one another but they are not constitutive of one another. Events are identified and located in spatio-temporal terms (i.e. where and when they appear) but there is no consideration of how events connect to and relate to one another in the production of the 'alliance', that is how they create and re-create what happens at other (past and future) events (Hernes, 2014a). Although some hint that events (thereby time) have agency in driving the formation and re-formation of alliances, such as Doz (1996), who suggests that some (early) events exert a disproportionate influence on the formation of alliances, the agency of events is remains obscured from analysis. Such an inert conception of temporality, that overlooks the agency of time in organisation, is characteristic of the organisational literature more broadly (Hernes, 2014a, 2014b) and also of strategic alliance literature in particular (Shi et al., 2012).

Overall, this section has suggested that whilst the process theoretical frameworks commonly adopted to understand the formation and development dynamics of strategic alliances are useful in directing analytical attention to movement, they are inherently limited by their foundational metaphysical assumptions. To recap, the ontological primacy afforded to stability, rather than change, necessitates the adoption of a representationalist epistemology, where the things are the way they are 'in here' because they reflect the state of things 'outthere'. Since these assumptions require the delineation of 'things', the complex world we experience in our day to day lives is distilled and compartmentalised into stable, homogenous abstractions (people, departments, organisations, institutions) that can be readily characterised by key distinctions and which are mistaken for the real complex world of experience.

Thus, analysis is constrained by these abstractions since focus is limited to what these abstractions 'do', which is why the frameworks place an overwhelming emphasis on formal organisation, rational managerial agents and calculable decision-making. In prioritising 'things' and motion over process and movement, these process models marginalise the roles of time, serendipity and unintended consequences of action (MacKay Bradley and Chia, 2013) in explaining the accomplishment of alliances. That is to say, they overlook the empirical complexity of the phenomenon at hand, producing simplistic and 'disjunctive' accounts of alliance development (Tsoukas, 2017). More worryingly, the models of alliance development produced by these approaches that appear increasingly irrelevant due to their neglect of the degree of abstraction undertaken in analysis. This is exemplified by Bell et al (2006) who conclude that research in the field of collaboration dynamics has failed to meet the needs of managers by not contributing greater understandings of alliance development processes.

Based on the discussion presented above, the primary research concern of this current research needs to be reconsidered. The principal research question here is "How do strategic university-industry research partnerships emerge and develop over time?" The discussion presented above suggests that there are clear limitations to adopting some of the existing theoretical approaches that have been proposed within the field of alliance dynamics. In particular, the discussion suggests that the existing models based on respresentationalist assumptions are limited in enriching understandings of alliance dynamics. Recently, it has been suggested that 'conjunctive' organisational theorising, based on alternative metaphysical foundations can provide the basis for more holistic and appropriate
understandings of the complex empirical phenomenon of organisational emergence and development (Hernes, 2014a; Tsoukas, 2017; Weik, 2011). Specifically, it has been suggested that more insightful theory can be developed by exploring the 'accomplishment' of organisation through connectivity (Hernes, 2014a; Hernes and Weik, 2007) based on the processual metaphysics of Alfred North Whitehead in particular (Bakken and Hernes, 2006; Hernes, 2014a, 2014c, 2008). Thus, a key question that arises is "How can processual approaches to organisation contribute towards more holistic understandings of change?" The next chapter outlines these process metaphysical assumptions in more detail, which provide the basis for a processual theorising of partnership development, that is able to account for the complexity and heterogeneity that characterises strategic alliances (de Rond & Bouchiki, 2004)

Chapter 4: Process Metaphysics and Methodology

This chapter is structured in two parts. The first part deals with questions of ontology, epistemology and theory. The aim of the first section is to elucidate the process metaphysics that underpin the current research and that form the basis for the theoretical framing of the empirical material that has been collected and analysed. The aim of this section is to answer the question that was posed at the end of Chapter 3, namely "How can processual approaches to organisation contribute towards more holistic understandings of change?" The second section deals with issues of research design and research methods. In this section, the rationale underpinning the empirical work, the approach to data collection and the process of data analysis are elaborated, the case material that forms the basis of the analysis is then outlined.

4.1 Ontology, Epistemology and Theory

4.1.1 Process Ontology: Whitehead's Metaphysics

The previous section concludes by drawing attention to the limitations of existing theoretical approaches to alliance development. Specifically, de Rond and Bouchikhi (2004) suggest that to develop a deeper understanding of alliance formation dynamics, we require a new conceptual apparatus based on different ontological assumptions about the nature of alliances. They suggest that alliances should be reconsidered as 'heterogenous phenomena' that are subject to continuous change. Epistemologically, this requires that alliances be regarded as "accomplished facts" which encourages analysis that focuses on "the becoming of alliances" (how they are accomplished) rather than how the being of alliances (or "how they ought to be" (de Rond and Bouchikhi, 2004, p. 67). Therefore, as we attempt to move towards more processual understandings of alliances, we can no longer draw upon established understandings of objects and entities (such as the normative understandings of alliance stability and performance). As suggested by de Rond and Bouchikhi (2004), to understand alliances processually, we should attempt to move away from theories and concepts that impose fixity and decontextualization and move towards frames of analysis that facilitate a focus on the dynamics of formation and reformation, or 'accomplishment'. In this section, I will begin to elaborate the conceptual apparatus that facilitates processual analysis,

drawing on the philosophy of Whitehead and organisational process theorists (de Rond and Thietart, 2007; Hernes, 2014a, 2008; Hussenot and Missonier, 2015; MacKay Bradley and Chia, 2013; Tsoukas and Chia, 2002; Weik, 2011)

Process thinking can be traced back to Heraclitus (1979, p. 53), who stated:

"One cannot step twice into the same river, nor can one grasp any mortal substance in a stable condition, but it scatters and again it gathers, it forms and dissolves, and approaches and departs"

This suggests that reality is as an indivisible stream of becomings and perishings (Chia and King, 1998). Alfred North Whitehead has arguably gone further than any other philosopher in elaborating a metaphysics of process, suggesting that "the flux of things is one ultimate generalisation around which we must weave our philosophical system." (Whitehead, 1929, p. 240). In outlining his philosophical system, Whitehead offered a number of helpful concepts that facilitate a processual approach to reality. In particular, he offered the concepts of 'Actual Entities' (Events), 'Nexus', 'Prehension' and 'Concrescence' as foundational to a processual understanding of the world (Whitehead, 1929).

'Actual Entities' or 'Events' provide the foundation of Whitehead's philosophical system. According to Whitehead (1929, p. 18)

"Actual entities- also termed actual occasions- are the final real things of which the world is made up. There is no going behind actual entities to find anything more real. They differ among themselves: God is an actual entity and so is the most trivial puff of existence in far-off empty space. But though there are gradations of importance and diversities of function, yet the principles which actuality exemplifies all on the same level. The final facts are, all alike, actual entities: and these actual entities are drops of experience, complex and interdependent"

For Whitehead, reality consisted of "real individual facts of togetherness of actual entities" and suggested that any particular 'fact of togetherness' should be termed a 'Nexus'. The

ultimate metaphysical principle is the advance from disjunction to conjunction, creating a new entity (event) distinct from the entities (events) given in disjunction. The novel entity (new event) is simultaneously the 'togetherness' of the many other entities (events) that it finds and also it is one of the 'disjunctive many' which it leaves. An entity [event] is actual when it has significance for itself, events are self-creative and in the process of their creation they transform a diversity of roles into one coherent role (Whitehead 1929, p.25). It is the 'production of this novel togetherness' that is embodied in the notion of 'Concrescence' (Whitehead, 1929, p. 22). Whitehead sums this up as follows:

"In the becoming of an actual entity [event], the potential unity of many entities [events] in disjunctive diversity acquires the *real* unity of the one actual entity [event]. So that the actual entity [event] is the concrescence of many potentials" (Whitehead, 1929, p. 22).

Therefore, it is highlighted that the nature of every 'being' (actual entity/ event) is also a potential for every becoming (Whitehead 1929, p.22). Based on this processual understanding of reality, constituted by relations of events (concrescence of actual entities), Whitehead elaborated an analytical scheme. In outlining his 'Categories of Explanation', Whitehead (1929) suggests that each 'Actual Entity' (Event) is analysable in an infinite number of ways, but proposes the analysis of actual entities into 'Prehensions' as the most viable way of understanding processual reality, stating "actual entities [events] involve each other by reason of their prehensions of each other". (Whitehead, 1929, p. 23)

Therefore, he suggested that two descriptions are required for an Actual Entity:

"one which is analytical of its potentiality for 'objectification' in the becoming of other actual entities and the other which is the analytical process which constitutes its own becoming. The term objectification here means the particular mode in which the potentiality of one actual entity is realised in another actual entity. That is, how an actual entity becomes constitutes what it is, so that the two descriptions of an actual entity are not independent. It's being is constituted by its becoming. This is the principle of process." (Whitehead, 1929, p. 22)

To elaborate, Whitehead (1929, p.23) suggests "the analysis of an actual entity [event], into its most concrete elements, discloses it to be a *concrescence of prehensions*." Therefore, Whiteheadian process analysis necessitates a focus on how events are produced by their prehensions. Whitehead (1929 p. 23) then elaborates on the analysis of prehensions, suggesting that every prehension consists of three factors: First is 'the subject' which is prehending, namely the actual entity in which that prehension is a concrete element. Second is 'the datum' which is prehended (i.e. other events). Third is 'the subjective form' which is how that subject (the actual event in question) prehends that datum (the other events). It is suggested that there are many different types of 'subjective forms', meaning that there are many ways in which events can prehend other events such as "emotions, valuations, purposes, aversions and consciousness" (Whitehead, 1929 p.24). Finally, Whitehead (1929, p.26) elaborates that, "in a process of concrescence, there is a succession of phases in which new prehensions arise by the integration of prehensions in antecedent phases." Thus, in these integrations, prehensions contribute their subjective form and data to the formation of novel prehensions, which constitute the 'actual entity'.

As summarized by Leclerc (1958, p. 167) "In Whitehead's doctrine, an 'actual entity [event] is formally a process of concrescence, of the 'growing together' of the objects prehended into an integral unity". Thus, the first phase of many simple prehensions must be succeeded by phases of activity that integrate these initial prehensions into one completed unity, which is called 'the satisfaction' of the actual entity. Based on the outline of Whiteheadian metaphysics provided above, it is clear that there is significant scope for the integration of his processual tenets to the realm of theorising organisation and change. The next section draws attention to organisational theory that has enrolled Whiteheadian process thought.

4.1.2 Epistemology and Theorising

Considering the process ontology outlined above, the question of epistemology needs to be more explicitly addressed. This is because the ontological and epistemological positions have implications for the way 'theory' is considered, which has a bearing on the types of knowledge claims that are made. To recap, for Whitehead, reality consists solely of events which are "concrete slabs of experience". Following his relational ontology, events are constituted by their connections to other events but there are variations in the degree of connection (i.e. some events are intimately connected while others are much more distantly connected, to the point where they *appear* disconnected). Fundamentally, it is these relations between events that make up both 'the world' and also us as 'subjects'. This one-substance ontology is radically different to modernist metaphysical systems that rely largely on Cartesian assumptions of mind-body duality. This is highlighted by Whitehead in *Process and Reality* when he suggests that:

"All modern philosophy hinges around the difficulty of describing the world in terms of subject and predicate, substance and quality, particular and universal. The result always does violence that that immediate experience which we express in our actions, our hopes, our sympathies, our purposes and which we enjoy in spite of our lack of phrases for its verbal analysis" (Whitehead, 1929 p.49)

Consistent with Whitehead's proposition that all reality is constituted by connections between events, the notion of 'detached' or 'universal' knowledge, such as rationalistic organisation 'theory' as a set of universal propositions becomes problematic. This is problem is highlighted in the above quote where it is suggested that the reliance on the subjectpredicate form of language by modern philosophy is inadequate for appreciating the complexity of the actual world of events because it forces separation of 'universal' and 'particular', which for Whitehead is only ever artificial.

"These terms, 'universals' and 'particulars', both in the suggestiveness of the two words and in their current philosophical use, are somewhat misleading. The ontological principle, and the wider doctrine of relativity on which the present metaphysical discussion is founded, blur the sharp distinction between the universal and the particular" (Whitehead, 1929 p.40)

113

In other words, experience is never reducible to 'objective truth' because underlying the objective truth claim there is always an event (a particular) and interactions that constitute it (Helin et al, 2014 p. 12-13). Following Whiteheadian process assumptions, it is incorrect to assume a 'sharp distinction' between 'knowledge' and 'the knower'. Therefore, it would be incorrect to assume that an 'objective truth' (universal) about the world 'out there' can be established though rigours application of scientific method as is conventionally assumed within positivist research. Similarly, it would be incorrect to assume that there are many different realities that can be uncovered through triangulating diverse experiences of conscious human subjects as is the case within constructivist research (Easterby-Smith et al., 2015, p. 52). Instead, Whitehead encouraged us to acknowledge the intertwinement of universal and particular, of 'knowledge' and 'knower' in situated action (i.e. within events). This assumption that knowing resides within action has been termed performative epistemology (Tsoukas ,2017 p.18). Here is it is assumed that "knowledge is the outcome of embodied knowers who are embedded within a discursive practice, on whose cognitive, affective and normative resources they routinely draw" (Tsoukas, 2017 p.18). It is to recognise that "both conceptual generality and situational particularity matter" (Tsoukas, 2017 p.18). The reliance upon what may be called a *relational* ontology and *performative epistemology* encourages a different type of theorising than that which is commonly aimed at by researchers informed by substance-based ontology and representationalist epistemology. Namely, it necessitates a shift from 'disjunctive theorising' to 'conjunctive theorising' (Tsoukas, 2017).

The previous chapter (section 3.5) elaborated some of the problematic elements of established notions of 'disjunctive' organisational theory. In particular, it highlighted that the majority of organisational theory (specifically pertaining to the phenomena of alliance development) is based upon representational epistemologies. This implies that 'organisational theory' typically deals with abstractions that *represent* organisations, with the aim of theorising being to offer a coherent set of propositions that explain the relationships between these abstractions (Zundel and Kokkalis, 2010). Conversely, the processual approach outlined above, based on the notion of a reality in continuous formation, cannot attempt to deal in circumscribed abstractions and propositions.

114

Conjunctive theorising, as outlined by Tsoukas (2017) seeks to account for empirical complexity by focusing on connection rather than division. This mode of theorising attempts to account for complex experience "in a unified manner" (Tsoukas, 2017 p.18). Furthermore, Tsoukas (2017) suggests that to deal appropriately with complexity, requires that we recognise ambiguity and uncertainty within our analysis. It is suggested that conjunctive research "seeks to restore the past to its own present, with all its incoherence, complications and might-have-beens" (Tsoukas, 2017 p.17). It is acknowledged that researchers cannot fully apprehend the ambiguities and incoherence of organisational agents, since the researcher cannot live the same experience as the agent (Tsoukas, 2017). It is however proposed that researchers can attempt to account for the 'messiness' of organisational life by focusing on the "uniqueness of the situation", including breakdowns, surprises and disruptions (Tsoukas, 2017). To avoid simplifying, Tsoukas (2017) encourages that we abandon "clear singlefocused hindsight" informed by established theoretical logics (such as evolutionary or teleological frameworks) and focus instead on the development of rich accounts "that preserve disorder and confusion" (Tsoukas, 2017; Weick, 2007). Within this mode of theorising, concepts (such as 'events, event-formations, actors, concepts, materials') are not fixed representations of the world, but are partially defined through the enactment of the phenomenon experienced (Tsoukas, 2017). Conjunctive theorising therefore "does not aim at decontextualized generalisations, but elucidation: to illuminate a phenomena through making ever-finer distinctions that provide practitioners a clearer, more integrated understanding of their practices" (Tsoukas, 2017 p.18). Crucially, it illuminates the role of agency to the agents, highlighting what they do and what they may-do (Tsoukas, 2017 p.18).

Based on this conception of 'conjunctive theorising', the notion of 'theory' may be reconsidered. Whereas, representationalist approaches to theorising are based on the generation of decontextualized models that explain the functioning of the empirical world, processual theorising is more aligned with the notion of *theoria*. Theoria "refers to the process of 'looking at' a spectacle or theatre stage" (Zundel and Kokkalis, 2010). Briefly, the ambition of *theoria* (as opposed to theory) is not to develop an 'explanatory scheme' but to open up new ways of seeing (observing the spectacle), creating new perspectives and vantage points from which organisation can be understood (Zundel and Kokkalis, 2010). The next section offers a consideration of how such a new ways of seeing might be opened up through a processual theory of organisation.

4.1.2 Towards Organisational Process Theory

One of the most seminal contributions towards processual approaches to organisation is offered by Tsoukas and Chia (2002) who outlined a case for 'organisational becoming'. They do not explicitly invoke Whitehead in their outline of organisational becoming, however their call to "approach 'organisational change' from the perspective of ongoing change, rather than stability" is clearly rooted in the type of processual metaphysics espoused by Whitehead. In approaching organisations from a perspective of 'continuous change', Tsoukas and Chia (2002, p. 580) suggested reconceptualization of organisations from "atomistic collections of functional pieces" towards a view which would recognize organisations as "quasi-stable structures and sites of human action in which , through the ongoing agency of organisational members, organisation emerges." They conclude by suggesting that embracing the organisational becoming would encourage a focus on 'how change and organisation is actually accomplished.

Chia and King (1998) explicitly draw in Whitehead to offer a new perspective on organisation by articulating the principles of "becoming, enduring and perishing of event-clusters". Highlighting that reality comprises "the continued building up and breaking down of 'actualised' entities through the assembling, disassembling and reassembling of past aggregations of events into ever newer and novel 'event-formations'" (Chia and King, 1998, p. 472). Curiously, work on elaborating an events-based understanding of organisation has remained relatively underdeveloped, with the recent works of Bakken and Hernes (2006); Hernes (2014a, 2008); Hussenot and Missonier (2015) and Weik, 2011) providing notable exceptions.

Bakken and Hernes (2006) explicitly invoke Whitehead to offer a complementary perspective on Weick's (1979) verb-noun relationship. They highlight that Whitehead rejects any notion of pre-existing entities and developed his conceptual scheme around the 'becoming of things' whereby processes consist of 'actual entities' rather than physical 'things'. They suggest that "events take place in time-space and carry themselves within other events; furthermore they come to form a unified event which is the basis for the formation of new events" (Bakken and Hernes, 2006, p. 1608). Importantly, in contrast to Weick (1979) who advocated the eradication of nouns from organisational theorising, it is highlighted that Whitehead considered such abstractions (nouns) as indispensable for process (Bakken and Hernes, 2006). The advantage offered by Whiteheadian process thought then, is that it avoids the problems associated with dualist ontologies, such as the (substance-process ontology advocated by Weick (1979) and latterly Tsoukas and Chia (2002)), since there is only one ultimate substance which is constituted by the movement between nouns and verbs. This is what is highlighted by Bakken and Hernes (2006) with their example of the 'pseudopod' . Following Whitehead, it is suggested that abstractions (nouns) are created from interacting process (verbs) and in turn shape subsequent processes (verbs). Bakken and Hernes (2006, p. 1609) view on Whiteheadian process and the implications for the verb-noun relationship is summarised as thus:

"Abstractions are entities created out of processes and re-entered into processes in turn. Abstractions serve the purpose of distinguishing totality from its details- they are the formations that unite attention; they are more or less random choices from a complex reality, but once they are formed they reproduce our understanding of the world, this makes them powerful and makes their formation the object of study...They are powerful because they unite attention- they give the impression that they restrict the possibility for change (i.e. give perception of stability)."

In the context of organisational analysis, they suggest that Whiteheadian process could be useful in studying the formation of organisations. Specifically, they suggest that:

"the initial stage might be characterised by 'direct experience' consisting of interactions between persons and ideas. This is the stage before concerted action is required and before organisational structure becomes necessary; what matters is the flow of experience and ideas within and among groups. As some ideas begin to crystalize together however, concerted action becomes necessary because ideas need to be tried out- choices and selections have to be made...Possible courses of action will present themselves and some will be selected over others. As commitment is made to a long-term project with specific intentions, the need to establish institutional legitimacy in relation to other organisations arises, which calls for the development of characteristics such as 'goals', 'a name' and 'control procedures'- these emerge in the form of labels that unite attention".

The key point emphasised by Bakken and Hernes (2006) is that experiences may evolve into abstractions through stages and that these abstractions may in-turn form the basis of further experience. They conclude by stressing that verbs and nouns interact in a process whereby they grow out of one another, suggesting nothing is ever wholly stationary or fluid but that reality is constituted by simultaneously by fluidity and stability.

This constitution of organisation through simultaneous stability and fluidity has been elaborated by more recent organisational process theory. For example, Weik (2011) draws upon Whitehead's metaphysics to propose a theory of organisational change that affords ontological equivalence to 'being' and 'becoming' (or nouns and verbs as referred to by Bakken and Hernes, 2006). Weik (2011, p. 668) suggests that "becoming is the actualisation of potentialities that creates being from non-being" or as Bakken and Hernes (2006) would say creates 'nouns' from 'verbs'. Change is characterised as "the actualisation of potentialities that creates a modified being from a previously existing being. Change is ontologically characterised by two aspects that should shape empirical research: relationality and activity" (Weik, 2011, p. 668). Elaborating on the concepts of 'relationality' and 'activity' Weik (2011) suggests that relationality refers to the "retaining capacity of the process" that links different states (beings) in the change process, it is the retaining of certain 'nouns' that constitutes relationality. Conversely, 'activity' refers to "the creative capacity responsible for the innovative part of change, it is a comparatively undetermined 'force' not limited to human agency" (Weik, 2011, p. 668). It is 'activity' that fosters continuous change and leads to the formation or reformation of perceived stabilities. Importantly, Weik's (2011) model suggests a move from 'inertia-jump-inertia' models of change, such as the life-cycle, teleological and evolutionary models outlined above. Instead, it encourages a view that would see 'relationality' (being/ stability) and 'activity' (becoming/ change) not as alternating modes but as simultaneously operative, reflecting 'two sides of the same coin' (Weik, 2011). Although Weik's (2011) contribution is incredibly useful in informing a processual analysis of organisational change, offering the concepts of 'relationality' and 'activity' as a basis for analysis of organisational change processes, there remains some work to be done in articulating a full conceptual frame for Whiteheadian process analysis. Recent efforts by Hernes (2014; 2008) and Hussenot and Missonier (2015) have been critical towards developing an events-based theory of organisation.

4.1.3 An Events-Based Theory of Organisation (and Change)

This section provides an overview of current events-based theorising within organisation studies. In doing so, it elucidates the core theoretical concepts used to frame analysis within the current research. These are; 'events', 'event-formations', 'prehensions', 'organisational meaning structures'. Together these concepts facilitate an elaboration of simultaneous 'relationality' and 'activity' as outlined by Weik (2011) and thus a processual account of organisational emergence and development.

4.1.3.1 'Events', 'Event-Formations' and 'Organisational Meaning Structures'

The adoption of a one-substance (flat) ontology as proposed by Whitehead presents problems for organisational analysis. As Whitehead himself acknowledged, although the world may be comprised solely of change, we as human analysts, are bound to 'entitative' thinking, that is thinking in spatio-temporal terms. The question that arises is how do we reconcile a world comprised of only events (Whitehead's 'Actual Entities') with our common experiences of a world comprised of fixed 'things' such as people, objects, technologies, organisations and alliances? Hernes (2008) emphasises that Whiteheadian process analysis requires us to work with both 'events' and 'entities' (or nouns and verbs), although I will use the terms 'events' and 'things' since the use of the term 'entity' can be confused with Whitehead's notion of 'actual entity'. Hernes' (2008) solution is that we can use both terms, so long as we recognise that 'things' are in actuality references to 'the coming together of events'. For Hernes (2008, p. 55), events are:

"seen as points in timespace serving to mark the process of the becoming of entities. As markers, events function like data for what is to come. Events may also serve as markers in the way of the aims of processes, for example, when deadlines are stipulated. In both cases, events are markers of processes while taking an active part in shaping them"

In a later definition, Hernes (2014a, p. 189) suggests an event can be conceptualised as "a generic description of any occurrence of duration", highlighting that "with the passage of time, actors can ascribe meaning to events, including their temporal extension, actions that took place, associated actors, intentions and outcomes". More recently, Hussenot and Missonier (2015) offer an events-based framework for organisation based on Whiteheadian metaphysics and the earlier work of Hernes (2014a). They define an event as "a concrete fact. [An event is] a moment in which an activity and its organisation are concrete and tangible". They go on to elaborate that "organisation is a structure of events" meaning that events are prehended as a coherent whole (Hussenot and Missonier, 2015, pp. 8–9). The framework offered by Hussenot and Missonier (2015) is incredibly helpful in elucidating the relationship between the notions of 'events' and 'organisations'. Simply, they suggest that organisations are 'event-structures', made up of connections between events, which they term 'prehensions', following Whitehead.

Hernes (2014a) offers a more nuanced conceptualisation of 'organisations' within an eventsbased logic. Specifically, he suggests that organisations are 'spatio-temporal orderings' that consist of conceptual, human and material elements forming interconnected wholes (Hernes, 2014a, p. 100). These heterogeneous, emergent wholes of connected elements are termed 'organisational meaning structures'. Hernes (2014a) elaborates that the words 'meaning', and 'structure' are intended to convey that organisations provide acts with meaning and that they are 'structured' heterogeneous wholes. Organisational meaning structures are considered heterogeneous because they include elements of different kinds (e.g. persons, material, concepts). These elements, consistent with Whiteheadian process thought, are not objects in of themselves but are "provisional outcomes of accumulated events" (Hernes, 2014a, p. 107). For Hernes (2014a), 'Organisational Meaning Structures' are not simply reflective of 'the organisation' *they are* the organisation. They are 'the things' or the perceived stabilities that enable us human actors, who can only think in spatio-temporal terms, to act in and upon the world. With regards to their relationship with events, Hernes (2014a, p. 122) suggests that:

"organisational meaning structures derive their existence (become) from event-formations that are seen as particular to those meaning structures. As much as events provide a sense of movement to organisational life, eventformations provide historicity and sense of movement to organisational meaning structures."

So, in summary, existing events-based approaches to organisation conceive of organisations being fundamentally constituted by events (Hernes, 2014a; Hussenot and Missonier, 2015). However, Hussenot and Missonier (2015) suggest that the organisation is itself the eventstructure whereas Hernes (2014a) suggest that event-structures (formations) merely provide the basis for explaining how organisations are constituted. For Hernes (2014a) organisations are, for all intents and purposes *real*, consisting of people, technologies, concepts, plans and so on...The important difference is that these 'organisational meaning structures' are only stable in perception, and they are actually constituted by the multiple relations between events. For Hernes (2014a) 'Organisational Meaning Structures' are necessary to enable us to think and act in a processual world constituted by events, they are reflective of the 'nouns' that were elaborated above (Bakken and Hernes, 2006). Hernes (2014a) suggests that organisational meaning structures are enacted through different 'modes of articulation' which takes place at events. 'Organisation' occurs at events where elements of the 'organisational meaning structure' (people, materials, concepts) are related through different articulatory modes. The different modes of 'articulation' outlined by Hernes (2014a) include textual (written documents), intersubjective (discursively through actors), practical (doings of actors), material (physical built environment) and tacit. Having outlined the conceptual relationship between 'events' and 'organisations', I will now move on to outlining the main principle of processual analysis, that is how the relations between events are productive of both stability and change, or emergence and development.

4.1.3.2 Prehension

As outlined in Section 4.1.1, Prehension is a key concept in Whitehead's processual scheme. To recap, Whitehead elaborated that events, as the fundamental building blocks of reality, were analysable into their 'prehensions'. Hernes (2008, p. 50) summarises that "Whitehead used the generic term prehension for *the force* that connects events in timespace...once certain patterns of are set in motion, they enrol events into a configuration". For Hernes (2008, p.50) prehension means that events 'grasp' for each other and the term relates to the "propensity of events to connect to other events with which it has common aims." More recently, Hernes (2014, p. 75) refers to prehension as the "temporal agency" of events, which is defined as their ability to 'reach out to' other events. According to Hernes (2014a) it is this co-creation of events through their prehensions that establishes the event-formations, which are the apparently stable provisional relational outcomes.

In their recent attempt at outlining an events-based framework for organisational change, Hussenot and Missonier (2015) draw upon the notion of prehension. For them "Prehension means that actors always define and act in their actual event through their engagement with past and anticipated events" (Hussenot and Missonier, 2015, p. 9). They suggest that "the structure of events is the past and future events prehended in the actual event. The notion of the structure of events insists that these events are prehended in a certain way by actors leading to order in the activity" (Hussenot and Missonier, 2015, p. 9). They emphasise that no event related to the organisation is discrete from another but that "events are prehended by actors" (Hussenot and Missonier, 2015, p. 9). Finally, they posit that the "understanding of organisation is done through *the events prehended by actors* in their activities". (Hussenot and Missonier, 2015, p. 9).

Although their contribution is incredibly helpful by way of bringing the notion of prehension into the realm of organisational analysis, there appears to be some divergence from the notion of prehension elaborated by Whitehead (1929) and indeed Hernes (2014a). Consider the definition of prehension outlined in Section 4.1.1, Whitehead suggests that **events involve each other** by way of their prehensions and that prehensions are defined by three factors:

122

- 1) The subject- or the 'focal' event that is *doing the prehending*
- 2) The datum- or the other events that are *prehended*, giving form (in-forming) the subject
- 3) The subjective form- or the way in which the focal event prehends the other events. This is to be taken in a literal sense, 'the way in which' does not refer to 'a mechanism or medium' but a feeling i.e. other events are prehended with a subjective form of optimism or scepticism.

It is important to highlight this because clearly, for Whitehead, it is the 'actual entity (event)' that is the 'prehending subject' not the 'actors' as in the human agents identified by Hussenot & Missonier (2015). It is precisely this which Hernes (2014a) refers to when emphasising the 'temporal agency' of events. To recap, Whiteheadian process analysis requires that 'events' *are the agents* of process, they *have agency* which is exerted through *prehensions*. This is not to deny the possibility of human agency, or to dismiss the notion that human agents can impact organisation, but it is to recognise that human agency is only exercised *within events*. That is to say, that human agency is derivative of and subjugated to the *agency of events*. To illustrate this subtle shift in the role of human agency, consider the example provided by Hussenot and Missonier (2015, p. 8) who suggest:

"The structure of events is shaped by the events prehended by actors in their actual event. By being prehended in actual events, these structures of events bring not only stability of organization but also novelty."

Here, they elevate the role of human agency beyond that of the agency of the event. They suggest it is *the actors* that *prehend* rather than the event. Conversely, my interpretation following Whitehead's (1929) conceptualisation of prehension would afford greater emphasis to the agency of events and would suggest that the structure of events is shaped by the prehensions of the actual event. By virtue of these prehensions, these events provide a sense of continuity and a discontinuity to the actual event in question. Taking the concepts outlined above in totality, I can now outline an alternative frame for processual analysis of strategic alliance development that is consistent with Whiteheadian metaphysics. Specifically, the key concepts that are drawn upon are: Events, Event-Formations, Organisational Meaning

Structures and Prehension (Relationality and Activity). An overview of the conceptual apparatus is provided in Table 4.2. The next section outlines approaches that have been adopted by researchers in attempting to develop processual theories of organisation. I then outline the methods employed in the current research.

Concept	Description	Example
Events	Whitehead: Actual Entities/ Actual Occasions- "The final real things of	Taken in the most extreme sense everything we encounter
	which the world is made up. There is no going beyond actual entities	in everyday life is an event. As highlighted by Whitehead,
	to find anything more real. There are gradations of importance and	events vary by gradations of importance and diversities of
	diversities of function, but all actual entities are on the same level".	function, but they are all fundamentally the same.
	They are "concrete slabs of reality".	Therefore, examples of events could include both: a) the
		writing of this chapter and B) The UK leaving the EU- both
	Hernes: The basic unit of analysis in under Whiteheadian metaphysical	are different in terms of function and importance, but both
	assumptions. Events are afforded ontological primacy in analysis; every	are events in the sense that they are occurrences of
	other aspect of experience is derivate of events. Reality consists of	duration.
	events only therefore all other aspects of reality exist only in relation	
	to events.	
	Hernes (2008: 52) "Events are the points in timespace where relations	
	happen between entities. They are the points which the analyst	
	defines as significant for the analysis, serving as markers of	
	processesevents also serve as 'generators of processes besides	
	serving as markers[events] influence the evolution of process both by	
	providing 'data' for what is to come and by being occasions at which	
	actors aim, such as the realization of goals". A generic description for	
	any occurrence of duration.	
	Hussenot & Missonier: "An event is simply a concrete fact. An event is	
	a moment in which the activity and its organization are concrete and	
	tangible"	

Event-Formations	Whitehead: Actual Entities involve each other by reason of their	An 'event-formation' is simply an interconnected pattern of
	prehensions of one another. There are thus real individual facts of	events. For example, a 'football match' consists of numerous
	togetherness of actual entities, which are real, individual and	events that are interconnected around discernible patters
	particularAny such particular fact of togetherness among actual	such as 'Liverpool score a goal' which consists of a number
	entities (events) is called a Nexus	of events such as 'a pass', 'a run', 'a cross' and 'a header'
		that are interconnected around the pattern of 'a goal'.
	Hernes: No event exists in isolation, even events that appear singular	
	cannot be since their singularity is derived by their apparent	
	dislocation from other events. Event-Structures refer to clusters of	
	events that are interconnected (prehended) in a discernible pattern.	

Prehension	Whitehead: Actual Entities can be divided into their prehensions.	Sticking with the football example. 'The Subject' (the focal
	Prehensions produce the general characteristics of the actual entity-	event) would be a football match between two teams (say
	they have a 'vector character' and involve emotion, purpose, valuation	Liverpool and Everton). In order to achieve satisfaction, the
	and consciousness. Actual Entities include each other by reason of	event 'prehends' past events that took place over the
	their prehensions of each other. Prehensions consist of 'the subject'-	previous 90 minutes e.g. A goal scored by a Liverpool player
	the focal event in question that does the prehending; 'the datum'- the	in the 28 th minute, a poor pass by an Everton defender, the
	other actual entities that are prehended in the focal event and 'the	award of a red card to the player, a penalty to Liverpool
	subjective form'- which refers to how the 'the subject'- focal event	which is scored in the 50 th minute and so on The
	relates to the other actual entities (the datum).	prehension of these events (amongst the many others that
		took place (e.g. the multitude of passes between players)
	Hernes: Prehension refers to the force that connects events in	gives the subject the form of 'a Football Match'- defining the
	timespace. It means that events grasp for each other and refers to the	event as "Liverpool beat Everton 2-0". The event may also
	propensity for an event to connect to another event with which it has	prehend other wider events such as those previous matches
	common aims. It is the 'temporal agency' of events- defined as their	between the two clubs and take the more particular form of
	ability to reach out to other events.	'Liverpool win the 250 th Merseyside Derby'. Similarly, it may
		prehend other events such as the previous results of the
		other matches played that day and the upcoming matches
		and take the form of 'Liverpool win the League for the first
		time in 25 years'. The key point is that the event (the
		football match) is determined by the events that it relates
		to, i.e. it's prehensions.
Organisational Meaning	Whitehead: N/A	Again, sticking with the football example: In the event 'the
Structure		football match' there are numerous, apparently stable
		'things' that are interrelated that enable the actors to act in

	Hernes: Meaning Structures are heterogenous wholes of	the event, these seemingly stable 'things' that enable
	interconnected elements that provide the meaning of the acts as they	human action constitute the 'Organisational Meaning
	are articulated in events. Organisations in the form of meaning	Structure'.
	structures are not seen as things in themselves, but as emergent	
	wholes of connected elements enacted through articulation by actors.	Elements would include:
	Organisational meaning structures are not seen as schemas that lie	
	between actors and a constructed reality, they are that reality, and	'Actors'- players, managers, officials, fans
	actors are part of the meaning structure. Although they are perceived	'Material'- The ball, the goalposts, the pitch, the stadium,
	as enduring 'things' meaning structure elements are really provisional	the kits, the badges, the logos etc
	outcomes of accumulated events. They provide acts at events with	'Concepts'- the rules of football e.g. 'a goal', 'a foul', 'offside'
	'meaning' and are 'structured' as heterogenous wholes consisting of	'out of play' 'a free kick' etc As well as more abstract
	multiple elements including 'human, conceptual and material'.	notions such as 'a good first touch' or 'a bad challenge'.
		These elements are interconnected in the event of the
		match, providing a frame from which those present at the
		event can understand what is happening and enabling them
		to act within the event. These interconnected elements
		constitute the Organisational Meaning Structure of 'A
		Football Match'.
Relationality	Weik (2011): Refers more broadly to "the retaining capacity of	Process Analysis requires a focus on relationality. It is
	process". Relationality links different states in the process, either by	important to consider how different 'states' are related,
	linking past present and future states or by linking contemporary	while being conscious that this stability is only ever
	'neighbouring' states.	perceived. Relationality is analogous to conventional
		understandings of 'change' i.e. things that move from one

The concept of relationality is based on the notion that there are for all	place to another. In the current analysis, relationality is
intents and purposes stable arrangements (although this stability is	analysed in terms of how elements of Organisational
really only ever perceived). Every event includes some form of	Meaning Structures are related and how these change over
stability- An important part of process analysis is consideration of how	time. It is primarily focused on the 'being' of organisations.
this perceived stability is constituted by connections between events.	
Here relationality is considered as one 'mode of prehension'- that	In Whiteheadian terms, a description of relationality
contributes towards the stabilisation of organisation by connecting	pertains to an explanation of an event "which is descriptive
past and future events.	of its potential in the becoming of other entities" i.e. what it
	is and how it is articulated.
	This analysis uses the concepts of Organisational Meaning
	Structures to explain how 'a partnership' emerges and
	changes over time with reference to apparently stable
	elements including 'Actors, Materials and Concepts'

Activity	Weik (2011): Activity refers to "the creative capacity responsible for	Process analysis also requires a focus on activity- that is how
	the innovative part of change. It is a comparatively undetermined	events connect to one another to shape the actual event in
	force, a dispersed activity" and thereby not limited to human agency.	question.
	The notion of activity refers to the unstable aspect of change. Here	In totality, A Whiteheadian perspective on organisational
	Activity is considered an alternative 'mode of prehension'- that	phenomena suggests that we are required to understand
	contributes to destabilisation (or novelty) by connecting events that	organisation as process by offering simultaneous
	alter prevailing meaning structures. Consistent with the process theory	explanations of both their 'being' and their 'becoming'. The
	outlined above, it is considered that relationality and activity (as	explanation of the 'being' of organisational phenomena is
	modes of prehension) work simultaneously to both establish and	accomplished through a focus on relationality, that is how
	modify organisational meaning structures by connecting disparate	different organisational elements are defined and realised.
	events.	
		In Whiteheadian terms, a focus on 'Activity' requires an
		explanation of the creative capacity of events- an
		elaboration of the undetermined force(s) that contribute to
		the modification of meaning structure elements.
		These two modes of change (relationality and activity) are
		here characterised as modes of prehension (the forces that
		underpins organisation and change).

 Table 4.2 Conceptual Frame for Whiteheadian Process Analysis (based on Hernes (2014; 2008), Weik (2011), Whitehead (1929))

4.2 Research Design and Methods

Research Design concerns the organisation of research activity, relating data collection and analysis to research aims in a coherent way (Eastby-Smith et al, 2015). The essence of research design is "making choices about what will be observed and how" (Eastby-Smith et al, 2015 p.68). To enhance coherence around the issue of research design, I will first recap the principal aims of this research, based on the preceding section and the two previous literature review chapters. I will then outline how data was collected and analysed in a way that enabled these questions to be answered.

4.2.1 Research Aims and Objectives

The literature review presented in Chapter 2 highlighted that, whilst there is a large corpus of literature concerned with university-industry interaction, the literature concerned with university-industry partnerships is relatively underdeveloped. Specifically, I showed that this literature has gone some way towards conceptualising university-industry partnerships but that there remain significant questions concerning the developmental dynamics of these partnering arrangements (Perkmann and Schildt, 2015; Perkmann and West, 2015). Therefore, the underlying aim of the current research is to provide a better understanding of the formation and development dynamics of university-industry partnerships. Based on this underlying aim, my overarching research question is:

"How do university-industry research partnerships emerge and develop over time?"

Following this, Chapter 3 offered a detailed consideration of the theoretical approaches to alliance development that could inform theorising the emergence and development of university-industry partnerships. Chapter 3 concluded by highlighting that the existing approaches to partnership development (with the exception of De Rond and Bouchiki's (2004) dialectical approach) are limited by their inability to fully account for the empirical complexity that characterises organisation and change. This conclusion was also reached by Thune and Gulbrandsen (2014) who suggested that models of alliance development proposed within the inter-organisational co-operation literature may be unsuitable for investigating the emergence of university-industry partnerships. In particular, they suggest that "university-industry partnerships may be even more unstable than the theoretical literature on alliance dynamics predicts, due to the complexity of initial conditions and modes of interaction" (Thune and Gulbrandsen, 2014 p.989)

Based on the analysis of existing theoretical approaches outlined in Chapter 3, it became necessary to explore how the complexity of organisational emergence and development can be accounted for in a more holistic way. I then outlined a metaphysics of process (Whiteheadian metaphysics) in this chapter that offers a solution to accounting for the complexity of emergence and development in non-representational terms. Thus, the second question that I pose is:

"How can a Whiteheadian process perspective contribute towards more holistic understandings of emergence and development (organisation and change)?

Following on from this consideration of emergence and development, it becomes important to consider the implications for theorising related to alliance dynamics in order to achieve the underlying research aim. Thus, the third research questions asks:

"How can strategic alliance development be understood processually?"

In totality, answering these two research questions establishes the final research question which is:

"How can processual understandings of alliance development contribute towards our theorising the emergence and development of university-industry partnerships?"

It is through providing answers to the three research questions that the overarching research question may be answered. The next section outlines how these research questions may be answered through process research methods.

4.2.2 Process Research Methods

A recent discussion paper in the *Journal of Management Inquiry* highlights the significance of 'theory-method fit' for conducting high-quality qualitative research (Gehman et al., 2018). Specifically, it is highlighted that "different approaches to qualitative research often presume distinct ontologies and epistemologies, resulting in different assumptions about the nature of theory and the relationship between theory and method" (Gehman et al, 2018 p.284). Therefore, I begin this section on methods by recapping how processual research of the type that I am attempting treats theory. Links can then be made to particular methodological choices that facilitate the type of theorising I am attempting.

Section 4.1.2 above elaborates the concept of 'conjunctive' or 'complex' theorising (Tsoukas, 2017) that I am attempting to offer in the current research. This 'complex' theorising that I am pursing aims to account for complex empirical experience "in a unified manner", without imposing definitive conceptual distinctions apriori (Tsoukas, 2017 p.18). In order to achieve this aim, research should attempt to "restore the past to its own present" (Tsoukas, 2017 p. 18) with all its incoherence, complications and 'messiness'. Tsoukas (2017) notes that it is impossible for researchers to "grasp the texture of organisational life with hindsight", however suggests that the complexity of 'action-lived-forward' can be revealed through disruptions, surprises or breakdowns. Furthermore, Tsoukas (2017) suggests that to understand the 'lived-forward' experiences of organisational life, researchers should pay close attention to 'the uniqueness of the situation' in which organisational life unfolds. Similarly, Hernes (2008 p.143) suggests that "once we try to understand [processually] a phenomenon, we owe it to that phenomenon to be treated on its own merits, bringing in its history and antecedents". In the same vein, Helin et al (2014 p.13), argue that research informed by process metaphysics should attend to 'the particular', encouraging a focus on "how the particular has become what it is today, in the context of its emergence." Thus, in order to engage in the kind of conjunctive, processual theorising I attempt here, a qualitative approach based on the longitudinal study of a particularly unique case is adopted. Fortunately, there is a well-developed literature pertaining to longitudinal process research methods (Gehman et al., 2018; Langley, 1999; Langley et al., 2013, 2007; Langley and Abdallah, 2015; Pettigrew et al., 2001; Van de Ven and Poole, 2005). The focus on a single case would be questioned by some over concerns related to reliability and generalisability (Easterby-Smith et al, 2015), however the single-case design is concordant with the aims of process research. The viability of the single-longitudinal case study design for process research concerns is illustrated by a 2013 special issue of *Academy of Management Journal*. The special issue included 13 papers focused on process research, of the 13 papers that were published 8 of them were single-longitudinal case studies. The other papers that were published included multiple-case studies and one quantitative paper (Langley et al, 2013). Thus, it is clear that the adoption of a) a qualitative approach and b) a single-longitudinal case study design is concordant with the ambitions of process research as outlined above.

Although there are multiple approaches to data collection and data analysis available to researchers within the process tradition (Jarzabkowski et al., 2017; Langley, 1999; Langley and Abdallah, 2015; Pettigrew, 1997; Pettigrew et al., 2001; Sminia, 2009), researchers have identified general characteristics of process methods. In presenting a review of process research, Sminia (2009) suggests that most process research draws upon single, qualitative case studies that make use of multiple sources of data (typically interviews, documents and observations). He notes that process researchers typically combine these diverse forms of data to construct 'a story' which in some abstracted form provides the answer to the research question. Although it is acknowledged that there are various ways in which 'the story' may be constructed and the truth claims of 'the story' presented. Despite the variety of data and analytical approaches that are adopted within process research, a common characteristic is the adherence to strict procedures of data collection and analysis that is required to safeguard 'internal validity' (Sminia, 2009). In other words, there needs to be transparency around the data collection and analysis process so as to enhance confidence that 'the story' that is presented is credible and trustworthy (Langley, 1999; Lincoln and Guba, 1985).

Similarly, Langley et al (2013) denote some common characteristics of process research methods. They suggest that one of the core elements of process research is the collection of longitudinal data, which is "necessary to observe how processes unfold over time" (Langley et al, 2013 p. 2). They also note that multiple methods of data collection may be drawn upon including interviews, archival data and observations, highlighting that such methods correspond well to process questions where the focus is on 'process' rather than 'things' (Langley et al, 2013 p. 6). One of the key characteristics of process data collection is close

134

involvement with the phenomena under observation (Langley et al, 2013). Specifically, it is highlighted that to study people, subject matter and their context in meaningful ways, researchers need to develop a sensitivity to their field and develop a degree of 'interactional expertise' that enables researchers to relate to informants in ways that facilitate the sharing of their knowledge and the setting in which the knowledge is created (Langley et al, 2013 p. 7). The following section outlines the characteristics of process data and methods of data collection before outlining the data collection approach adopted in the current research and an overview of the data collected.

4.2.3 Data Collection

This section first outlines the characteristics of process data, including a particular focus on research that relies upon data composed of events. Then I outline the primary data that was collected for the current research, affording particular attention to the decision to focus on the Unilever-University of Liverpool case and to the choices made about data collection methods.

Langley (1999 p.692) offers a useful characterisation of process data. It is suggested that because the primary concern of process research is on understanding the temporal evolution of phenomena, process data "largely consists of stories about what happened and who did what, when- that is events." In an outline of the his contextualist approach to research, Pettigrew (1990) offers a detailed outline of process data collection. Specifically, Pettigrew outlines that process researchers should aim to collect data that: emphasises action and is pluralist, historical and contextual. In practical terms, this encourages the collection of data through multiple methods, namely interviews, documents and observation. However, before data is collected through these methods, it is important to select an appropriate 'site' for study of the phenomenon (Pettigrew, 1990). Some suggest that the selection of an appropriate 'site' should be informed by a rational calculation based on the ambitions of the study and phenomena of interest (Yin, 2009). However process researchers have noted that in actuality, site selection is often a consequence of "forethought, intention, opportunism, chance and environmental preparedness" (Pettigrew, 1990, p. 276). Thus, it is recognised that in reality site selection is not solely a detached, informed choice but is often a consequence of a multitude of factors that enable or constrain the viability of access to different sites of interest. Despite this practical complexity, it is suggested that process researchers should select sites that reflect 'extreme situations, critical incidents or social drama' (Pettigrew, 1990 p.276). The rationale behind this approach to site selection is that these cases will often provide the most transparently observable access to the phenomena of interest, namely organisational growth, change and decay over time (Pettigrew, 1990). It is also suggested that 'highly visible sites' should be prioritised where possible, due to the knock-on effects of researching esteemed organisations and institutions (Pettigrew, 1990).

Bearing this in mind, the site that was chosen for the current research was the Unilever-University of Liverpool strategic partnership. There were several factors that informed the focus on this case. First, the selection of the Unilever-University of Liverpool case was necessitated by the conditionalities of my studentship. This is not to suggest that I focused on this case solely because of conditions of my funding, but it is to acknowledge that the conditions of my studentship encouraged a focus on this case. To elaborate, I was awarded an ESRC CASE (Collaborative Award in Science and Engineering) studentship that was sponsored in the form of funding and supervision by Unilever Central Resources UK. At the time of application for the studentship, the Unilever-University of Liverpool relationship was in a state of dramatic expansion and the developments in this relationship were having a significant influence on how Unilever R&D mangers were thinking about their engagement with their 'science partners'. Unilever's Director of Open Innovation in particular was leading a project on re-articulating Unilever's approach to open innovation with universities, in light of the developments at Liverpool and was keen to support a research project that could contribute towards crystallising the experience at Liverpool.

When I first began the project in Summer 2014, I held conversations with Unilever's Director of Open Innovation who explained the general structure of Unilever and provided detail on the structure of their R&D operations. It was clear that Unilever had developed an expansive network of university collaborations across their global R&D sites (referred to as the 'Unilever Science Grid') and I explored the possibility of examining multiple R&D partnerships with multiple universities (for example with Manchester in the UK). However, it became apparent that this approach would not offer the richness that would be afforded by the singular focus on the relationship with the University of Liverpool. Following these initial discussions about the Liverpool case in Summer 2014 it became clear that there was a sufficient amount of activity at Liverpool alone to enable an in-depth investigation into the evolutionary dynamics of university-industry partnerships.

Another motivating factor behind the singular focus on the Liverpool case was the fact that the case represented what might be called an 'extreme case' that was also 'highly visible' (Pettigrew, 1990). The Liverpool case reflects an extreme case in the sense that there are very few examples of long-term strategic research partnerships between firms and universities. As indicated in Chapter 2, there are many examples of one-off research collaborations between firms and universities, but there are relatively few examples of what are conceptualised as 'University-Industry Research Alliances' (Boardman and Bozeman, 2015) or 'Open-Research Partnerships' (Perkmann & West, 2015), particularly in Europe. At the other end, research has explored consortia, involving multiple universities and firms in a research project but has not considered dyadic partnerships of such scale and complexity (Perkmann and Schildt, 2015). The case is 'highly visible' (Pettigrew, 1990) in the sense that it focuses on one of the largest R&D performing firms in Europe (by R&D expenditure) and focuses in particular on the largest external research projects that this organisation has ever engaged in globally. In short, there are indications from senior levels (Director and Vice-President) within Unilever that the Liverpool case in particular reflects a collaboration with a university that is distinct, in terms of scale and breadth, from most university-industry collaborations. The fact that this is the largest university collaboration within Unilever, a multinational with a multi-million-euro annual R&D expenditure and global research operations is also testament to the distinctiveness of the case.

A third, more pragmatic reason for focusing on the Liverpool case was access. As highlighted above, Pettigrew (1990) suggests that process researchers should focus on cases that are transparent and observable. As a PhD student, at the University of Liverpool, funded by Unilever through a studentship, I was able to occupy a unique position in the field that facilitated access to key informants and documents (more details on which are provided below). I was also able to observe the unfolding of the partnership in real-time as I was present (both physically located and involved personally) at the site where decisions and actions were unfolding. Another advantage of the Liverpool case was that the time-horizon

137

of the investigation was not too expansive, so that almost all of the individuals who had been involved in the development of the partnership in the past, or who were involved in the future development of the partnership were still accessible. In order to develop an understanding of the dynamics of the Liverpool case, data was collected through various means from multiple different sources, these are detailed below.

Semi-Structured Interviews

Primary data were collected principally through semi-structured interviews with key participants within the Unilever-University of Liverpool strategic partnership. These individuals included: Unilever senior R&D management (Vice-Presidents and Directors), Unilever research scientists, University of Liverpool Senior Management Team (Pro-Vice Chancellors past and present), University of Liverpool academics, regional policy-makers, University of Liverpool technical support staff and University of Liverpool technology transfer office personnel (Director and Lead for Knowledge Transfer Partnerships). In total, I conducted 34 formal semi-structured interviews with 21 different informants. I interviewed a number of key informants on multiple occasions due to their centrality to the case and their active participation in the unfolding of the strategic partnership. All interviews were recorded and transcribed verbatim (within a week of them taking place). There are four interviews that are not transcribed verbatim. One because there were concerns about commercial sensitivity and three because of the sensitive personal nature of the discussion. In these instances, I took extensive notes that were typed up within 24 hours.

De Rond and Bouchiki (2004) note that gaining direct access to participants involved in strategic alliances (particularly in R&D contexts) is difficult due to the commercially sensitive nature of this phenomenon. Potential participants may be reluctant to engage in research related to strategic alliance development for a couple of reasons. Research has identified that one of the primary motivations for firms engaging in alliances is to enhance their competitive advantages by expanding internal capabilities or leveraging complementary capabilities (Gulati, 1998; Koza and Lewin, 1998; Reuer et al., 2002). Therefore, information related to the establishment and development of alliances is inherently commercially sensitive. The strategic significance of alliances and partnerships often means that there are attempts to constrain the flow of information to a limited number of individuals involved in decision-

making so as to minimise the chances of unintended spillovers of commercially sensitive information. Another motivation behind this limiting of information is the possibility that there could be negative consequences for the ongoing operations of the firm. Alliances usually have implications for employees in terms of the distribution of work (i.e. possibilities of job losses or relocations), therefore there may be attempts to limit information about alliance development to mitigate disruption amongst the existing workforce. Research into alliance development, particularly that which has adopted a single case design, has tended to rely on relatively fewer numbers of interviews and participants and it is common for the number of participants to be substantially lower than the number of interviews due to the concentration of decision-making authority in alliances.²

Although I was able to interview most of the key participants who were involved in the decision-making related to the Unilever-University of Liverpool partnership, I was unable to access a few notable individuals. This was because they were either no longer available and contact details were unobtainable through my network of participants or because they were contacted and declined to participate. In these instances, I identified and interviewed people who were working alongside those individuals for a significant period of time. I also attempted to corroborate their accounts of what these individuals did with documentary evidence that I was able to collect (see below).

I conducted interviews in three waves, although this was not necessarily deliberately planned. Initial interviews took place at the end of 2014, where the focus of the project was on the relationship between university-industry interaction and regional entrepreneurship (see Horner and Giordano (2016). Reflecting on these initial 5 interviews, it became apparent that

² To support this claim I drew on Majchrzak et al's (2015) review of qualitative case studies on strategic alliance development. In their study Majchrzak et al (2015) provide a systematic review of 22 qualitative case studies of strategic alliance development. I identified 17 of the 22 cases (all published in top management journals-see Majchrzak for search protocol) that drew upon single-site data. In all but 3 studies the number of participants was lower than the number of interviewees. I analysed the information given on the number of interview participants and number of interviews and discerned that within these studies, 27 was the average number of interviews from an average of 14 participants. Furthermore, in a recent study on the organisation of the Structural Genomics Consortium, Perkmann & Schildt (2015) draw upon an interview sample of 22 participants who were directly involved. I only mention this here to illustrate that the number of interviews and informants I was able to conduct and access is not atypical for the field (strategic alliance development) nor the context (university-industry interaction).

the collaboration was still too nascent to observe any real discernible impact on entrepreneurship in the Liverpool City Region. The very fact that the collaboration was still too nascent became the point of departure for a re-framing of the direction of research. In other words, it became apparent that the collaboration was still very much 'in development' despite the fact that it had been established for nearly 6 years. Based on this I decided that the most fruitful direction for research would be to examine the emergence of this collaboration and its continuing development.

The second round of interviews, conducted in early 2016, were very much informed by this emerging interest. At this stage, I had discovered the different theoretical approaches to alliance development outlined in Chapter 3 and these theoretical approaches informed the interview guide. Although I did not ask specific questions related to the theoretical constructs outlined by Ring & Van de Ven (1994), I asked questions that were very much informed by their processual account of alliance development. There were three themes that structured these interviews: First, informants were asked about their personal details, their job role and their relation to the emerging Unilever-University of Liverpool partnership. This included both their formal mandate for involvement in the relationship as well as their informal connection and involvement. Second, informants were asked to recount their understanding of the Unilever-University of Liverpool partnership, referring where possible to particularly significant events, experiences and interactions. At this stage, I asked follow-up questions when particular events were referred to, probing as to why informants felt these events were significant and exploring whether the events they identified were of general significance or of particular personal significance to them. Thirdly, informants were asked about how they personally became implicated in the partnership, how they felt about it initially when becoming involved and how their involvement had changed over time as well as the nature of this change and reasons for their changing involvement. Following this second round of interviews I gained access to a substantial tranche of documentation that related to the partnership (detailed below) which allowed me to identify new informants and new topics for discussion.

A 'third wave' of interviews were conducted around Spring 2017. From the documentation I had accessed I was able to identify a number of actors who had been involved in the

partnership in different capacities that I had been previously unaware of. It was because of these documents and the previously conducted interviews, that the approach to this third wave of interviews was slightly different. These interviews were more focused on identifying consistencies and inconsistencies within accounts of the partnership that I had been developing based on previously collected data. I was also able to explore facets of the partnership that had previously been very sparsely covered in much more depth because I could talk to people about the events and incidents that I had identified from documentation but had no direct experience of. I still relied upon the three themes that guided the second round of interviews which aimed to unpack personal experiences of the development of the partnership.

Finally, I conducted a small number of interviews in early 2018 with a number of key informants. I took interim narrative accounts to these interviews as well as copies of my event-chronology (see below). These interviews were informed by a joint-reading of this interim narrative and event-chronology in an attempt to validate the accounts that I had constructed and ensure that no details (particularly from retrospective accounts) had been misrepresented or neglected. These final interviews provided some very rich data on particular incidents that had not been covered in as great a depth as they needed to be given their significance in the broader narrative. I feel that by this stage, I had established enough legitimacy with these informants that they felt comfortable disclosing sensitive personal information. Furthermore, the event-chronology served to offer a reminder about particularly distant events resulting in the disclosure of details that had previously been absent.³ A full list of interviews can be found in Appendix 1

Documents

As mentioned above, in Summer 2016 I gained access to a substantial amount of documentation pertaining to the Unilever-University of Liverpool partnership. One of interviews had identified the existence of a 'Joint Strategy Board' that was responsible for the governance of the partnership at that time. I contacted key gatekeepers in Unilever and the

³ One informant appeared a little unnerved about the personal history that I was able to recount to him but this yielded a much richer discussion that would have otherwise been possible.

University of Liverpool about access to these meetings and their records. There were significant concerns, primarily from University of Liverpool senior management about the commercial sensitivity of these meetings and documents related to the partnership. Through the endorsement of my research by key Unilever and University of Liverpool informants, I was able to negotiate access to these documents although it was decided that I would be unable to observe the actual meetings themselves. In total, I was able to access 139 separate documents related to the Unilever-University of Liverpool partnership. These documents comprised of: Minutes of meetings of the JSB and the MIF Board (39 sets of minutes over a 3 year period), annual business plans (and drafts), legal agreements (SLAs, Agreement to Lease, Lease, Licences, Heads of Terms, Memoranda of Understanding), internal project reports, internal presentations, speeches & talks, funding proposals (and marked-up drafts), audit reports, offer letters, an MBA dissertation of a key informant and press articles covering different aspects of the partnership. A breakdown of the documentary data collected is provided in Appendix 1. Briefly, these documents combined to a total of over 480,000 words, which gives a sense of scale of the documentary evidence base that informed the analysis and later interviews.

Observational Evidence and Fieldnotes

As intimated above, I was unable to gain direct access to the meetings of the Joint Strategy Board. However, I broadly immersed myself within the unfolding partnership. I held regularly (monthly) meetings with Unilever's Director of Open Innovation who was the key decision maker responsible for the management of the relationship over the period of study. At these monthly meetings which typically lasted from 1-3 hours I would take notes about the topics of discussion. I also undertook a four-month internship at the Materials Innovation Factory, taking an active part in the collaboration. This aim of this project undertaken during the internship was to explore how the Unilever-University of Liverpool partnership could be mobilised to aid the internationalisation efforts of the University in India. During this time, I reported directly to the MIF Managing Director and produced a report for the Chair of the MIF Board (who was the University of Liverpool's Pro Vice-Chancellor for Science and Engineering). I spent a significant amount of time with Unilever R&D staff at their Bangalore R&D site where I got a good understanding of how other partnerships with universities are established and managed. I also produced a 13,600-word report for the MIF MD, MIF Board Chair and the University's Director of Internationalisation about the viability of expansion in India via leverage of the Unilever relationship. This work was also included in the 2017 MIF Business Plan, to which I contributed.

Some of the notes I recorded during my regular meetings with Unilever and University of Liverpool personnel were typed up, but these were not used directly as empirical material for analysis. This was because the range of topics covered was usually quite diverse and not always of direct relevance to the principal research concern. However, these notes proved hugely influential in aiding interpretation of the empirical material collected from interviews and documents. My proximity to the partnership and active role in its development also gave me a greater understanding than would have been possible if I had relied solely on interviews and documentation.

4.2.4 Data Analysis

Stage One: Event-Coding

Since the primary unit of analysis in this research was 'the event', the first stage of data analysis was to create an events-database by "triangulating across" the multiple data sources (Gehman et al., 2013). To construct this database, I collated all of the empirical material including interview transcripts and documents into an NVivo file. I then re-read all of the empirical material attempting to identify occurrences (events) related to the emergence and development of the Unilever-University of Liverpool partnership. To guard against retrospective biases, I only coded events when evidence from interviews could be corroborated by more than one participant or when events referred to by one interviewee were supported by documentary evidence. Events were coded along various dimensions including date, type (formal meeting, informal interaction, 'external' events) and actors implicated. For each event identified, a short narrative description was written which was informed by the related primary data. This initial coding of events produced a list of 394 events stretching from July 1999 through to April 2017. This initial list of events was sent to three key informants who were encouraged to make annotations on the list, two informants responded with further clarifications about events and their sequencing. This initial coding of
events allowed me to establish a great degree of familiarity with the case and also provided a couple of initial insights that guided further analytical work.

It became apparent that due to the multitude of events that were associated with Unilever-University of Liverpool strategic partnership, I needed to engage in some form of data reduction. This initial coding of events disclosed the complexity of the partnership, in terms of the numbers of actors involved and the various activities in which they engaged. It also became apparent that some events were peripheral or incidental and remained so but others that appeared peripheral became connected to a much boarder network of events. Reading through the initial list of events, it became clear that there were four distinct patterns that characterised the partnership between 1999-2017. These patterns of connected events reflected the notion of 'event-formations' outlined in Table 4.2. To clarify the structure of these event-formations and probe the interconnections between events further, I constructed 'visual maps' (Langley, 1999).

Stage Two: Visual Mapping and Construction of a Case History

When visual mapping is typically adopted as a sense-making strategy within process analysis, the map is divided up into hierarchical 'bands' that reflect different stakeholder groups (Gehman et al, 2013) or functions (Langley and Truax, 1994). The purpose of my mapping was not to delineate between different stakeholders but to clarify relationships between events. Therefore, I plotted maps of events that were broadly related to the four themes (eventformations) that I had identified through my initial event-coding. Broadly, these four eventformations corresponded to overlapping time-periods (1999-2007;2007-2012; 2012-2014; 2014-2017). I used a mind-mapping programme called XMind to construct these maps. Initially, events from the database (date and title) were coded as a node on the map, I then identified the common themes to which related clusters of events. For example, 11 events (Jun 14: Initial discussion on E-Science held; Aug 14: E-Science team formed; Jan 15: CAMS Concept proposed following sign-off of Stage 1 IT Report; Jun15: IT feasibility report reviewed; May15: Unilever offer to licence proprietary data management software to UoL; Jul15: Technical review of Unilever software undertaken; Aug15: Proof of principle on FLOW/EMS software established; Sep15: Proposal to consider software as an in-kind contribution; Apr 16: Heads of terms agreed for FLEX; Jul16: Negotiations ongoing for JDART; Aug16: FLEX agreement between UoL and Unilever signed off) were recoded as one thematic event called 'Computer Aided Materials Science Concept Develops'. An example of one of these visual maps is provided below



Fig 4.3 Snapshot of visual-mapping

The output of this visual-mapping exercise was a more manageable set of events (that were the larger event-clusters) which were interrelated around recognisable patters. I constructed a visual map for each of the four event-formations covering the different time periods I identified. These maps allowed me to narrow my focus on particular clusters of events which informed the construction of a case history.

To construct a case history, I wrote narrative vignettes for each of the event-clusters identified in the visual-mapping stage. Verbatim quotes from interviews and documentary evidence were used to construct these narrative vignettes. The narrative vignettes for each event-cluster were then combined and ordered chronologically. Combined, these narrative vignettes produced a "thick description" of the emergence and development of the Unilever-University of Liverpool strategic partnership. This extensive case history, which was approximately 32,000 words in length, was sent to two key informants for review. This case history formed the basis of further analysis.

Stage Three: Abductive Coding of Partnership Development Process

Reviewing the extended case history, I was struck by the complexity and non-linearity of the partnership development process. In particular, there were multiple actors that were involved and then disconnected in driving the development of the relationship. There were several changes in leadership of the respective partner organisations, there were changes of partnership management, changes of technical focus and ambition and changes of funding and governance arrangements. In short, it became apparent that the process models of alliance development that depict an iterative model of learning cycles towards a predetermined conclusion did not reflect the complexity of my empirical material. At this stage, I went back to the literature concerned with organisational change and began to explore alternative approaches that are more attentive to the discontinuous nature of change. I was guided in this literature search, I discovered MacKay and Chia's (2013) model of 'unowned' change processes. Their account of the demise of an American automotive company, whilst not directly reflective of my material, demonstrated some of the dynamics that I had observed in the case narrative I had constructed.

Therefore, I went back to the case narrative and analysed each event-formation independently to try and establish a 'pattern' that accurately reflected the connections between different types of events. Following MacKay and Chia (2013), I was particularly attentive to the choices that were made by actors involved in the decision-making for the partnership. I also observed that throughout the different event-formations, 'luck' and 'timing' played a significant role in precipitating some of the major accomplishments of the alliance (for example the Centre for Materials Discovery and the Materials Innovation Factory). I also noticed that, although there were individuals making purposeful, intentional decisions about the development of the partnership (in particular projects) as in established theories of alliance development (e.g. Ring and Van de Ven, 1994; Doz, 1996), these decisions were not the only ones that impacted the eventual accomplishment of the alliance. In fact, decisions that were being made outside of the scope of the partnership, such as those related to broader corporate strategy or R&D structure, has a significant impact on the way that the partnership developed. Therefore, I began to code these distinct influences on the

development of each event-formation, categorising choices made by collaboration actors, chance occurrences and changes in 'causal backgrounds' that were beyond the scope of the partnership decision-makers. I constructed a table for each event-formation that detailed the time period, the choices, the chance events that took place and the changes in causal backgrounds that shaped the development of the event-formation. I also linked these codes to examples from primary data that highlighted their significance in the development of the event-formation. Abridged versions of these tables are presented in Appendix 2. I removed links to primary data in these tables because evidence from primary data related to events is presented in Appendix 3 (a lot of this was duplicated and it would have meant an appendix of over 200 pages). This coding of the case history into choices, chance occurrences and unowned processes enabled the construction of an analytical narrative account of the emergence and development of the Unilever-University of Liverpool partnership that is presented in Chapter 5.

Stage 4: Analysis of process to unpack agency of events

The third-step of analysis outlined above produced an analytical account of how universityindustry partnerships emerge and develop over time. However, the broader theoretical issue related to the nature of change was still obscure. To elaborate an events-based view of change (and organisation), I re-read the case narrative in light of the events-based framework developed in Section 4.1 (presented in Table 4.2). At this stage, I revisited all of the narrative vignettes related to the four event-formations and searched for narrative themes, focusing on what the events did. My thematic coding was guided by the broad notions of 'Relationality' and 'Activity' offered by Weik (2011) in her process framework for organisation and change. This analysis produced six narrative themes that could be observed across all four eventformations. These themes were: 'connecting actors', 'connecting concepts' and 'connecting materials', which were seen reflective of the theoretical process of 'Activity'. The other three themes identified from this analysis were 'Reinforcing meaning structure elements (actors, concepts, materials)', 'Defining Meaning Structure Elements' and 'Defining future events' which were considered reflective of the theoretical process of 'Relationality'. Examining the inter-relationships between these themes in light of events-based theories of organisation, I constructed a model of organisational development that consists of parallel modes of Relationality and Activity. This model incorporated elements of events-based theorising (Events, Event-Formations, Prehension) with process theories of change (Relationality and Activity) to offer a holistic account of the unfolding of organisation (in this case a strategic partnership). This coding and data structure are presented in Appendix 3 (A-D). The next section provides a brief overview of the Unilever-University of Liverpool case before presenting the analytical narrative of how the partnership developed.

4.2.5 Case Overview: The University of Liverpool-Unilever Strategic Partnership

The empirical analysis presented in the following two chapters focuses on the strategic partnership between Unilever and the University of Liverpool. This partnership began in the year 2000 with collaboration between a newly appointed research fellow at the University of Liverpool and a research group leader at Unilever. The partnership is multifaceted in terms of its research scope, but it has largely focused on aspects of Materials Chemistry. Over the lifetime of the partnership, Unilever's Port Sunlight site has become a strategic research hub for the organisation. There have been recent substantial investments in the Port Sunlight site aimed at securing the long-term future of the facility, this is significant at a time when a lot of R&D is moving towards emerging markets (such as India and China) which are often the highest-growth markets for R&D performing organisations such as Unilever. Furthermore, over the duration of the partnership, the chemistry department at the University of Liverpool has become one of the most highly-regarded in the world. In the 2014 REF the University's chemistry department was ranked as the best in the UK, which is not insignificant given the competition (Cambridge, Oxford, Imperial) and the economic challenges faced by the Liverpool City Region. This partnership is considered distinctive by University senior management and Unilever senior management for a number of reasons. One of the key distinctive features of this partnership is that it is an 'open' partnership. That is to say that the results of collaboration between Unilever and the University of Liverpool of open to any third party that wishes to access them. Conventionally, university-industry partnerships are underpinned by pre-existing intellectual property, which often prevents the opening up of research results.

The Unilever-University of Liverpool partnership is distinctive because the collaboration is not based on underpinning IP, rather the focus of collaboration on the establishment of mutually beneficial research infrastructure. In all of the instances where mutually-beneficial research infrastructure has been established (i.e. the outcomes of collaboration), it has been made available on an open-access basis. This means that, in-principle, you could have a situation where there are researchers from Proctor & Gamble (Unilever's largest competitor) working in research facilities designed and financed by Unilever and the University of Liverpool, using the same equipment and same technical support staff.

It is not just the operating model of the partnership that marks it as distinctive, it is also the scale. In April 2017, the Materials Innovation Factory opened, this project reflected the largest ever investment by Unilever in an external R&D project (over £25m) and the largest ever investment in an industry project by the University of Liverpool. In total, the collaboration over the 17 years studied has been worth approximately £80m, including investment from Unilever and the University. The scale and complexity of the relationship makes it distinct from any other collaborative partnership that the University have been involved in and from other University partnerships that Unilever are involved in. In fact, Unilever are now working towards developing other partnerships with Universities based on the template of the partnership with Liverpool, which has been called the 'Liverpool Model' by senior R&D managers. It is the belief of University Pro-Vice Chancellors and Unilever Vice-Presidents that the Unilever and University of Liverpool partnership is unique within the UK, if not within Europe. Based on my research and reading around the case, I also share this belief. The next chapter presents an analytical narrative that explains the emergence and development of this partnership as an unowned process.

Note: Chapter 5 and associated appendix redacted

Chapter 6: A Whiteheadian analysis of strategic partnership development: events, prehensions and organisational meaning structures

6.1 Introduction

Chapter 5 provides a detailed narrative account of the development of the strategic partnership between Unilever and the University of Liverpool, covering the period 1999-2017. The narrative presented is structured around the choices, chance events and changes in 'causal backgrounds'. This framing provided coherence to the chronology of events presented, following other research that has adopted an 'unowned' view of process (De Rond and Thietart, 2007; MacKay and Chia, 2013). Whilst this framing is useful in providing structure and coherence to the entangled narrative, it does not offer a theoretical explanation of processes of formation and development otherwise referred to as organisational change (Tsoukas and Chia, 2002; Weik, 2011). An explanation of the accomplishment of change is the role of this chapter, which draws upon the process-theoretical concepts outlined in Chapter 4 to elucidate how change occurs through simultaneous forces of 'Activity' and 'Relationality' (Weik, 2011). To recap, the key concepts that are adopted to explain the 'becoming' of the partnership are events, event-formations and prehensions. The first section (6.2.1) outlines how a concrescence of prehensions established an 'Organisational Meaning Structure' (Hernes, 2014a), a "heterogeneous whole of interconnected elements that provide the meaning of the acts as they are articulated in events" (Hernes, 2014a p. 190). Sections 6.3, 6.4 and 6.5 elaborate how further connections between events served to reconfigure some of the Meaning Structure elements and served to stabilise others. The Meaning Structure (partnership) is reconfigured by events as they connect and disconnect actors, concepts and materials. It is stabilised by events as they connect elements with both past and future events, fixing the partnership in spatio-temporal terms and defining Meaning Structure elements. Table 6.1 presents an overview of the Organisational Meaning Structure as was articulated in the four main event-formations.

	T1- CMD Established (Dec	T2- RPIF Proposal	T3-MIF Legal	T4- MIF Opened (Apr 2017)
	2006) (Event-Formation)	Successful (Sep	Framework Agreed	(Event-Formation)
		2012) (Event-	(Apr 2014) (Event-	
		Formation)	Formation)	
Actors (Meaning				
Structure				
Elements)				
Individual	Alex Stephenson; Archer Mills; Jack	Archer Mills; Peter Blanken;	Mark Ward; Elliot Murray;	Mills; Blanken, Jackson; Moss;
	Groves; Tyler Henderson; Richard	Daniel Jacobs; Royle; Claire	Peter Blanken; Archer Mills;	Rutherford (VP Homecare); Harcup
	Clarke	McIntyre; Elliot Murray;	Arnold Royle; Brad Moss;	(VP Personal Care); Brewster (Head of
		Jacob Richards; Dennis	Trent Sweeting; Jean White;	Lab); Robinson (Technical Support);
		Green; Edward Gordon;	James Decker; Anthony	Ware (Technical Support); Knuckey
		Milosz Rossi	Fitzgerald	(Lab Ops Manager); Douglas;
				Stephenson; Sanchez-Lopez; Schultz
				New MIF Academics (x9); Jean White
				(UL Strategic Science Group)
Macro-Actors	Unilever R&D University of	Unilever R&D University of	Unilever; University of	Unilever; University of Liverpool; MIF
	Liverpool; NWDA; North West	Liverpool; Regional Growth	Liverpool; HEFCE; Joint-	Board; Para-dime working group;
	Chemical Companies (ICI, Tessella,	Fund; Relationship	Strategy Board; Project	Unilever Client Group; Academic Leads
	OMIC)	Committee; Joint Strategy	Control Group; Relationship	Group; Health and Safety Group;
		Board	Committee; Unilever Client	Strategic Marketing Group; Royce
			Group	Board-University of Manchester; Joint
				Development and Authority
				Requirement Team (JDART)

Materials				
(Meaning				
Structure				
Floments)				
Liementsj				
Capital Resources	£2.5m Capital from UoL ; £2.5m from	£2.8m RGF Round 2;	£20m Unilever + £5m in-kind;	£10m Royce Capital Funding for
	Unilever; £2m from NWDA	£1.73m RGF Round 3;	£26m University of Liverpool;	Analytical Equipment
		£2.3m CMD Contract	£11m HEFCE RPIF Fund;	
		Renewal; £20m UoL Capital	£1.75m RGF2 for MBR; £2.8m	
		Investment; £20m Unilever	RGF3 for HTFC	
		capital investment +£5m in-		
		kind; £11m HEFCE capital		
		investment from RPIF		
Physical Infrastructure	Refurbished Lab-Chemistry	CMD Lab at the Chemistry	CMD High-Throughput	11,300 sqft Building at the UoL
	Department; Automated platform	Department (including	Platform for Synthesis and	Campus; Analytical & Measurement
	for HT synthesis; standard Analytical	general analytical	Characterisation- Lab at the	Equipment; HT Synthesis and
	and Measurement equipment (Mass	equipment and 14 desks);	University of Liverpool; Radio-	Characterisation Robots; HT
	Spec, HPLC); 10 Desks	Radio-Tracer Lab	Tracer Lab at the University of	Formulation Robots (formerly HTFC);
			Liverpool; Micro-Bio Refinery	Para-Dime software for data
				management and experimental design
				(valued at over £4m); Micro-Bio
				Refinery; Radio-Tracer Lab;
Concepts				
(Meaning				

Structure				
Elements)				
Technical/ Scientific	Organic Synthetic Chemistry;	High-Throughput Synthesis	High-Throughput Synthesis	Computer Aided Materials Science-
	Inorganic synthetic Chemistry;	and Characterisation; High-	and Characterisation; High-	Computational Chemistry (in-sillico
	Nanomaterials	Throughput Formulation;	Throughput Formulation;	modelling); Modular Robotic
		Sustainability (sustainable	End-to-End High-Throughput;	Formulation (Formulation Engine);
		materials); Organic	Organic Chemistry; Inorganic	Organic Chemistry; Inorganic
		Synthesis; Inorganic	Chemistry; Sustainability (bio-	Chemistry; Sustainability;
		Synthesis; Genomics and	refining); Automation;	Nanomedicine; Genomics and
		Proteomics; Nanomaterials	Genomics/ Proteomics;	Proteomics; Computer Science/
			Nanomedicine	Cognitive Computing
Organisational/ Legal	Collaboration on differentiated	Alignment on Research	The 'Liverpool Model'-	Service-Level Agreement; Lease; 'The
	physical infrastructure; alignment on	Challenges; co-location;	Alignment on Capabilities not	Liverpool Model of University-Industry
	research challenges; separation of	Service Delivery; SLA for	Outcomes; Differentiated	Interaction'; Cross-Licence Agreement;
	scientific leadership from business	CMD	Physical Facilities; Separation	SLA OMICs; Relationship Agreement
	development; Service Delivery-SLA;		of Academic and Operational	
	distinct managerial infrastructure		Leadership; Open-Access;	
	(different management groups)		Credit Access System; Annual	
			Business Planning- KPIs,	
			Vision, Mission, Aims,	
			Procurement Planning,	
			Marketing and Business	
			Development, Staffing	
			Planning, Annual Accounts,	
			MIF Board and MIF Chair;	
			Service Level Agreement;	

	Agreement for Lease; Lease; Relationship Agreement	

 Table 6.1: Organisational Meaning Structure (2006-2017)

6.2.1 Concrescence of events into a Formation creates an Organisational Meaning Structure: 'Becoming' of the UoL-Unilever Strategic Partnership

The Subject:

Recalling the conceptualisation of events outlined in Chapter 4 (Section 4.1.1), events are the fundamental units of process, all other aspects of reality, including strategic alliances exists only in relation to events. Hernes (2008) suggests that "they are the points which the analyst defines as significant for the analysis, serving as markers of process". For Whitehead (1929) events are simultaneously a 'togetherness' of many events that it finds and also one of the 'disjunctive many' that may be 'found' by other events. Events become 'actual' when they have significance for themselves, they are self-creative and in the process of their self-creation they transform a diversity of roles (other events) into one coherent role (event). The first event that I have identified that resonates with this theoretical description is the event of 'the establishment of the CMD', in December 2006.

The establishment of a research centre, called the Centre for Materials Discovery, in December 2006 marked the first transition in the Unilever-UoL partnership. This event is part of a larger event formation (as detailed below) but it was significant because this is when the notion of a 'partnership' became tangible, manifesting in an entanglement of actors, concepts and materials. The Centre for Materials Discovery opened to University and Unilever researchers in December 2006. The CMD focused on the integration of 'High-Throughput' approaches to synthetic chemistry with conventional bench-chemistry and in doing so was the first facility of its type in Europe. The opening of the CMD also reflected the first time that Unilever scientists had been located 'off-site' to perform Unilever R&D work programmes. Similarly, the University of Liverpool had never previously leased out space for industrial researchers to occupy permanently on their campus. The opening of the CMD was therefore a landmark moment for both of the stakeholder organisations in terms of the technical research undertaken and the organisation of collaborative R&D. For Unilever R&D at the time, it was the largest contract that had ever been signed (in terms of financial outlay) with a University. Likewise, for the University of Liverpool, the CMD represented the largest ever collaborative agreement with an industry partner. Following the opening of the CMD it was anticipated that a contingent of Unilever R&D staff would be co-located with Unilever researchers at the University of Liverpool and that they would continue to share the new High-Throughput capabilities until at least December 2010. It was also anticipated that the CMD would offer regional development assistance through the provision of training to local SMEs and the creation of IP and high-tech start-up firms. The analysis presented below details how this event was brought into being by its prehensions of other events, following the Whiteheadian scheme of analysis.

Prehensions

There were multiple events prehended that defined the 'establishment of the CMD' in December 2006. These events constituted what Whitehead would term 'the datum' of the subject which is the 'establishment of the CMD'. The events prehended included: the meeting of Mills and Stephenson at a dinner in Cambridge (Jun 99), Mills' successful application for a Royal Society fellowship and relocation to Liverpool (Sep 99), the launch of the 'Path to Growth' change programme (Feb 00), the launch of the ERDF 'Objective One' programme with priority given to the Liverpool City Region, the submission of a proposal to BIS for a research grant (Aug 02), the rejection of the BIS proposal (Dec 02), the in-principle agreement between Mills, Stephenson and Groves (Feb 03), the submission of a business plan and proposal to the NWDA (Apr 04), the expression of concern in Unilever about the project (Jun 04), the NWDA approval of the project (May 05), the appointment of a Business Development Manager and commencement of legal negotiations (Mar 06) and the sign-off of the Service Level Agreement by senior managers from UoL and Unilever (Dec 06). These disparate events were brought together in the establishment of the CMD in December 2006.

The events outlined above constituted the establishment of the CMD in 3 main ways: they connected actors, connected concepts, connected material elements. Below I outline how these events worked to define the establishment of the CMD.

Connecting Actors

Several of the events that were prehended in the establishment of the CMD established connections and relations between actors. It was through the connection of these actors that the social infrastructure required for the partnership to take place was established. First, the

dinner at Cambridge in Jun 1999 connected Mills and Stephenson, defining them as the primary actors in the emerging relational whole. The dinner brought these previously disconnected actors together and defined them as potential collaborators, laying the foundation for the development of a personal relationship. Then Mills' successful application for a Royal Society Fellowship and associated re-location the University of Liverpool served to reconnect Mills and Stephenson, re-establishing the connection that had been formed at the dinner in Cambridge. This event also served to connect Mills with another set of actors at the University of Liverpool's Chemistry department and the University of Liverpool's management, both of which could become connected to the emerging relationship between Mills and Stephenson. The third event that expanded the emerging relational complex was the in-principle agreement between Stephenson, Mills and Groves in February 2003. This agreement connected the Mills-Stephenson relationship with other actors, namely Jack Groves and Tyler Henderson, who held decision-making authority for the nascent CMD project. In doing so, this event enrolled more actors and their associated interests into the collaboration, taking the project beyond the Mills-Stephenson relationship and adding perceived legitimacy to the developing relationship,

The submission of a proposal and accompanying business plan to the NWDA in April 04 enrolled more actors into the emerging CMD event-formation. It connected the project and associated relations (Mills, Stephenson, Henderson, Groves) with local policy makers (NWDA, Richard Clarke) and Supra-National policy makers (ERDF) as well as other industry actors who were involved in the supporting the business proposal (ICI, Tessella, AstraZeneca). The proposal connected these actors via shared interests, in particular the in interest of regional policy-makers to cultivate innovation-based growth. The expression of concern by Stephenson's research group in June 2004 also connected more actors to the developing project. The CMD project had been developed principally by Mills and Stephenson with support from more senior decision makers, but the escalation of concerns by Unilever researchers meant that they became more central to the definition of the project. In particular, their concerns about the impact of the project on their working conditions would have to be considered if the project was to be realised. Finally, the appointment of Peter Blanken as Business Development manager in January 2006 also connected another actor to the developing collaboration. The appointment of Blanken ensured that the diverse needs of

the multitude of stakeholders could be represented in the legal negotiation. It also altered the relational complex by establishing another personal relationship (Stephenson and Blanken) that was to characterise the collaboration, lessening the centrality of the Mills-Stephenson relation. Thus, when the CMD was established in December 2006, it consisted of a multitude of connected actors, some of which were more central and other more peripheral. The actors that were implicated in the establishment of the CMD included: Mills, Stephenson, Groves, Henderson, Blanken, as well as more abstract macro-level actors such as: The University of Liverpool, Unilever, NWDA, ERDF, Northern Chemical Companies (ICI, Tessella, AstraZeneca).

Connecting Concepts

While the events described above principally served to connect actors that would define the establishment of the CMD events also connected concepts that would define the technical and organisational elements of the Meaning Structure (Partnership). These events include: the bi-monthly research meetings of Mills and Stephenson (from Feb 00), the submission of a grant proposal to the Department for Business Innovation and Skills (BIS) in August 2002 and the subsequent rejection of the BIS proposal, all of which would inform the technical concepts for the CMD. The bi-monthly research meetings connected Stephenson's research interests and challenges with the research interest of Mills. These meetings connected Mills to the conceptual approach to chemistry in Unilever which was based on the idea of High-Throughput Screening and connected Stephenson to the organic synthesis research that Mills was developing at Liverpool. Whilst these meetings connected the technical concepts that informed the developing collaboration, they also connected organisational concepts as well. Stephenson "would explain Unilever" to Mills and the approach that was being taken to the restructuring of R&D and Mills would explain the working environment of the UoL Chemistry Department to Stephenson. These connections between scientific and organisational concepts provided the basis for the submission of a grant proposal to BIS in August 2002. This proposal specifically connected the concept of High-Throughput Screening with established bench chemistry that was practiced at the UoL chemistry department to offer a new concept of High-Throughput Materials Discovery. The rejection and revision of the proposal in December 2002 connected the concept of 'High-Throughput Materials Discovery' with other related concepts which meant that the proposal was transformed from the concept of a

technology platform and reconceptualised as a research centre. The concepts that were linked included other areas of chemistry research (Inorganic Chemistry and Polymer Science), other forms of activity (PhD studentships and Post-doc positions), dual organisational structure (separation of academic and technical staff) and multiple sources of funding (NWDA, ERDF, UoL, Unilever). This reconceptualization is presented in Fig. 6.1 which was taken at the meeting between Mills and Stephenson following the rejection of the BIS proposal.



Fig 6.1 Reconceptualization of Collaborative project- nascent CMD- December 02

Connecting Materials

When the NWDA agreed to support the project in May 2005, material elements that enabled the actualisation of the CMD were connected to the emerging relational complex. In particular, the event connected the relationships between the actors and the concepts of HT enabled chemical synthesis to £8m of funding. The £2m provided by the NWDA in this event released £2m from the ERDF which enabled the commitment of £2m from the UoL and £2m from Unilever. This funding enabled the material establishment of the CMD since it was used to purchase new analytical equipment (Mass Spectrometers, High-Performance Liquid Chromatography), as well as the bespoke robotic platform. It also enabled the refurbishment of the labs at the University of Liverpool where the CMD would be physically located. This event also connected to an explicit set of future, projected events that were enabled through the connection of material elements, such as 'the opening of the Centre' in 2006, 'the Centre providing service to Unilever researchers', 'the provision of assistance to local SMEs throughout 2006 through 2008' and 'the establishment of new spin-off firms' before December 2008. These particular future events were expressed as targets that had to be accepted as conditions of the NWDA investment. The event of the NWDA committing investment to the developing project in May 2005 meant that these future events became related to the project, contributing towards the definition of the organisational meaning structure (the strategic partnership)

Creating an Organisational Meaning Structure: Defining Meaning Structure Elements and Spatio-Temporal Trajectory

The signing of the SLA in December 2006 brought together the actors, materials and concepts that had coalesced into a project called the CMD and physically located them in a facility at the University of Liverpool. The SLA defined the roles and obligations of the actors, including Mills (Centre Director), Blanken (Business Development Manager), Stephenson (Unilever Group Manager), experimental officers and Unilever researchers. It outlined how the activities of these actors would be integrated and committed those actors to the realisation of those activities, for example by describing the decision-making framework (Lab Operations Group, Unilever Research Group, Strategic Oversight Group) that would underpin CMD activity. Furthermore, it brought together the concepts that had become enrolled in the CMD project (Open Innovation, High-Throughput Methods, Organic Synthetic Chemistry, Inorganic Synthetic Chemistry, Nanomaterials) together within a coherent organisational framework based on the idea of 'controlled access' through a 'credit-access system'. This conceptual element multiple actors to work with multiple different concepts (organic chemistry/ inorganic chemistry, nanomaterials) using the same material elements (analytical equipment/ robotic platforms/ technical support) to address their own issues (product innovation/ academic research/ enhancing regional innovation capacity). It also brought together the

material elements of 'the CMD', enabling the purchase of new equipment, the transfer of Unilever equipment from the Port Sunlight site and the physical re-location of Unilever research activity to refurbished labs in the department of Chemistry. These conceptual, material and social Meaning Structure elements coalesced in December 2006 when the CMD opened and established the 'Strategic Partnership' between Unilever and the University of Liverpool.

6.3 Organisational Meaning Structure reconfigured through Relationality and Activity.

In August 2012, a proposal was submitted to the Research Partnership Investment Fund that was being administered by the Higher Education Funding Council for England (HEFCE). The proposal was based on the construction of a new, state-of-the-art shred research facility at the University of Liverpool campus. It included capital investment from the University of Liverpool, the Research Partnership Investment Fund and Unilever. The proposed investment was £15m from the University, £11m from HEFCE and £25m from Unilever. Significantly, the social relationships, concepts and material arrangements underpinning this proposal were drastically different from those that constituted the CMD, which was the initial instantiation of 'the partnership' conceptualised here as an Organisational Meaning Structure. However, some of the core elements of the Organisational Meaning Structure remained and were in fact significantly reinforced in the submission of this proposal. The analysis below outlines how the connections between events served to alter the social, conceptual and material elements of the Organisational Meaning Structure (Activity) and how some of these connections also served to stabilise some of the established Meaning Structure elements (Relationality).

6.3.1 Activity: Events reconfigure Meaning Structure Elements

Activity of Events reconfigures Social Elements of the Organisational Meaning Structure

Several events were instrumental in reconfiguring the actors implicated in the Organisational Meaning Structure. Fist, an organisational restructuring at Unilever in late 2006 disconnected Stephenson from the partnership he helped to create. This disconnection was completed when Stephenson was hired as a full academic member of staff at the University of Liverpool, meaning he could no longer influence the activity in the CMD nor the decisions made in

relation to the collaboration. Both of these events (the organisational restructuring at Unilever and the exit of Stephenson) meant that a new actor became connected to the Meaning Structure. Daniel Jacobs assumed the role of relationship manager and was responsible for managing Unilever activity in the CMD. Later in February 2007, a decision to relocate all Unilever High-Throughput activity to the Port Sunlight site saw the appointment of a new 'lead for High-Throughput' which was undertaken by Dennis Green. Green therefore became connected to the Meaning Structure, since his formal role required that he develop internal capabilities that were complementary to those established with the CMD. Third, the retirement of Prof. Drummond Bone in August 2008 saw a reconfiguration of the actors associated with the Meaning Structure, firstly Jack Groves who was a key actor within the Meaning Structure in December 2006 left his position as PVC for the Faculty of Science and Engineering. He was replaced by Prof. Arnold Royle, who had been the Head of the Department of Chemistry during the construction of the CMD. The promotion of Royle to a faculty position led to the appointment of Mills as the new Head of Department of Chemistry. Thus, by the end of 2008 some actors had been disconnected (Stephenson, Groves, Bone), some been connected (Jacobs and Green) and some had been reconfigured such that they occupied different positions in the Meaning Structure (Royle and Mills)

Fourth, the early completion of the funding objectives in December 2008 meant that the NWDA and ERDF who had provided capital investment (material elements) to the Meaning Structure became disconnected, since their interests had been served. The disconnection of the NWDA and ERDF lessened the requirement for a business development manager, whose role was principally to ensure that the project delivered against the funding requirements. Based on successful achievement of funding targets and decreased demand for a business development manager, Peter Blanken was promoted to a new permanent position in the University. Blanken's position as director of Business Gateway meant that he became formally responsible for engagement with Unilever actors. In undertaking this role, Blanken connected with Daniel Jacobs, who was already implicated in the Meaning Structure by the Unilever restructure, and Henry Pizzorno who was an Open Innovation Director at Unilever.

Fifth, the development of a proposal for the Micro-Bio Refinery in April 2011, connected other Unilever researchers to the Organisational Meaning Structure, including Dr. Jean-Phillipe Courtois and Dr. Edward Gordon, who was leading the implementation of the 'Disruptive Sustainability' programme at Port Sunlight. The development of the MBR proposal and its relevance for the 'Disruptive Sustainability' programme meant that Courtois and Roberts had a role in designing the facility that would be located at the University, thus adding more actors to the emerging collaborative arrangement.

Sixth, meeting of the N8 in February 2012 also served to connect actors around the emerging collaborative arrangement. Specifically, this event brought Unilever's Head of Lab (Claire McIntyre) and Lead for High-Throughput (Dennis Green) into contact with Blanken, Royle and Richards. The submission of a proposal for the High-Throughput Formulation Centre reinforced the connection between Royle, Blanken, Green and McIntyre and connected the VP of Open Innovation Dr. Elliot Murray. In particular, this event connected the work of Green, McIntyre and Murray to the University decision makers Blanken and Royle and Mills.

Finally, the submission of the RPIF proposal in August 2012 served to reinforce the emerging actor-network. The proposal itself was developed by Mills, Blanken and Jacobs who were supported in their activity by senior decision makers including Royle and Richards at the University and McIntyre and Murray at Unilever. The submission of this proposal also connected senior university decision-makers with senior Unilever decision makers, including the VP for R&D (Geneviève Berger) and CEO Paul Polman. In particular, during the development of the proposal, University actors implicated in the developing project attended a dinner at the Port Sunlight lab where Unilever executives were introduced. The submission of the RPIF proposal also enrolled macro-agents into the actor network that constituted the social element of the Meaning Structure. For example, the Higher Education Funding Council for England (HEFCE) now became a stakeholder in the Meaning Structure through their investment of capital. Upon confirmation of the success of the proposal in September 2012, a joint-decision making body that consisted of individuals to represent Unilever interests and individuals to represent University interests was established and labelled the 'Joint Strategy' Board'. This board is considered an actor in the Meaning Structure since it 'made choices' relevant to the Meaning Structure, although this agency was dispersed across the agents that constituted it. Ultimately, no substantive decision about the meaning structure could be made without agreement of the Joint Strategy Board.

164

Thus, in light of the reconfigurations of the actor-network outlined above, the actors implicated in the Organisational Meaning Structure in September 2012 when HEFCE confirmed that the RPIF proposal had been successful were significantly different from those that were implicated in the initial Organisational Meaning Structure that was created through the event-formation in December 2006. In particular, Blanken, Mills and Jacobs were now the key actors in the conceptual development of the partnership, but other actors had become much more involved in the decision-making. These included, Arnold Royle and Jacob Richards at the University of Liverpool and Claire McIntyre and Elliot Murray at Unilever. Through these events, the social network evolved from one focused primarily on the connection between Mills and Stephenson to one that concentrated on the connection between Mills, Blanken, Jacobs, McIntyre, Murray and Green and more peripherally Roberts, Courtois and the Unilever VPs such as Geneviève Berger and Leonard Hart. It also included other macro-actors that could make choices about and act upon the Meaning Structure, including HEFCE, the Department for Business Innovation and Skills (through the Regional Growth Fund) and the 'Joint Strategy Board'.

Reconfiguring Conceptual Elements

Whilst the events identified in the previous section connected to reconfigure the social elements of the meaning structure, the conceptual elements of the Meaning Structure were also reconfigured by events. First, in February 2010, a 'brainstorming workshop' convened by Blanken and Jacobs brought together 30 Unilever researchers and 30 University academics for the first ever attempt to identify strategic research themes. The workshop identified three research themes that were deemed strategically significant for the participants involved including: 1) Water, 2) Energy Efficiency and Sustainability and 3) Health and Wellbeing. These three themes were to form the basis of the conceptual development of the collaboration. Second, in April 2011, the submission of the RGF2 proposal for the Micro-Bio Refinery specifically focused on research collaboration in the area of 'Sustainability'. In particular, it meant that the University actors would work with Unilever actors on developing bio-derived monomers and sustainability' became a core concept of the emerging Meaning Structure. Third, in May 2012, a proposal was submitted for the 3rd round of the Regional

Growth Fund which focused on the development of High-Throughput Formulation capabilities. The proposal highlights that the existing collaboration between the University and Unilever had been based on High-Throughput Synthesis and Characterisation but that there was no work on Formulation. This project added the concept of 'High-Throughput Formulation' and other derivative concepts (Bio-assay) to the conceptual element of the Organisational Meaning Structure.

Fourth, the launch of the Research Partnership Investment Fund by Chancellor George Osbourne enabled the development of a new concept for collaboration that was pursued initially by Jacob Richards, a joint research facility that would leverage this source of public funding. Whilst the launch of this programme in April 2012 did not create the MIF concept, it added the notion of an 'RPIF proposal' to the Organisational Meaning Structure which later manifest into the Materials Innovation Factory when other concepts and actors were related.

Finally, the submission of the RPIF proposal in August 2012 connected these novel conceptual elements ('Sustainability' and 'High-Throughput Formulation' and 'RPIF Project') within the one unified concept, the Materials Innovation Factory. It also saw the addition of novel conceptual elements to Meaning Structure including 'Genomics and Proteomics' as well as 'Nanomedicine' as key research themes of the Materials Innovation Factory. Thus, when the RPIF proposal was supported in September 2012, the conceptual elements that had previously included 'High-Throughput Synthesis and Characterisation', 'Organic Chemistry' and 'Inorganic Chemistry' now included 'Materials Innovation Factory', 'High-Throughput Formulation', 'Micro-Bio Refinery', 'Genomics and Proteomics' and 'Nanomedicine' as well as the established organisational concepts including: 'Co-location', 'Open-Access' and 'Bespoke Physical Infrastructure'.

Reconfiguring Material Elements

Several events connected to the event-formation over the period 2006-2012 that reconfigured the material elements of the Organisational Meaning Structure. First, in March 2011, Blanken and Jacobs agreed an extension to the CMD contract, which meant that another £2.3m would be invested in the facility by Unilever over a five-year period until December 2016. This enabled a renewal of the facilities and upgrades to some of the

analytical equipment that comprised the lab. Second, the success of the RGF Round 2 proposal in October 2011 meant that another facility would be established at the University of Liverpool Campus that would house the lab for the Bio-Refining Equipment. It also meant an additional investment of £2.8m from public sources via the Regional Growth Fund. Third, the success of the RGF Round 3 proposal for the High-Throughput Formulation Centre meant that another facility would be created although it was not clear where this would be located on the campus. The award of this grant added new equipment (robotic formulation platforms) to the existing high-throughput synthesis and characterisation capabilities. It also connected another £1.73m to the Meaning Structure through investment from the Regional Growth Fund. Finally, the success of the RPIF proposal in September 2012 drastically altered the material elements of the Meaning Structure. This event connected £11m of public funding, £25m of Unilever Funding and £20m of University funding to the Organisational Meaning Structure. It also meant that significant new physical infrastructure, in the form of a 10,000 sqft. building, including a whole Unilever lab with separate offices would be established on the University campus.

Thus, when the RPIF proposal was supported in September 2012, the Organisational Meaning Structure, constituted by Social elements (Actors), Material Elements (physical objects) and conceptual elements (ideas and concepts) was substantially different from the Meaning Structure in December 2006, yet it still reflected what was called 'the University of Liverpool-Unilever partnership'. While this heterogenous whole changed through the connection of several events which constituted the successful MIF proposal. There were several elements of the original Meaning Structure that were reinforced through the connections between events, which were also enrolled in the success of the RPIF proposal. These elements and their reinforcement through events are outlined in the next section.

6.3.2 Relationality: Events preserve Organisational Meaning Structure Elements and define developmental trajectory

Events define meaning structure elements and temporal trajectory of the meaning structure Whilst the connection of some events to the Meaning Structure reconfigured the conceptual elements, some events connected to the meaning structure served to reinforce some of the conceptual elements that were stabilised in December 2006. A number of events, including the successful submission of the RPIF proposal in September 2012 served to reinforce the core conceptual element of 'High-Throughput Materials Science'. Other events served to reinforce the conceptual model of collaboration established with the CMD in December 2006 (co-creation, co-location, open-access, differentiated facilities).

The core concept of 'High-Throughput Material Science' that was established with the CMD in December 2006 was reinforced by a number of events. First, in January 2007, the Head of Lab for Port Sunlight decided that the development 'High-Throughput' should be a key strategic priority for the Port Sunlight site. Thus, the key conceptual element of the Meaning Structure which was high-throughput synthesis became more central to the concerns of the Port Sunlight Lab, enhancing the significance of the CMD facility and the Meaning Structure in which it was an element. The concept of High-Throughput Material Science was further reinforced when a product was launched to market in March 2009. This product launch was based on the science that had been conducted at the CMD and working in High-Throughput mode with suppliers. The successful launch of this product served to provide a direct link between the conceptual elements of the Meaning Structure and the perception that High-Throughput was a viable means of conducting future research to enhance commercial performance, connecting conceptual elements of the Meaning Structure to future research activity at Port Sunlight (future events).

High-Throughput Materials Science became more important again in late 2010 following the launch of the Unilever Sustainable Living Plan and the associated 'Disruptive Sustainability' research programme. The ambitions outlined in the Sustainable Living Plan and the Disruptive Sustainability work programme reinforced the concept of High-Throughput since if the entire Home and Personal Care product range was to be reformulated by 2020, it would only be feasible with the application of High-Throughput methodologies. Therefore, the core concepts of High-Throughput synthesis and characterisation became entrenched in the developmental trajectory of events. In other words, the launch of the Disruptive Sustainability Programme defined a trajectory of events in which the conceptual elements of the Meaning Structure would be present.

Finally, the submission of the RGF2 proposal in April 2011 and the RGF3 proposal in May 2012, also served to reinforce the concept of High-Throughput Materials Science. In particular, the RGF2 proposal was based on the extension of High-Throughput methods to the discovery and synthesis of sustainable materials. Similarly, the RGF3 programme was based on extending the concept of High-Throughput to formulation issues, rather than synthesis and characterisation issues. Significantly, both of these projects reinforced the centrality of High-Throughput to the strategic research ambitions of Unilever, which served to build on the core conceptual element established in the initial Organisational Meaning Structure in December 2006.

Whilst these events served to reinforce the technical concept of 'High-Throughput', they also reinforced the organisational concepts that were core elements of the Meaning Structure that stabilised when the CMD was established, such as 'co-location', 'open-access' and 'shared infrastructure'. For example, the achievement of CMD funding targets in December 2008 demonstrated that the collaborative framework established by the credit-access agreement and the Service Level Agreement could enable the realisation of regional development goals. The launch of a new product to market in March 2009 also served to highlight the viability of this collaborative model for delivering commercial impact. The collaborative working model was also reinforced by the signing of a contract extension in March 2011, which was based on the same principles and access arrangements that were agreed in the initial December 2006 agreement, connecting this organisational construct to future activity. Furthermore, the three funding proposals submitted between December 2006 and August 2012 all invoked the collaborative framework. The RGF proposals (for the Micro-Bio Refinery and the High-Throughput Formulation Centre) recalled the same organisational concepts that were established with the CMD, based on the co-creation of differentiated physical infrastructure that would have dedicated technical staff and would physically colocated university and Unilever researchers. The key distinction between the RGF proposals and the PRIF proposal was that there was no academic leadership element in the RGF proposals, whereas the RPIF proposal included a distinct academic leadership element (consisting of Mills, Douglas, Stephenson, Hall & Sanchez-Lopez).

The submission of the three funding proposals also served to reinforce the material elements of the initial Organisational Meaning Structure. For example, the RGF proposals submitted in April 2011 and May 2012 respectively, were based on physical extensions of the CMD equipment profile, with one adding equipment that would enable bio-refining capabilities and one adding equipment that would enable analysis of formulations as opposed to individual materials. The transportation of High-Throughput equipment from the Netherlands to the Port Sunlight site in January 2007 also served to reinforce the material elements of the Meaning Structure. The physical location of specialised High-Throughput equipment at the Port Sunlight site meant that future developments of High-Throughout infrastructure would be located in Port Sunlight, reinforcing the connection between material elements of the Meaning Structure located at the University of Liverpool and the material elements of Unilever R&D.

Finally, some events also served to reinforce the social elements of the initial Organisational Meaning Structure, namely, the actors that were connected to the OMS and their relationships. First, the promotion of Mills to Head of Department served to enhance his authority in the University of Liverpool, giving him a role in the strategic direction of the department, including the RGF projects and the discussion about an RPIF submission. Secondly, the promotion of Blanken from his position in the CMD to a permanent senior role at the University of Liverpool enhanced his position within the University of Liverpool, also giving him a role in the deciding the direction of future collaborations with Unilever. In combination, these events meant that both Mills and Blanken, who had been key actors implicated in the initial Meaning Structure remained central to the unfolding events that were redefining the meaning structure, such as the submission of the two RGF proposals and latterly the submission of the RPIF proposal. The fact that Mills and Blanken remained and were in-fact relocated to positions of greater decision-making authority enabled them to preserve relations with other actors in the OMS (such as Jacobs) and helped ensure the retention of core OMS concepts that they were instrumental in defining, such as High-Throughput Materials Discovery and the Open-Access Model of collaboration.

The Relationality and Activity exerted by the events outlined above were critical to defining the successful RPIF Submission in September 2012, which brought together all of these disparate events into a unified collaborative project called the Materials Innovation Factory. Confirmation of the success of this proposal meant that the social, conceptual and material elements that constituted the Meaning Structure (the partnership) became fixed once again. The modified meaning structure and its elements are outlined below.

6.4 Organisational Meaning Structure 'fixed' in the establishment of the MIF

In April 2014, the Legal Framework for the MIF project was signed off by senior organisational actors. This event marked the transition of the Materials Innovation Factory from concept to operation. It meant that the funding that had been promised could be released so that work on the building project, the recruitment and the procurement of equipment could begin. It also meant that there was a greater degree of certainty about the future of the project in terms of clearly articulated ambitions, targets and deadlines. In short, it meant that the MIF became a reality for the actors involved, presenting another temporal stability that enabled actors to understand and act upon the 'the partnership'. The completion of the legal framework therefore temporarily fixed social, conceptual and material Organisational Meaning Structure elements. The Organisational Meaning Structure that became fixed in April 2014 included some elements that were already connected to the structure and that were reinforced through events. Other connections between events introduced some novel elements that altered the Meaning Structure from its previous iteration that was stabilised in September 2012. Analysis presented below outlines how the Meaning Structure became fixed through preservation of some elements and the addition of novel elements that were connected by events.

6.4.1 Activity: Events reconfigure Organisational Meaning Structure Elements

Social Elements Reconfigured

Several events between September 2012 and April 2014 connected new elements to the Organisational Meaning Structure that was stabilised in the signing of the legal framework. First, another organisational restructure of Unilever R&D saw Daniel Jacobs promoted to a different role. The change in role meant that Jacobs would no longer have formal responsibility for the management of the relationship with the University of Liverpool, disconnecting him from the Organisational Meaning Structure which he had previously been a central actor. This disconnection of a key actor culminated in the connection of a new actor

to the Meaning Structure. In January 2013, the JSB reached the decision to co-ordinate a 'partnership event' that aimed to generate investment from potentially interested 3rd party organisations. The motivation for more 3rd party investment was due to the reappraisal of the business case at Unilever, the idea being that if 3rd party investment could be leveraged it reduced the costs (and therefore the risks) to Unilever R&D and made the business case more compelling. Mark Ward was asked by his line manager Elliot Murray to co-ordinate the partnership event, connecting him peripherally with Organisational Meaning Structure with which he had no prior involvement. In February 2013, Murray asked Ward to draft a job description for a full-time project manager for the Materials Innovation Factory project, which he did. At the end of March 2013, this position had been advertised and remained vacant. In co-ordinating the partnership event and job description Ward had become more connected to the Meaning Structure and requested that he undertake the project management role that remained unfilled. Thus, these events: The organisational restructure which disconnected Jacobs, the co-ordination of a partnership event and the failure to recruit a full-time project manager from one of the Unilever research groups served to connect Ward to the emerging Meaning Structure, redefining one of the key social elements.

Second, in February 2012, Blanken received a report from the project manager he had assigned to the MIF project. Blanken had been central to the Meaning Structure in past iterations but had become more peripheral following the successful submission of the RPIF proposal. Following the update, Blanken became concerned that the project was proceeding at risk due to the failure to agree legal terms, which meant that the proposal was unsecured. Following this report, he requested to be seconded to the project and once again became a central actor within the Meaning Structure, the project manager that had been appointed who had been a member of the JSB became disconnected from the Organisational Meaning Structure entirely. Third, the Joint-Strategy Board was restructured in June 2013, led by the newly connected actors. This restructure saw the creation of a new subcommittee that was responsible for oversight of the biological components of the MIF project (Genomics and Proteomics) and connected the Director for the Centre for Genomics (Prof. Trent Sweeting) and Unilever's lead for Microbial research (Jean White) to the Meaning Structure.

Fourth, a new Head of Lab for Port Sunlight was appointed in August 2013 after McIntyre decided to step down for personal reasons. This meant that McIntyre, who had been a central actor in the development of the Organisational Meaning Structure became disconnected and could no longer effect the Meaning Structure in the way that she had done previously. In sum, these events contributed to a fundamental reconfiguration of the actors connected within the Meaning Structure, fundamentally changing 'who' the partners were. The connection of Ward and re-connection of Blanken to the Meaning Structure changed the core social relationship, with the relationship between these two actors constituting the key interface between the respective stakeholder organisations. The disconnection of McIntyre and Jacobs reflected the loss of two key actors who had been instrumental in shaping the Organisational Meaning Structure in September 2012 but who were now unable to act upon the Meaning Structure.

Conceptual Elements Reconfigured

The appointment of external legal counsel by Ward in May 2013 and the addition of Blanken to the JSB also connected new concepts to the Meaning Structure. Specifically, Organisational concepts including an 'Agreement to Lease' and 'Service Level Agreement' became connected to the Meaning Structure. In fact, following the connection of Ward and Blanken to the JSB, these organisational concepts became more central to the Meaning Structure than the 'technical' concepts that had been central to previous Meaning Structure iterations such as the scientific research areas and the technical design of the facility. The 'Agreement to Lease' reflected a new organisational concept that would structure interaction during the construction phase of the building process. Similarly, the signing of the SLA in April 2014 connected novel organisational concepts to the Meaning Structure, for example, the concept of 'annual business planning' became connected in the signing of the SLA, which enrolled numerous associated concepts such as 'Key Performance Indicators', 'Vison', 'Aims', 'Mission', 'Procurement planning', 'staffing planning', 'capability development planning', 'business development planning' and 'annual financial accounts and forecasts'. The SLA also defined and connected concepts such as the 'Unilever Client Group', the 'Academic Leads Group', the 'MIF Board' and the 'MIF Chair' which would constitute the governance of the Meaning Structure. The definition of the Legal Framework which was completed in April 2014 was constituted primary through the connection of these novel Meaning Structure elements

that were connected through the events identified above. However, the signing of the legal framework was also constituted by the linkages between these novel Meaning Structure Elements, past Meaning Structure elements and projected (future) Meaning Structure Elements that were connected through the events outlined below.

6.4.2 Relationality: Events Define Meaning Structure Elements and developmental trajectory

Some events that were prehended in the completion of the Legal Framework for the MIF in April 2014 reinforced the connections between actors, concepts and material elements of the Organisational Meaning Structure. As well as recalling previously enrolled Meaning Structure elements, these events also invoked future potential events, defining the developmental trajectory of the Organisational Meaning Structure, culminating in the stabilisation that occurred in the signing of the legal framework.

First, some events reinforced previously enrolled material elements of the Meaning Structure. For example, the re-appraisal of the business case that was initiated in February 2013 recalled the commitment of £20m capital that was enrolled in the submission of the RPIF proposal. It also elaborated on future material elements of the Meaning Structure, such as the expenditure of this capital on the creation of a new facility and the impact of this material facility on the Unilever research groups. The re-appraisal of the business case reinforced the relationship between the material element of the Meaning Structure (capital expenditure and physical facility) and the future research activity of Unilever researchers at the Port Sunlight site, articulating how 'the partnership' would relate to future Unilever activity.

Second, the commitment of more capital funding from the University SMT also reinforced the material elements of the Meaning Structure. This event reinforced the capital commitment that had already been enrolled in the Submission of the RPIF proposal and expanded the actual physical building by 1,300sqft. Furthermore, the connection of such significant material resources to the Meaning Structure signified that the MIF project would be more intertwined with the long-term research strategy of the University of Liverpool, which identified 'Materials Science' as a research priority area in a 10-year strategic plan. Similar to the

reappraisal of the business plan in Unilever, this event enhanced the significance of 'the partnership' to the future activity of the connected stakeholders.

Other events reinforced the social elements of the Meaning Structure. For example, the intensive SLA workshops in August 2013 forged a relationship of trust between Blanken and Ward (who were connected to the Meaning Structure by other events) which became increasingly central to the Meaning Structure. These meetings cultivated a personal relationship between Blanken and Ward, including the development of shared heuristics that were used to make sense of the emerging MIF project. These workshops also connected Ward and Blanken to the future of the Meaning Structure by linking these actors to the legal framework that would define the developmental trajectory of the partnership.

Fourth, the meeting between Blanken, Dowdall and HEFCE recalled conceptual elements of the Meaning Structure, in particular 'the SLA', 'the Agreement to Lease' and 'the Lease'. The meeting with HEFCE confirmed the final date for the drawdown of HEFCE funding which highlighted the significance of these conceptual elements. The meeting demonstrated that without these conceptual elements, the MIF project would be at risk of losing funding, which would constitute a fundamental reconfiguration of the Meaning Structure (i.e. disconnection of material elements in the form of HEFCE funding). Thus, the meeting with HEFCE connected existing conceptual elements with the future developmental trajectory of the partnership, enhancing their centrality to the Organisational Meaning Structure.

Finally, the signing of the legal contracts (SLA and the Agreement to Lease) were critical in linking Meaning Structure elements. The signing of the Agreement to Lease in January 2014 linked conceptual and material elements that were enrolled in the RPIF proposal to future events, providing stability and continuity to the Meaning Structure. It linked the concept of the 'Materials Innovation Factory' as a specialised research facility integrating researchers from the University of Liverpool to projected future events including; the signing of the Service Level Agreement, the appointment of contractors and project managers, the practical completion of the building, the activation of the Lease and the non-completion of the building (Longstop-date). It defined the material elements of the Meaning Structure by connecting capital investment to the building project which enabled the commencement of the building activity. It also reinforced the relationship between the two abstract actors Unilever and the University of Liverpool, by entangling the activities of these stakeholders in contractual terms, ensuring the future activities of these actors would be interrelated for at least two years.

Similarly, the signing of the Service Level Agreement in April 2014, connected previously enrolled Meaning Structure Elements to future events. The signing of the SLA recalled conceptual elements from the establishment of the CMD, such as the 'Credit Access System' and the 'dual leadership structure' and an 'open access area' and connected them with the operation of the Materials Innovation Factory. It also recalled conceptual elements of the Meaning Structure that were connected in the Submission of the PRIF proposal, such as 'High-Throughput Formulation', 'Organic Chemistry', 'Inorganic Chemistry', 'Sustainability', 'Genomics and Proteomics' and 'Nanomedicine' and outlined how these concepts would be interrelated in the Materials Innovation Factory through connecting them to labs and individual actors. Other concepts from the Regional Growth Fund projects were also recalled in the SLA, with the 'High-Throughput Formulation Centre' and the 'Micro-Bio Refinery' being related to the future development of the MIF through an integration plan. The signing of the SLA also defined material elements, namely the capital committed by stakeholders by elaborating a detailed spend profile over a future 5-year period, detailing expenditures on building contributions, rent prepayments and access fees. The signing of the SLA also linked the capital element to more specific material elements through defining lab specifications of the MIF facility, the equipment list and the staffing profile. Similar to the signing of the Agreement for Lease, this event fixed the emerging Meaning Structure by linking established elements to future projected events, further entangling the activity of Unilever and University of Liverpool and providing a developmental trajectory for the Organisational Meaning Structure.

6.5 Organisational Meaning Structure reconfigured again through Relationality and Activity of Events

In April 2017, the Materials Innovation Factory was opened at the University of Liverpool and Unilever R&D researchers began to occupy the facility. When the MIF opened in April 2017,

the technical capabilities and ambitions as well as the actual material infrastructure was substantially different from that which was envisioned in the SLA and the Business Plan in April 2014. This section illustrates how the social, conceptual and material elements of the Meaning Structure were redefined through the activity of events. It also illustrates how events served to stabilise these Meaning Structure elements by recalling the past and defining the future. It was through this relationality and activity that the Organisational Meaning Structure was redefined and stabilised in April 2017.

6.5.1 Activity: Events reconfigure Actors, Concepts and Materials

Reconfiguration of Actors

Several events redefined the social elements (actors and their relationships) of the Meaning Structure between April 2014 and April 2017. Events engaged in this re-definition by; connecting new actors, disconnecting established actors and by re-defining the relationships between previously connected actors. For example, actors were connected to the Meaning Structure through the recruitment of MIF Technical Support staff in November 2014 and March 2015. These events connected Martin Gerrard and Jon Ware to the Meaning Structure, creating a new macro-actor that was called the "MIF Technical Team" which became responsible for implementing procurement plans. Another macro-actor was formed when the "E-Science Team" met in August 2014. This event connected previously entangled actors (Mills, Blanken, Ward) but in a new way, framing their attention on the IT infrastructure that would be required for the realisation of the MIF technical ambition. This establishment changed the nature of their interactions which differed for example, at JSB meetings, where their attention was not explicitly on the IT requirements, or in the other events outside of the Meaning Structure, for example Mills as a lecturer, Blanken as a business development manager and Ward as an R&D director where there relations were much less pronounced. Patricia Lyle became connected to the Meaning Structure by the commission of a work package to explore the High-Throughput capabilities and requirements in March 2015. Lyle would later become the Director of the University of Liverpool's Technology Transfer Office (Business Gateway) through this initial connection. The appointment of a Unilever Programme Director connected Barney Jackson to the Meaning Structure in March 2015,

changing the involvement of Ward who would be less involved in the future integration of Unilever work with the new facility.

Another major reconfiguration of the actors constituting the Meaning Structure occurred through the retirement of Jacob Richards in February 2015. Richards had previously been highly influential in the Meaning Structure in deciding to pursue an RPIF submission. His retirement disconnected him from the Meaning Structure and ensured he would not be implicated in future events. It also reconfigured the position of other actors within the Meaning Structure, first by connecting Janet Beer who was appointed the new Vice-Chancellor. Second, by disconnecting Arnold Royle who was Chair of the JSB, Royle became disconnected following differences with the ideology of Beer and left his role formally in June 2015. This meant that Moss, who had been a more peripheral actor within the Meaning Structure became more central to future activity, since he assumed the role of Chair of the JSB and Chair of the MIF Board that had been vacated by Royle.

More macro-actors were connected the Meaning Structure by the informal agreement to become a "Royce partner" in December 2015. This agreement connected the Royce Board (and its individual members) with the Meaning Structure, since that Board could make decisions related to the future equipment portfolio of the MIF through the fund that would be provided by the partnership, more peripherally, it implicated the University of Manchester within the Organisational Meaning Structure. Finally, nine new academics became connected to the Meaning Structure following the completion of the third recruitment round in April 2016. The academics appointed were supported by MIF funding and would be responsible for future research activity within the facility.

Reconfiguration of Concepts

The relation of some events fundamentally reconfigured the conceptual elements of the Organisational Meaning Structure and the technical ambition of the Materials Innovation Factory by connecting the concepts of "Computer Aided Materials Science (CAMS)" and the "Formulation Engine". The meeting of the "E-Science Team" in January 2015 first connected the concept of Computer Aided Materials Science to the Meaning Structure. At this meeting the IT requirements for the MIF facility were first considered. Mills invoked the submission of

a large EPSRC Programme Grant in August 2014 to connect the notion of 'integrated computational chemistry' and high-throughput experimentation' to the MIF. Ward also presented the idea of a "MIF Operating System" that would facilitate the user engagement and design of workflows. At this meeting, these two conceptual elements were combined in to what was called "Computer Aided Materials Science". The connection of this concept meant that the technical priority would be on 'modularity' meaning that different pieces of equipment could be separated and combined in different ways for different purposes. The completion of the 1st Equipment Report in March 2015 produced a set of equipment that was inconsistent with the modular concept of CAMS, therefore the stage-gated procurement process that was conceptualised in the SLA in 2014 was abandoned (disconnected) as were to conceptualisations of different capabilities that were outlined in the SLA. In April 2015, following the report by Lyle, the equipment proposals were re-defined so as they were consistent with the CAMS concept. These conceptual categories for equipment included 'Make, Measure, Standalone, Modular, IT and Automation'. The automation component was defined as the "Formulation Engine" and formed a key component of the CAMS ambition. Other subsidiary concepts connected under the CAMS label included an 'e-lab book' and a 'data handling and storage system' as well as a 'booking and scheduling system'.

Other events disconnected concepts, such as the termination of the Micro-Bio Refinery contract in December 2015, which meant that 'the MBR' was lost from the Meaning Structure, although some of the equipment (material elements) that were connected with this concept were reconnected to the MIF when the building was completed in January 2017. Similarly, the termination of the CMD contract in April 2016 saw the disconnection of 'the CMD' from the meaning structure, which was now based on 'the MIF' and its associated conceptual elements.

Reconfiguration of Materials

The Material elements of the Meaning Structure were changed by the connection to the Sir Henry Royce Institute. This connection was established by an informal agreement between Brad Moss and his counterpart at the University of Manchester in December 2015. The connection with the Royce institute added another £10m capital to the Meaning Structure that would be spent on analytical equipment which would be located in a discrete lab in the
MIF building called "Royce @ MIF". The other major alteration of material elements occurred when the offer was made by Ward to Blanken for the licence of Unilever proprietary software. This offer was made in May 2015 and connected another material element in the form of a bespoke data handling and experimental design software package. Finally, the practical completion of the Materials Innovation Factory building in January 2017 connected a new physical space to the Meaning Structure.

6.5.2 Relationality: Events stabilise actors, concepts and materials

Events also contributed to the stabilisation of different Meaning Structure Elements. In particular, once the concept of Computer Aided Materials Science had been connected by the meeting of the e-science team, it was reinforced by several connected events. For example, in May 2015 Mills and Douglas' proposal for the EPSRC programme grant on integrating computational and experimental approaches to materials discovery was successful. This event ensured that the future work undertaken by Mills and Douglas (two OMS actors) would focus on the concept of Computer Aided Materials Science. The CAMS concept was further reinforced by the successful proof-of-principle test in June 2015 which demonstrated that it would be technically possible to transfer the Unilever software that had been offered as an underpinning asset of the CAMS concept. The sign-off on the re-defined equipment proposals by Murray and Mills in September 2015 also served to reinforce the CAMS concept by articulating how CAMS would be realised through particular pieces of equipment that were to be purchased before April 2017. This included a sign-off on the procurement of the 'Formulation Engine', commenced in November 2015. The most emphatic stabilisation of the CAMS concept occurred when the MIF Board signed off the 2nd Business Plan in May 2015. This business plan clearly and explicitly articulated the concept of Computer Aided Materials Science and emphasised its centrality to the MIF project. It also elaborated a timescale for the realisation of the CAMS ambition both for the MIF opening in 2017 and a broader ambition for 2020. The sign-off of the Business Plan indicated that the senior decision-makers were supportive of the concept and ensured that the operationalisation of the plan to realise CAMS by April 2017 could progress. The signing of the Cross-Licence agreement for the 'FLEX' software platform also served to reinforce the concept of Computer Aided Materials Science. This event connected to future events such as the transfer of the software as well as the installation and upgrading of the software to ensure that the 'computational' aspects of the collaboration would be maintained over the coming years.

Material elements were stabilised by the practical completion of the MIF facility in January 2017, which meant that the Lease agreement became active, connecting new physical infrastructure with the Meaning Structure. The agreement between Mills, Moss and the Royce Board about the governance framework for the Royce engagement also served stabilise the material elements of the Meaning Structure. Up until this point, there was uncertainty about the availability of capital funding from the Royce partnership, but following the agreement on governance principle, a plan for the investment of the Royce capital in specific pieces of analytical equipment was created. In sum, the events described above 'stabilised' the conceptual and material elements by locating them in spatio-temporal terms (i.e. in procurement plans, licence terms and development plans, new physical infrastructure).

6.6 Conclusion

In sum, this chapter has elaborated the mobilisation of an events-based framework for the analysis of organisation and change. It demonstrates that strategic partnerships can be usefully reconceptualised as event-formations that are both stabilised and changed by the work of events (prehension). In particular, I have demonstrated that the work of events contributes towards the stabilisation of organisation by defining different meaning structure elements (actors, concepts, materials) and locating them in spatio-temporal terms by connecting past and future events. This spatio-temporal stabilisation is reflective of the 'noun-making' activity suggested by Bakken and Hernes (2006) and is considered here as a mode of prehension called 'relationality' (following Weik, 2011). I have also demonstrated that the work of events serves to reconfigure stable meaning structures by connecting and disconnecting elements (actors, concepts, materials), showing that 'partnerships' and their constituent elements are in actuality always in-formation. I show that what an alliance is (actors, concepts, materials) is constituted by the connections between events. In other words, what an alliance is, is determined by how the alliance becomes. The next chapter explores the implications of this chapter and the analysis presented in Chapter 5 for the research questions posed in Chapter 4.

Chapter 7: Implications for theorising organisational change, strategic alliance development and university-industry partnerships.

7.1 Introduction

As Chapter 2 illustrates, there exists a large corpus of literature focused on the interactions that take place between universities and organisations. Chapter 2 also shows that the primary concern of this existing literature is with the commercialisation of academic research via technology transfer, such as the patenting and licensing of academic research and the establishment of spin-out firms by university academics. There is less research that is focused on what has been termed 'academic engagement' or what may broadly be described as university-industry research collaboration. Even within this subset of the university-industry interaction literature, the primary focus has been on identifying the antecedent factors that drive engagement in transactional, one-off collaborations. As highlighted in Chapter 2 (Section 2.4), individual, organisational and environmental factors have been identified as

important drivers of university-industry collaboration. An emerging research stream has defined 'University-Industry Research Alliances' (Bercovitz and Feldman, 2007) or 'Research Partnerships' (Perkmann and Schildt, 2015; Perkmann and West, 2015) as a differentiated form of collaboration. Whilst we understand the dimensions of research partnerships and some of their technical and organisational characteristics, we still know very little about how university-industry research partnerships emerge and develop over time (Perkmann and Schildt, 2015; Perkmann and West, 2015). Therefore, the primary research question addressed in this thesis is:

"How do University-Industry Strategic Research Partnerships emerge and develop over time?"

In order to answer this overarching research question, a number of conceptual and theoretical issues require attention. First, theoretical notions of 'emergence and development' needed to be fully considered. Thus, it became important to consider issues related to process studies "which address questions about how and why things emerge, develop grow or terminate over time" (Langley et al, 2013 p.1). Second, the notion of 'Strategic Research Partnerships' required theoretical clarification; thus it became important to consider the wider literature related to research partnerships and strategic alliances, particularly on that which has attempted to offer theoretical accounts of the alliance development process. Consequently, I posed several ancillary questions that, when answered, would enable a theoretically informed understanding of university-industry research partnership development. For clarity, these ancillary research questions were:

- How can a Whiteheadian process perspective contribute towards more holistic understandings of organisational emergence and development (organisation and change)?
- 2) How can the development of strategic alliances be understood processually?

Finally, the insights from addressing these questions can be used as a basis to answer the question of:

3) How can processual understandings of alliance development contribute to theorising the emergence and development of university-industry research partnerships?

This chapter provides detailed answers to these research questions in light of the empirical findings presented in Chapters 5 and 6. As suggested by the ordering of the questions above, the current discussion begins with a focus on the theoretical issues related to organisation and change which are distilled down to more empirical insights that elaborate the process through which university-industry research partnerships emerge and develop. The chapter is therefore structured as follows: First, I elaborate the implications of adopting an explicitly Whiteheadian process ontology for theorising organisational emergence and development (otherwise termed organisational change). Second, I reflect on the implications of this ontological shift for theorising the process of strategic alliance development, highlighting the divergences from current theorising and the advantages of such 'conjunctive theorising' (Tsoukas, 2017) for enriching our understanding of alliance development processes. Third, I outline the implications of this processual perspective on strategic alliance development for understandings of university-industry research partnerships and university-industry collaboration more broadly, suggesting an 'unowned' (MacKay and Chia, 2013) model of university-industry partnership development Table 7.1 provides an overview of how this chapter attempts to move from theoretical abstraction to the empirical phenomenon in order to answer the overarching research question.

	Research Question	Key Theoretical	Key Literature	Associated
Alberture et /		Constructs		Chapters
Theory	How can	Events,	Whitehead 1929; Hernes,	3, 4, 6
	Whiteheadian	Prehension	2014; Weik, 2011; Hussenot &	
	process metaphysics	(Relationality	Missonier, 2015	
	contribute to new	and Activity),		
	insights to theorising	Organisational		
	organisational	Meaning		
	change?	Structures		
	How can processual	Organisational	Hernes, 2014; MacKay & Chia,	3, 4, 5
	approaches to	Meaning	2013; De Rond & Thietart,	
	organisation	Structures,	2007; De Rond & Bouchicki,	
	contribute new	Event-	2004; Ring & Van de Ven, 1994	
	insights to theorising	formations,		
	strategic alliance	Choice, Chance,		
	development?	Determinism		
	How can processual	Unowned	De Rond & Thietart, 2007;	1, 4, 5
	theories of alliance	process,	MacKay & Chia, 2013;	
	development	Agency,	Perkmann et al, 2013;	
	contribute towards	Chance,	Perkmann & West, 2015;	
Concrete/ Empirical Phenomen	theorising	Environmental	Perkmann & Schildt, 2015;	
	university-industry	Determinism,	Thune & Gulbrandsen, 2014;	
	collaboration?	University-	Philbin, 2008; Ankra & Al-	
		Industry	Tabbaa, 2015	
		Research		
		Partnerships		

Cor Em Phe

Table 7.1 Chapter Overview

7.2 Towards the integration of 'Being' and 'Becoming': Events as the agents of process The purpose of this section is to explore, in more detail and with regards to previous literature, how examining emergence and change from a Whiteheadian lens can contribute to more holistic understandings of organisation and change. Issues of emergence and development are the principal concerns of process researchers (Langley et al, 2013; Langley, 1999; Van de Ven and Poole, 2005. They can play a central role when understanding the development of organisational forms such as the partnerships between universities and businesses, where entitative conceptions of organisations and individuals as separate and clearly demarcated increasingly fail to account for the fluid and transitional processes at play in the formation of something new.

My analysis presented in Chapter 6 demonstrates the apparently fixed 'properties' of alliances that, in entitative theories of alliance development, determine developmental trajectories are in fact fluid. The particular 'properties' that are fluid in this instance are actors, concepts and materials. My analysis shows that 'actors' are only recognisable as 'actors' because of *prehensions between events*. For example, in Section 6.2.1, I describe how the event 'CMD Established' in December 2006 connected to several past events including: the dinner at Cambridge in Jun 1999; the bi-monthly research meetings between Mills and Stephenson; the agreement between Stephenson, Groves and Henderson; the investment of the NWDA in August 2004; the appointment of a Business Development Manager in January 2006'. It was through these accumulated encounters, that were connected in the 'Establishment of the CMD' that these individuals became 'actors' within the emerging Organisational Meaning Structure. When the CMD was established in December 2006, these previous encounters were given coherence. For example, it was only when the CMD was established in December 2006 that the relationship between Mills and Stephenson (instantiated through previous events such as 'the dinner at Cambridge' and the 'bi-monthly research meetings') became meaningful, as they became 'key collaborators driving the CMD'. Up until this point, this relationship was peripheral and the monthly meetings and research exchanges were of no more significance than any other event involving individual scientists exchanging research ideas. Similarly, in the 'establishment of the CMD' in December 2006, Groves and Henderson became the 'key organisational sponsors' of the CMD, giving meaning to their previous encounters that occurred in 2004. Likewise, in 'establishment of the CMD', the NWDA became 'a stakeholder' in the emerging meaning structure. The point is, that outside of this event [Establishment of the CMD in December 2006], these individuals and organisations were not defined (or did not exist) in the same way, that is to say they were not 'actors'. For example, the NWDA did not exist as a stakeholder in the CMD, Mills and Stephenson did not exist as individuals delivering innovative collaboration, Groves and Henderson were not key organisational sponsors for investment in open innovation. All of these actors were realised in this way in the 'establishment of the CMD' in December 2006 which defined them as *meaning structure elements*. To summarise, it is the connection of 'the establishment of the CMD' in December 2006 to all of these events that gave the previous encounters coherence and defined the individuals and organisations as 'actors' within the meaning structure of 'the University of Liverpool-Unilever Research Partnership'.

As illustrated above, the process theory I am advocating suggests that it is the *prehension* between events that creates organisational meaning structures (organisational stabilities) which define social, conceptual and material elements of the organisation (or the partnership in this particular case). I have already outlined how events do this through connecting to past events, which define stable meaning structure elements (such as actors) but they also define meaning structure elements by connecting to future events. It is through the prehension of future events that meaning structure elements become fixed in temporal terms. For example, in section 6.4.2 I outline how 'the completion of the Legal Framework for the MIF' in April 2014 invoked several future events, at which social, conceptual and material elements were to be present. To elaborate, 'the completion of the legal framework' (within the SLA agreement) identified Mills as the Director of the MIF and outlined the numerous events at which he would be present, including submission of the annual business plan every April for the next 5 years and annual meetings of the MIF Board. The 'Agreement to Lease' outlined the presence of 'Unilever representatives' at the meetings of the project control group to oversee the completion of the capital works project. The SLA also indicated that there would be three Unilever Vice-Presidents who would be present at the annual meetings of the MIF Board. All of these connections to anticipated future events (annual MIF Board meetings, submission of annual business plans every April, meetings of the Project Control Group) served to reinforce each actor's entanglement with the meaning structure.

The entangled material elements of the meaning structure, such as the £20m capital investment from Unilever and the previously built high-throughput equipment were also temporally located by the connection that 'the completion of the MIF Legal Framework' made to future events such as 'the Longstop Date'; 'The completion of equipment reports (3)'; 'the activation of the lease' and 'the integration of the CMD'. The capital material elements were defined by relations to particular events such as 'the commencement of the construction programme' which connected that £20m capital to a particular expenditure at specific points in time. Similarly, the high-throughput platform that constituted another key material element in the meaning structure was defined by the connection of past events (construction

of robotic platform for CMD; construction of high-Throughput Formulation Centre) to future events (e.g. opening of the MIF, Unilever move in date) through an 'integration plan' that was outlined within the Service Level Agreement. The articulation of plan connected these past and future events, ensuring that the equipment would be present at a particular point in time in the future where it would be a material element in the Organisational Meaning Structure. The connection between the 'Completion of the Legal Framework' in April 2014 and 'the Longstop Date' in December 2017 also served to locate material elements, such as the actual MIF building to particular points in time, in this case the building (material element) would be present at this envisaged future event (Longstop date) in December 2017 contributing to the stabilisation of the Organisational Meaning Structure.

Completion of the MIF Legal Framework in April 2014 also connected existing conceptual elements to future events, such as the completion of the MIF Building, the recruitment of new members of staff and the meetings of the MIF Board. For example, the previously entangled conceptual elements such as 'High-Throughput Formulation' and 'University-Industry collaborative research' were implicated in the vision outlined in the MIF Business Plan, which formed part of the MIF Legal Framework. The vision that was articulated was as follows:

"To create a world leading University research and business innovation hub in materials chemistry and high-throughput materials and formulation research" (MIF SLA-Schedule C, April 2014).

These concepts were also articulated in the aim:

"To create shared central analytical facilities, a new high-throughput formulation laboratory, and maximise usage and leverage for the University's pre-existing, leading capabilities in molecular biosciences, as well as integrating these with highly successful research facilities such as the Centre for Materials Discovery" (MIF SLA-Schedule C, April 2014) Scientific concepts such as 'organic chemistry', 'inorganic chemistry', 'nanomedicine', 'sustainability' 'high-throughput formulation' and 'sequencing' were also explicitly outlined in Schedule C of the SLA as the core future activities of the MIF. In particular it is highlighted that:

"The materials activities of the MIF will be based around six research specialisms where the University of Liverpool has or is establishing world-class strengths, including: Organic Materials, Inorganic Materials, Nanomedicine, Sustainability, High-Throughput Formulation and Sequencing" (MIF SLA- Schedule C, April 2014)

These scientific conceptual elements were also connected to the future recruitment and resource plans of the University:

"The University will reflect its significant investment in the MIF with a commitment to strengthen the relevant academic research base through the resource plans of the Faculty of Science and Engineering in particular, towards fully realising the benefits of the MIF. The immediate priority for investment is in Formulation, as mentioned above. Advances in materials made by Unilever and University of Liverpool researchers and other business partners will need strong characterisation and measurement capability. The MIF will accommodate a powerful suite of instrumentation, suggesting that one area which will need to be strengthened is separation, characterisation and analytical science" (MIF SLA-Schedule C, April 2014).

Organisational concepts entangled in the Meaning Structure, such as 'open access' and dual 'governance structures' were also defined with reference to future events, that were connected to the completion of the MIF Legal Framework, such as: the quarterly meetings of the MIF Board, the appointment of a permanent Managing Director and activation of the operationalisation of a credit access system, all of which were outlined in the SLA.

These examples are provided to illustrate that it is the connecting activity of events that brings the organisational meaning structure elements together and defines them by locating them in spatio-temporal terms. It is this *prehension of* past and future events which establishes connections between meaning structure elements that is reflective of Weik's (2011) notion of 'relationality'. To recap Weik (2011 p.668) suggests that "relationality refers to the retaining capacity of the process...it links the different states in the process". In light of the events-based theory I am advancing here, I suggest that 'relationality' characterises one mode of prehension. To clarify, I suggest that one of the ways 'prehension' functions is to link different (past and future) states, connecting meaning structure elements and 'stabilising' organisation by locating elements in time and space. It is this mode of prehension that is responsible for the stabilisation of organisation (in spatio-temporal terms), allowing actors to perceive and intervene in meaning structure.

However, as illustrated in the previous chapter, prehensions not only serve to produce organisational stability (meaning structures) through connecting meaning structure elements and locating them in spatio-temporal terms. Prehensions also serve to reconfigure, or modify the relations between connected meaning structure elements. It is this mode of prehension, that accounts for the innovative aspect of change. Whilst 'relationality' serves to connect events and meaning structure elements, the alternative mode of prehension serves to modify the nature of the connections between events and meaning structure elements. I use the term 'activity' to characterise this second mode of prehension again following Weik (2011 p.668) who defines 'activity' as "a comparatively undetermined force, a dispersed activity not limited to human agency" that is "responsible for the innovative part of change".

Here, prehensions change the connections between events that constitute the meaning structure and in so doing change the meaning structure elements. For example, the organisational restructuring of Unilever R&D in January 2007 connected to 'the establishment of the CMD'. In so doing, it changed the significance of events related to the development of a relationship between Mills and Stephenson (e.g. the dinner in Cambridge, the bi-monthly research meetings, the agreements they reached with Henderson and Groves etc). It did this by disconnecting Stephenson from the management of the CMD project, which meant that his relationship with Mills, which had been produced through the events connected above, became inconsequential for the meaning structure. Thus, the events that were highly significant in producing the initial meaning structure when connected in 'the establishment of the CMD' in December 2006 now became unimportant for the meaning structure. The

restructuring of Unilever R&D in January 2007 defined Daniel Jacobs as an actor and made the interactions between Blanken and Jacobs more significant than the interactions between Mills and Stephenson at that point in the meaning structure.

Another example of the 'activity' mode of prehension can be observed in the connection between the 'meeting of the e-science team' in January 2015 with other events that constituted the meaning structure such as 'the completion of the MIF legal framework', 'the completion of the stage one equipment report' and 'the signing of the FLEX cross-license agreement'. The initial meeting of the E-Science team defined the concept of 'Computer Aided Materials Science' as a conceptual element of meaning structure. Thus, previous events that had defined the meaning structure such as 'the completion of the first business plan' and 'the agreement on the procurement process' were redefined. Specifically, the vision that was agreed when the first business plan was signed off in April 2014 was redefined in light of the CAMS concept and was articulated as:

"By 2020, the Materials Innovation Factory (MIF) will be the world leader in Computer Aided Material Science (CAMS). Computer Aided Material Science accelerates scientific discovery and innovation in materials chemistry, soft solids and complex mixtures by seamlessly integrating a wide range of modular computational and experimental techniques" (MIF Business Plan 2015/16, 2015)

Similarly, the stage-gated procurement process that had been agreed in the SLA was redefined following the connection of 'Computer Aided Materials Science' as a conceptual element. The connection of the Computer Aided Materials Science concept prompted a fundamental reconsideration of the type of equipment and infrastructure that would be required. Thus, some significant aspects of the MIF Legal Framework signed in April 2014 became viewed as inappropriate or insignificant through the connection of the 'first meeting of the E-Science team'. The connection of this event and associated conceptual elements (Computer Aided Materials Science) also redefined the trajectory of future events, eventually connecting to the completion of the FLEX cross-license agreement in November 2016. This event itself connected new conceptual and material elements and broadly constituted a shift in the scope of the meaning structure which initially focused on collaboration in materials

chemistry but expanded to include computer science and software development. Thus, what 'the collaboration was about' shifted dramatically as these novel conceptual and material elements were connected.

Having demonstrated the key analytical insights of my Whiteheadian process approach above, I will now elaborate how this enriches existing approaches to process theorising within organisation studies. Within the field of process research, there are various ways in which process has been conceptualised. In Chapter 3, Section 3.2.1, I outlined-two prevailing approaches to process based on different ontological assumptions. One perspective adopts a 'substance ontology' that characterises reality made up of static entities or 'things' that can change but which retain their fundamental character (Langley et al., 2013; Tsoukas and Chia, 2002; Van de Ven and Poole, 2005). Theory that is grounded in substance-based ontologies "pre-suppose that an organisation is a social entity or structure (a thing or 'noun') that retains its identity while changing from one state to another over time" (Van de Ven and Poole, 2005 p. 1380). Therefore, while processes are considered significant for analysis, they are conceptualised as ultimately reducible to the actions of 'things' (organisations, institutions, markets, logics, entrepreneurs). As Weik (2011 p.657) summarises "organisations are stable or inert, quite unproblematic 'things' that suddenly 'jump' (i.e. enter into a change process)...the moments before and after the 'jump' are empirically relevant and 'change' is the difference between the two".

Chapter 3 (section 3.2.1) also highlights that organisational theorists have recognised the limitations of such a static conception of change, based on substance-ontologies (Hernes, 2014a, 2008; Hernes and Weik, 2007; Hussenot and Missonier, 2015; Langley et al., 2013; Tsoukas and Chia, 2002; Weik, 2011). Alternative approaches to change built on process-ontological assumptions have more recently emerged. Early examples include Weick's (1979) call to 'stamp out nouns' in organisational analysis. Latterly, Tsoukas and Chia (2002p. 567) proposed the notion of 'organisational becoming', which viewed organisation as a "secondary accomplishment" reconceptualising organisation as "a pattern in that is constituted, shaped and emerging from change". Research that adopts process at an ontological level (rather than a theoretical level), reconceptualises change as an endogenous rather than exogenous phenomena (Hernes and Weik, 2007). This means that:

"process becomes its own rationale... in the absence of exogenous factors, the process interacts with itself and its own past as a basis for further process...[it] shifts the focus away from the way a state of organisation correlates with its context and towards the way an state of organisation comes about via a process of enactment" (Hernes and Weik, 2007 p. 258).

Organisation is therefore reconceptualised as a heterogenous assemblage of elements that achieves relative (but never absolute) stability through the relations between elements. Therefore, the primary focus of analysis is how *organisation is accomplished* through the connectivity of process rather than *how organisations move from one state to another*. In order to elucidate how organisation is accomplished, process is conceptualised as connectivity (Hernes and Weik, 2007), which helps understand how various social and material elements interact (connect) to produce stabilised configurations identified as 'organisations' (Hernes and Weik, 2007).

Some have suggested that two ontological positions, characterised as 'weak' and 'strong' process perspectives, are fundamentally conflicting (Chia and King, 1998; Tsoukas and Chia, 2002; Van de Ven and Poole, 2005) whereas more recently it is argued that the binary conceptualisation of these ontological positions is unhelpful and in-fact not reflective of processual thinking in terms of the requirement for both stability and change to be accounted for in analyses (Bakken and Hernes, 2006; Weik, 2011). For example, Weik (2011 p.667) explicitly advocates "discarding the 'nothing but being' and 'nothing but becoming' views" and advocates the adoption of a process perspective that integrates both 'being' and 'becoming'. In particular, Weik (2011) draws on Alfred Whitehead's metaphysical system to argue that the dichotomisation of the 'substance' and 'process' perspectives is misleading and illustrates that these seemingly contradictory positions are much more closely related than is commonly depicted by organisational process theorists. Weik (2011) suggests that a Whiteheadian perspective would distinguish 'change' from 'becoming' and include both concepts within analysis. Specifically, 'change' would "refer to an already existing entity that undergoes some modification but continues to be recognised as the same entity", whereas 'becoming' "would refer to the emergence of new entities...it is an event that perishes as soon as the process of becoming is finished and the activity maintaining the event ceases" (Weik, 2011 p. 664).

Similar to Weik, other organisational theorists have sought to establish holistic theories of organisation based on Whiteheadian concepts. Most notably, Hernes (2014a) who articulates a detailed 'process theory of organisation' as outlined in Chapter 4. The work of Hernes (2014) is critical in that it elaborates a detailed framework for Whiteheadian process analysis, proposing key concepts including 'Events', 'Event-Formations', 'Prehension' and 'Organisational Meaning Structures', details of which are outlined in Chapter 4 (Section 4.1.3). Despite the sophistication of Whiteheadian process theory, there is little empirical research that adopts a Whiteheadian perspective. Critics have suggested that this is characteristic of most work within the processual tradition (Van de Ven and Poole, 2005), although this could be attributed to the self-imposed empirical challenges perpetuated by the 'nothing but becoming' perspective (Weik, 2011).

My analysis presented in Chapter 6 and outlined above demonstrates the utility of Whiteheadian process philosophy for organisational analysis. Specifically, I highlight that it is useful to conceptualise 'things' (actors, materials, concepts, organisations, partnerships) as aspects of events rather than as abstractions or 'entities'. The utility of this conceptualisation of organisations (as aspects of events) is useful because it facilitates a focus on the empirical fluidity that characterises organisational life. In considering organisations as aspects of events, it becomes possible to appreciate their simultaneous being and becoming. This is enabled because this approach produces explanations of organisation that shows that things 'are the way they are' because of how they are related in events. Importantly, this allows us to appreciate seemingly stable aspects of organisation (actors, concepts materials) while focusing attention on how these seemingly stable aspects are produced through prehensions (process), something that has been called for yet not achieved within organisation studies (Bakken and Hernes, 2006). In other words, my analysis demonstrates that it is possible (and indeed helpful) to analyse organisational becoming without recourse to static entitative constructs that obscure their dynamic nature. Similarly, this framework allows us to draw upon established organisational constructs (actors, concepts, materials, partnerships, organisations) to talk about *organisational becoming* without having to develop an entirely

new vocabulary devoid of nouns (Bakken and Hernes, 2006). In short, my analysis offers a resolution to the 'nothing but being' and 'nothing but becoming' conflict by demonstrating how an events-based framework facilitates analysis of both being and becoming.

In demonstrating the utility of an events-based framework for processual analysis, I build on the work Hussenot and Missonier (2015), who offer the only other study that has attempted an empirical analysis of organisational becoming through a Whiteheadian lens. Hussenot and Missonier (2015) offer an important contribution to organisational process theory by bringing Whiteheadian concepts into organisational analysis. In particular, they rely on the concepts of 'events', 'event-structures (organisation)' and 'prehension'. They also attempt to foreground the analysis of events, suggesting that "organisation is observed and understood through events in which humans and things acquire existence" (Hussenot and Missonier, 2015 p.11). However, as noted in Chapter 4 (Section 4.1.3.2) whilst their adoption of 'events' as a unit of analysis for theorising organisation is timely and useful, their operationalisation of other Whiteheadian concepts is problematic for processual analysis of the type advocated by Whiteheadian process theorists (Bakken and Hernes, 2006; Hernes, 2014a; Weik, 2011).

In particular, Hussenot and Missonier (2015) propose the concept of 'prehension' as the principal force through which organisation (and change) occurs. For Hussenot and Missonier (2015 p.9) prehension:

"means that actors always define and act in their actual event through their engagement with past and anticipated events...The notion of a structure of events insists on the fact that these events are prehended in a certain way by actors." [my emphasis added]

They also suggest that:

"Events related to the organisation are not separated from one another, but *are prehended by actors* in an ongoing present. As a consequence, the understanding of organisation is done from the events *prehended by the actors in their activities...By*

prehending a structure of events, actors produce and re-produce the organisation". (Hussenot & Missonier, 2015 p.9). [my emphasis added]

The core of their theoretical framework is that events are prehended by actors in similar ways, or are recalled in a similar way which produces 'stability' but these "structures of events are constantly renewed, ever-changing and open" (Hussenot and Missonier, 2015 p.9) which brings novelty (or change) to the organisation. However, at this point we also see a divergence of my theory from this existing work. In particular, whilst this Whiteheadian framework provides a useful attempt to theorise the intertwinement of stability and change through events, the particular variety outlined by Hussenot and Missioner (2015) appears to be limited by an over-emphasis on human agency, particularly with regards to the conceptualisation of 'prehension'.

To clarify, the conceptualisation of prehension outlined by Hussenot and Missonier (2015) implies that it is the human actors who undertake the 'prehending' at events. Furthermore, they explicitly state that through their prehending activity at events, actors produce and reproduce organisation. This agentic interpretation of Whitehead's notion of prehension affords them a take on their empirical materials that, equally emphasises the role that actors play in *defining the structure of events*, which they appear to consider analogous to organisation. For Hussenot and Missionier (2015), organisation and change are therefore produced through prehensions of events by actors, subjugating 'prehension' to an interpretive exercise actors engage in through recalling past events and projecting future events. By conceptualising prehension in this way, the analytical account(s) provided by these authors goes only some way towards the development of a processual understanding as actors, and their prehensions, remain key units of analysis through which sense is made. In this regard, the notion of prehension conceptualised by Hussenot and Missonier (2015) is similar to the 'temporal work' described by Kaplan and Orlikowski (2012), which involves the interpretive re-imagining of the future, the reconsideration of present concerns and the reinterpretation of the past (Kaplan & Orlikowski, 2012 p. 977). A similar logical inconsistency is evident in Hernes' (2014a) elaboration of Organisational Meaning Structures and their articulation. Specifically, he suggests "organisations in the form of meaning structures are seen as things in themselves, but as emergent wholes of connected elements, enacted *through articulation by actors"* (Hernes 2014a p. 190). This is despite previously characterising 'actors' as provisional meaning structure elements that are themselves products of accumulated events over time (Hernes, 2014a p.190).

This emphasis on the role of actors in the definition of organisation appears to contrast with the claims that events are productive of organisation and change, in fact, there remains very little analysis of *how events 'work' to produce organisation and change*. As Hernes (2014a p. 130) highlights, the agency of an event depends on the participation of human actors, but the *agency of the event* is not reducible to the actions of human participants at events. However, as demonstrated above, the matter is not merely one of philosophical correctness but is also of chief importance when it comes to identifying the generative processes at play in the formation of the partnership without recourse to individuals, organisations and other entitative substances. In order to appreciate the fluid and emergent character of organisation it is necessary to reject such an agent-centred conceptualisation of prehension.

Counter to Hussenot and Missioner (2015), Hernes (2014 p.130) suggests that it is events that have agency that they (as agents) exhibit through the connection of past and future events. Specifically, Hernes (2014 p.130) suggests that "the agency of an event relates to its ability to enter into the process of historicising, to be viewed as temporally significant." Organisation (and change) is therefore "characterised by the connecting of events" (Hernes, 2014a p.130). Therefore, it is suggested that more work needs to be done on the actual work performed by events in forming other events and organisational meaning structures (Hernes, 2014a p.130). In the analysis presented in Chapter 6, I attempt to elaborate more on the work of events as the agents of process (Hernes, 2014a p.129), in both creating and modifying organisation.

In particular, my analysis of the University of Liverpool- Unilever Research Partnership distinguishes two types of 'work' performed by events in driving organisation and change. These two 'modes of prehension' are *Relationality* and *Activity*, terms I have adopted from Weik (2011) who highlights different functions of process. First, I demonstrate that events 'work' to produce organisational stabilities by linking past and future states. This relating of past and future events enables the definition of meaning structure elements that are aspects of the interlinked events. This relating of past and future events also facilitates the definition

of 'an entity' in spatio-temporal terms by linking meaning structure elements to particular pasts and futures (times and places). In tandem, this work allows the definition of an organisational meaning structure, an apparently stable set of arrangements that we can describe as 'an organisation', or in this case, a partnership. I term this form of work (mode of prehension) 'Relationality' since it produces stability through its relating.

Second, I demonstrate that events 'work' to produce change by altering the connections between meaning structure elements and events. This type of work involves the connection and disconnection of social, conceptual and material elements from the meaning structure. It also involves the modification of the nature of already connected events, making them more or less significant for the meaning structure. This mode of prehension opens up new trajectories for development and closes down potential developmental trajectories through the novel connections made. Based on the empirical analysis presented in Chapter 5, I suggest that this mode of prehension can be characterised by various forces that stimulate the connections of events to (and disconnections from) the meaning structure. The forces identified in Chapter 5 are 'choice' (human agency), 'chance' and (soft) 'determinism' (more details on this aspect of prehension in the creation of the partnership are elaborated in Section 7.3). Due to the creative capacity of this form of prehension, I adopt the term *Activity*.

Figures 7.1 and 7.2 provide a conceptual overview of my event-based model for organisation and change. Figure 7.1 outlines my conceptualisation of events, which are temporal occasions that are constituted by prehensions of events and meaning structure elements. Prehension is represented by the double-headed arrows which illustrate that 'what the event is' and 'what the meaning structure elements are' are mutually defined by the prehension. The text in the boxes and circles provides the descriptive characteristics of 'events' and 'meaning structure elements'. Figure 7.2 builds on Fig 7.1 which is highlighted as a constituent element by the dotted line. Figure 7.2 expands on Fig 7.1 by unpacking the notion of prehension, illustrating that there are two modes of prehension which reflect 'the work of events' which contribute to the stabilisation and change of organisational meaning structures. In this case, the organisational meaning structure is the University of Liverpool- Unilever strategic partnership but the model presented in Fig 7.2 is not a model of *partnership development* per se. Rather Fig. 7.2 illustrates the general theoretical process of organisation and change according to the events-based theory I am advancing on the basis of the analysis of this particular case. I elaborate a model of partnership development based on this theoretical basis below in Fig 7.3.

In sum, I have developed a Whiteheadian model of process based on the work of process theorists who have advanced a conception of process that is sensitive to both 'substantive' and 'flux' based conceptions of process (Bakken and Hernes, 2006; Hussenot and Missonier, 2015; Weik, 2011). This model builds on recent developments in events-based theories of organisation (Hussenot and Missonier, 2015) and advances the argument that organisation and change should be understood in parallel, produced through events and prehension (Hussenot and Missonier, 2015; Whitehead, 1929). Building on Hussenot and Missonier (2015), I focus on the Whiteheadian concept of 'prehension' as the force that underpins both organisation and change. Based on the insights from the empirical material, I elaborate a conceptualisation of prehension that is divergent from the concept proposed by Hussenot and Missonier (2015). Specifically, I suggest that prehension is reflective of the *agency of events* and that it is manifest in two forms which I term 'relationality' and 'activity'. My analysis indicates that it is events that are they key agents of process and it is their connections that constitute organisation, which here is termed 'organisational meaning structure' to reflect its provisional nature (Hernes, 2014a).



Fig 7.1 Anatomy of an event

My analysis further elaborates how these two modes of prehension both produce both stability and change in organisational meaning structures. This elaboration of organisation and change attempts to satisfy calls within process theory to build a more nuanced understanding of organisation and change based upon Whiteheadian notions of process (Hernes, 2014a). Broadly, the framework and analysis presented here suggest an alternative model of change from the dominant stage-gate, teleological and evolutionary models of change (Van de Ven and Poole, 2005). In particular, I show that change and organisation occur in parallel through the relationality and activity of events (Weik, 2011). I propose prehension as a key theoretical construct around which organisation and change can be understood, enriching current conceptualisation of this complex and important theoretical construct. I also highlight how organisations, including strategic partnerships, can be usefully reconceptualised as 'Organisational Meaning Structures' to reflect their heterogenous assemblage and provisional nature (Hernes, 2014a). The empirical analysis presented in Chapter 6 offers insights as to how such meaning structures are produced through the agency of events. More broadly, my analysis also demonstrates how notions from Whiteheadian process metaphysics might usefully be incorporated into organisational analysis, something

that has eluded proponents of Whitehead thus far within the field of Organisation Theory (Bakken and Hernes, 2006; Hernes, 2014a, 2014c, 2008; Weik, 2011). The next section provides a more detailed articulation of the implications of this framework and analysis for theorising change and development, particularly in relation to the development of strategic alliances.



Fig 7.2 Event-Based model of organization and change

7.3 Reconceptualising Strategic Alliance Development: An 'Unowned' perspective

The aim of this section is to explore how the Whiteheadian process theory outlined above contributes towards theorising inter-organisational relationships and their development, also termed 'alliance dynamics' (Majchrzak et al., 2015). The answer to this question provides the foundation for theorising university-industry partnership development. Given the Whiteheadian framework outlined above, in particular its emphasis on events as the agents of process, the fundamental nature of alliances has to be reconsidered. This Whiteheadian reconceptualization of alliances has significant implications for theorising pertaining to alliance dynamics.

The analysis presented in Chapters 5 and 6, alongside the framework presented above, suggests the explanatory insights that can be gained when adopting a 'relational' conceptualisation of alliances. Through reconceptualising alliances as Organisational Meaning Structures and illustrating how they are created and re-created through the 'work' of events (prehension), we are invited to reconsider the prevailing conceptualisations of interorganisational relationships within the existing literature. Following the elaboration of my events-based theory of organisation presented above, we are invited to reconsider alliances not as static and enduring 'things' but as processes, that are mutually constitutive of their social, conceptual and material elements. The theory of organisation and change advanced above suggests that an alliance is, at any given time, a heterogenous assemblage of events which connect social, conceptual and material elements. It is these connections, engendered in events, that define 'what an alliance is' and also define the entangled elements (actorsorganisations, individuals, concepts- modes of governance, technical ambition and materialscapital and physical infrastructure). This relational conceptualisation of alliances is radically different to most of the existing literature pertaining to alliances and their development, that commonly adopt an entitative approach. For example, Bruyaka et al (2018, p. 445) conceptualise alliances as:

"voluntary co-operative agreements between two or more organisations, designed to create value by combining resources, including knowledge to carry out common projects- whether launching a new activity, increasing speed to market and/ or gaining greater market access"

Furthermore, they suggest that alliances themselves have agency by highlighting that they "are distinguished from short-term arms-length contracts by *the alliance's joint activities."* They also distinguish 'the parties' from 'the alliance' suggesting that alliances are delineated from conventional market transactions by "the reliance *by the parties of an alliance,* on a greater commitment of time, resources and effort" (Bruyaka et al, 2018 p.445). Similarly, Lumineau and Oliveira (2018, p. 441) propose a conception of alliances that places strong emphasis on the delineation of 'entities' and 'environment'. Specifically, alliances are conceptualised by four definitional characteristics, in particular alliances: involve several *autonomous organisations,* they are not just arms-length transactions but refer to connections and the *manner in which organisations behave to one another* and they are '*embedded' in contexts* which impact their operation. Lumineau & Olivera (2018) also suggest that alliances *occur over time* and involve processes through which they are formed, managed and terminated.

Bell et al (2006 p.1067) also offer an entitative conception of alliances, suggesting that they are *"intentionally* long-term contractual and equity-based co-operative arrangements between firms...they are *socially complex organisms*, consisting of individuals or groups whose mindsets and interests are likely to shape the relationship". This definition highlights the assumption that managerial intention lies behind the formation and development of alliances. This is also exemplified in the definition of alliances offered by Kale & Singh (2009 p.46) who suggest that a strategic alliance is a *"purposive relationship* between *two or more independent firms* that involves the exchange of resources or capabilities to *achieve mutually relevant benefits*".

What is common about all of these conceptualisations of strategic alliances is that they are focused on the delineation of 'entities'. Thus, alliances are predominantly viewed as entities that are distinct from organisations, the organisations that engage in alliances are viewed as discrete and 'autonomous' actors that establish alliances to achieve some pre-determined aim or purpose. Furthermore, alliances are distinct from their 'context', that is to say they are seen to exist within a broader delineated 'environment'. Analysis based on this conceptualisation of alliances is therefore focused on entities and the ways in which these

entities (i.e. different organisations, individuals, environments) interact to produce desired outcomes. Therefore, the principal concern of 'alliance dynamics' literature has been to explain changes in these discrete entities, flowing a cause-effect logic. This is illustrated by Majchrzak et al (2015 p.1339) who define alliance dynamics as the "changes in the conditions" (e.g. goals), processes (e.g. structure) or mechanisms (e.g. interaction style) of an interorganisational collaboration". However, my relational reconceptualization of alliances suggests that such an approach to change (or development), is inadequate for understanding the empirical dynamism of alliances. In particular, if alliances are to be reconsidered as relational wholes of heterogenous elements connected by events, it follows that any attempts at arresting 'change' into static and fixed dimensions such as 'conditions, structure or interaction style' (Majchrzak et al, 2015) obscures a focus on the process through which alliances are accomplished. In other words, these attempts to analyse the development of alliances by focusing in changes in alliance properties are flawed precisely because alliance properties are never actually fixed but rather are continuously redefined through the prehension of events (as outlined in Section 7.2). This is what de Rond & Bouchiki (2004) highlight when then encourage a greater focus on 'the becoming' of alliances in future empirical research.

The Whiteheadian model of organisation and change presented in Section 7.2 provides a basis for reconsidering these entitative conceptions of alliances, enabling a focus on *the becoming* of alliances. Rather than being considered 'entities' with discrete boundaries and characteristics made up of isolated organisations and individuals that act purposively to achieve pre-determined goals, Section 7.2 illustrates that alliances are assemblages of events called event-formations. It is these event-formations and that define the social, material, conceptual and environmental elements that characterise 'the alliance'. My analysis suggests therefore that the substance-process assumption that underpins the existing entitative approaches to alliance development can be inverted. Rather than being a discrete entity that is produced through purposive action of other discrete entities, I propose that alliances be reconceptualised temporary outcomes or 'effects' (de Rond and Bouchiki, 2004) of interacting processes that produce the temporary stabilities that we can perceive as entities (organisational meaning structures). It follows therefore that theories of alliance development, informed by this conceptualisation of alliances, would require a focus on the forces that facilitate, encourage and shape the connection of events, which then define the alliance and its constituent elements. That is to say, in order to better understand 'the development of alliances', we need to elaborate on the different forms of 'activity' that facilitate novel connections to the meaning structure. Chapter 5 illustrates this conceptualisation of alliances, showing how the interacting forces of Choice, Chance and Determinism guide connections between events that constitute the alliance.

Consider what might conventionally be called the 'formation of the alliance'. Chapter 5 illustrates how the partnership was formalised with the 'Establishment of the CMD'. However, rather than characterising partnership formation as a rational, linear process Chapter 5 shows that the 'formation of the partnership' was in actually driven by a confluence of forces that were not under the control of any particular actor or party. That is, it was driven by "a comparatively undetermined force, not limited to human agency" (Weik, 2011 p.668). Specifically, the key personal relationship that formed the intellectual basis of the partnership was initiated by a chance encounter between two unrelated scientists at a dinner. Furthermore, the development of this relationship was facilitated by the relocation of Mills from Cambridge to Liverpool which was a decision informed by the desire to be closer to his family. So, whilst the interaction and joint research interest with Stephenson was interesting, it was not a key factor in determining the relocation of Mills, who could just have easily moved elsewhere depending on the location of his family. Thus, the initiation of the relationship was due to a chance encounter and the development of personal relationship between Mills and Stephenson through the bi-monthly research meetings was largely an unintended consequence of Mills' decision to relocate to Liverpool for personal reasons. The significance of unintended consequences is also highlighted by the revision of the rejected BTIA proposal. In retrospect, the model for what became the UoL-Unilever strategic partnership was devised largely in response to this rejected proposal. Mills and Stephenson were not thinking consciously about how to design a long-term multifaceted university-industry partnership, rather they were simply responding to the reviewer comments on their proposal to enhance the potential viability of the CMD project. Thus, chance and unintended consequences played a significant role in 'the formation of the partnership' for without such occurrences, the partnership would not have been formed. Mills and Stephenson would not have met, their relationship would not have developed in the same way and the operating model of the UoL-Unilever partnership would not have been established.

Although chance and unintended consequences were important forces that contributed to the formation of the partnership, they interacted with the purposive strategic choices of individuals. For example, the decisions taken by Mills and Stephenson were critical to the formation of the partnership. These include the decision to submit a proposal to the BTIA programme without the expressed support of their line managers and the decision that each of them made to persist with the project despite growing disquiet and uncertainty. Another example of the importance of individual agency in the formation of the partnership was the decision by Stephenson to assume personal liability for equipment that was to be transferred. This crucial decision enabled the move to occur as planned which prevented damage to trust and confidence. It also expediated the contracting process which formed the legal framework for the partnership. Thus, whilst chance and unintended consequences were significant in facilitating connections between some of the events which culminated in the formation of the partnership choice and individual agency was equally as instrumental in shaping the course of events. As summarised by Stephenson "I think if I had left Unilever and gone to another job, it would have died. And that's not me being big headed...If Archer Mills had left the University of Liverpool, it would have died." Thus, it is difficult to overstate the importance of the choices by the actors that were made culminating in the formation of the partnership. Simply, if Mills and Stephenson had not made the choices they did, or had taken actions that compromised their relationship, the CMD would not have been established and the trajectory of the partnership would have been altered dramatically (if not eliminated).

As highlighted in Chapter 5, the formation of the partnership was also driven by characteristics of 'the causal background' (de Rond and Thietart, 2007) that facilitated the development of a university-industry research partnership. For example, the organisational background of Unilever became significant in the formation of the partnership because R&D managers were under pressure to deliver 'Open Innovation' projects as part of a wider organisational change programme. Similarly, the 'organisational background' of the University of Liverpool became important because the key decision-maker had a natural science background and thus had a greater appreciation of the technical details of the

collaboration and its potential implications. The wider 'policy background' became significant in the formation of the partnership since the Liverpool City Region had an abundance of public funding available to support investment in R&D due to policy decisions made at the EU Commission. These causal backgrounds were equally as important in driving the formation of the partnership as choice and chance. For example, if Unilever were not in the midst of the internal reorganisation and therefore not moving towards an 'open-innovation' R&D approach, there might have been a lesser appetite for a project that appeared high-risk and unconventional. Similarly, if senior decision makers at the University were not as appreciative of the technical ambition of the project then it might have been more difficult for them to see the potential of the project and they would have been less likely to sanction its development. Furthermore, if the project was taking place elsewhere, where the collaborators were more geographically distant and where there was less public funding available to support the technical ambition of the proposal then it is unlikely the CMD would have been established since sufficient capital could not be raised in absence of public funding.

This example of 'partnership formation' reflects an 'unowned' process perspective of alliance development (MacKay and Chia, 2013). Unowned process theory, as outlined by Mackay and Chia (2013) privileges change over social entities within analysis. Decisions taken by actors always entail unintended consequences, suggesting "multifaceted change processes that interact with managerial agency the shape organisational realities" (MacKay and Chia, 2013 p.212). Unowned process theories of change also reject the notion of underlying structures that determine organisational development and suggest that order is more often achieved spontaneously through interacting process complexes (MacKay and Chia, 2013). In the example outlined above of 'partnership formation', chance events presented opportunities for individuals to make strategic choices about research collaboration. In exercising these choices, the actors unintentionally developed a model for organising a university-industry partnership that would persist for over 10 years and that would lead to a £68m project called the Materials Innovation Factory. This model for a university-industry collaboration was devised in response to a negative funding decision and was viewed as a way to organise the project that Mills and Stephenson wanted to pursue to further their immediate research objectives of establishing high-throughput materials synthesis capabilities. This was all facilitated by organisational and policy decisions that were initially disconnected and peripheral but became connected and significant through the process of alliance formation.

The analysis presented in Chapter 5 and the example of partnership formation outlined above clearly demonstrates that the 'life-cycle' models are not concordant with the empirical complexity of the phenomena. Specifically, life-cycle models present alliance emergence and development as a rational, linear process that proceeds along trajectories that are defined a *priori,* which clearly does not reflect the complex emergence of the partnership in this case. Similarly, the formation example presented above and the broader case analysis presented in Chapter 5 suggests that teleological models of alliance development, such as those proposed by Ring and Van de Ven (1994), Doz (1996) and latterly Majchrzak et al (2015), are inadequate for fully elucidating the formation and development processes of strategic alliances. These perspectives are based on the assumption that desired end-states are known at the outset of a collaboration. Whilst it is conceded that managers cannot predict or fully control the events impacting the development of an alliance (de Rond and Bouchicki, 2004; Doz, 1996) it is suggested that managers actively work towards the desired end-state, modifying the alliance towards the realisation of this desired end. Furthermore, these models assume that alliance managers constantly evaluate and assess the performance of the alliance and attempt to make adjustments to the characteristics (goals, tasks, governance, structure) of the alliance so as to achieve these desired end states (Ring and Van de Ven, 1994). Others suggest that it is the ability of managers to learn within the alliance that determines the developmental trajectory and end-state, which is characterised as either successful (function/ stable) or unsuccessful (dysfunctional/ unstable) (Doz, 1996). According to these frameworks, alliances proceed through discrete sequences of negotiations, commitment, execution (Ring and Van de Ven, 1994) which are mediated by managerial assessments (Ring and Van de Ven, 1994) or managerial learning (Doz, 1996).

The processual analysis informed by Whiteheadian notions of change and organisation suggests that these models for analysing alliance formation and development are useful, in that they acknowledge the discontinuous nature of the formation and development of alliances, but they are limited by their over-emphasis on managerial rationality and cognition as a determinant of the developmental trajectory of an alliance. For example, the analysis presented in Chapter 5 illustrates that the desired 'end-point' for the partnership was rarely (if ever) fixed. Conversely, the alliance appeared to 'develop' in terms of goals, tasks and design in a comparatively ad-hoc manner through individual 'coping' with the issues at hand (at events) (Chia and Holt, 2009). For example, the initial collaboration was established as Stephenson coped with the resource constraints and the threat of outsourcing of synthetic chemistry at Port Sunlight and Mills attempted to address the resource limitations he faced as a new academic at an out-dated chemistry department. The organisational model for the CMD was devised as Mills and Stephenson attempted to address comments from a rejected funding proposal. The model they devised was based on the creation of a research facility within the existing chemistry department at the University of Liverpool which would co-locate 10 Unilever researchers with academics from the various research groups at the chemistry department (principally Mills'). At this stage, they were not at all considering a facility that would combine the Department of Chemistry with 150 Unilever research staff.

When considering how the collaboration expanded, the same pattern of dealing with the 'situation at hand' can be observed. For example, Jacobs decided to propose the MBR at Liverpool because the costs associated with transporting chemical material between Warwick and Port Sunlight were prohibitive. Similarly, the decision to submit a proposal for a High Throughput Formulation Centre was borne out of Green's attempt to expand the Unilever HT capability across the different research categories within a limited budget that was available for the purchase of HT equipment from Unilever Central Resources. At no stage was an alliance manager or alliance governance board making these decisions as part of a conscious move towards the establishment of the Materials Innovation Factory. However, the accumulation of resources in high-throughput materials science that emerged through these disconnected efforts meant that the MIF proposal and eventual realisation became a more salient potentiality.

In actuality, structured monitoring and evaluation of 'the alliance' only began once the MIF project had been supported by HEFCE, at which point the Joint-Strategy Board formed and a Relationship Committee was established, collectively these performed the assessments of efficiency and equity. This is not to say of course that development of the partnership was

irrational, but the key events that culminated in the establishment of the MIF reflected an accumulation of decisions that were made to deal with the situation *at that time*. This is also not to say that learning did not take place, early events facilitated the development of trust and the collaborators (both at 'bench level' and at an organisational level) became more accustomed to how each other worked and how the alliance functioned. However, when considering the developmental trajectory of the alliance, this learning played only a partial role, namely that it facilitated a willingness from the parties to continue collaborating. Unlike the analysis presented by Doz (1996) this learning did not drive the development of the alliance. Conversely, it was the interconnection of events and their interrelating of conceptual, social and material elements that fundamentally drove the development of the partnership (as highlighted in section 7.2)

Thus, it is suggested that development of the partnership reflected an 'unowned' process (MacKay & Chia, 2013). This unowned model of alliance development advocated here acknowledges the importance of both managerial agency (and associated learning) as well as powerful causal forces without relegating the significance of chance and unintended consequences, which remain largely absent from existing accounts of strategic alliance development aside from de Rond and Bouchiki (2004). This means that instead of being driven by enlightened managerial decision making, or pervasive environmental forces, alliance development is a consequence of the interaction between these two forces. Furthermore, I suggest that this interaction is mediated by chance events and the unintended consequences of purposive action (Giddens, 1984). Such a conceptualisation of alliance development is similar to the dialectical model advocated by de Rond and Bouchicki (2004 p.66). Specifically, de Rond and Bouchicki (2004) advocated that alliances be reconceptualised as heterogenous phenomena, that alliance performance be reconceptualised as socially constructed (rather than an objective attribute) and that unintended consequences of action be considered as a driver of change. Note, I am not advocating that it is these three forces of choice, chance and determinism that underpin organisation and change, rather I am suggesting that these three forces are significant in guiding novel connections between events (prehensions) which then underpin organisation and change (as elaborated in Section 7.2). I label these three forces as different forms of 'Activity' which is the primary force that drives organisational development.

My analysis builds on the work of de Rond and Bouchicki (2004) by showing how the interaction between dispersed forces guides the developmental trajectory of the alliance in a relatively undetermined manner. My 'unowned' model suggests that alliances develop through the interplay of choice, chance and causal backgrounds which guides the connection of events. Furthermore, the interplay of these forces results in unintended consequences which are critical in the formation and development of the alliance. Where my model differs from de Rond and Bouchicki's (2004) is in the characterisation of the forces and their interplay. Specifically, de Rond and Bouchicki (2004) propose that forces that shape alliance development are perpetually in conflict, whereas my model suggests that the forces of choice, chance and determinism are not necessarily in conflict but that they co-exist to shape the alliance and the developmental potential. Second, de Rond and Bouchiki (2004) propose forces that are largely within the domain of human agency, for example, they suggest that alliance development is propelled via conflict between 'design and emergence, co-operation and competition, trust and vigilance, expansion and contraction'. As Weik (2011) points out, these are forces that are largely determined by human action, so the interplay of generic forces that all organisations are subjected to and how these interfere with (strategic) human action remains outside the scope of de Rond and Bouchiki's (2004) analysis. Conversely, I illustrate how disparate forces such as determinism and chance interact with human agency (de Rond and Thietart, 2007), which produces unintended consequences that form the basis of my alliance development model.

The implication of this unowned process approach to alliance development will now be considered in light of the existing literature related to university-industry partnerships, which provides an answer to the primary research question, namely "How do university-industry research partnerships emerge and develop over time?"

7.4 On the Emergence and Development of University-Industry Research Partnerships: A processual perspective

The previous section suggests that existing theoretical models of strategic alliance development, based on entitative conceptions of alliances (e.g. life-cycle models, teleological

models, evolutionary models) are useful in orientating analysis of process but are limited by their restrictive ontological and epistemological foundations. The previous section also outlines the processual conception of alliances outlined by de Rond and Bouchicki (2004) and elaborates how my model of alliance development is consistent with their characterisation of alliances as 'heterogenous wholes' but subtly divergent from their dialectical framework based on conflicting forces. Following their call for further longitudinal research of alliance dynamics based on alternative metaphysical foundations, I elaborated an unowned perspective of alliance development.

To recap, I argue that organisations (such as university-industry research partnerships), are temporary outcomes of connections (prehensions) between events. These connections serve to provide stability, through relationality which 'defines' the organisation in spatio-temporal terms. They also serve to provide novelty or change through 'activity' which produces novel connections between events that reconfigures the relationships between existing events and facilitates alterations in meaning structure elements. I conclude Section 7.3 by suggesting that alliance development can be understood as 'activity', that is to say the development of alliances can be understood by examining how events become connected. The empirical analysis suggests that there are three forces that influence the connections of events, these are human agency (choice), chance and determinism (de Rond and Thietart, 2007; MacKay and Chia, 2013). The determinism I refer to is not 'hard' determinism which holds that "events are fully accounted for by prior states of affairs in accordance with causal laws that govern the world" (de Rond and Thietart, 2007 p.536). In using the term determinism, I mean the softer form of determinism typically adopted within the strategy literature which describes "that which constrains and informs choice" (de Rond and Thietart, 2007 p.536). These have been referred to as 'causal backgrounds' (de Rond and Thietart, 2007) which are characterised simply as "the social and material contexts for choices" (de Rond and Thietart, 2007 p.536). Following this conceptualisation, the force I refer to when using the term 'determinism' reflects the causal force of prevailing social and material conditions. In line with de Rond and Thietart (2007) I suggest that this force is not fully deterministic of events but interacts with other forces to produce change. Specifically, following MacKay and Chia (2013), I suggest that the interactions between the forces of choice, chance and determinism produce unintended consequences which are important events that shape the development of the alliance. Thus, the alliance development is conceptualised as an 'unowned' process that cannot be fully explained through sole reference to purposive strategic action, environmental selection or serendipity. Rather explanations for alliance development must examine how these three forces interact to create novel connections between events that constitute the alliance.

Figure 7.3 provides a graphical overview of my model of university-industry partnership development. Each event-formation is represented by a dotted box, these event-formations (patterns of interconnected events) are represented by dotted boxes to highlight their transitional and precarious nature. Each event-formation that constitutes the partnership is influenced by the interacting forces of choice, chance and determinism which are included within each box. This represents the 'Activity' mode of prehension outlined in Fig 7.2. Although Fig 7.3 appears to show that 'Relationality' alternates with 'Activity', this is not the case (it is just difficult to show their simultaneous work in a 2D format). I have attempted to illustrate the pervasive influence of Relationality by using two recursive arrows that run through the event-formations. Fig 7.3 shows that the four key event-formations identified (CMD Establishment in 2006, Expansion of scope in 2012, Establishment of the MIF in 2014 and the re-definition of the MIF in 2017) also 'worked' to define meaning structure elements by connecting past and future events, which enabled the perception of a seemingly stable entity that was 'the partnership'. These arrows are reflective of the notion of 'Relationality' that is highlighted in Fig 7.2. Collectively, Fig 7.3 shows how the Unilever-University of Liverpool partnership emerged and developed through the prehension of events as outlined in Fig 7.2. This processual model stands in contrast to the bulk of existing theories of university-industry partnership development.



Fig 7.3 Unowned process of University-Industry partnership development
Existing research focused on the particular form of university-industry interaction labelled 'research partnerships' is limited compared to the broader literature on university-industry collaboration. To recap, university-industry partnerships have been recognised as a distinct form of university-industry interaction, although there remains some uncertainty around their conceptualisation. Therefore, the existing research pertaining to university-industry partnerships has largely been focused on conceptual clarification. For example, Boardman & Bozeman (2015) offer a framework for conceptualising 'University-Industry Alliances'. They helpfully suggest that university-industry alliances can be distinguished by three defining characteristics, namely that they are university-based, research focused and have a discernible organisational structure. Perkmann and West (2015) also offer a useful conceptualisation of different types of university-industry partnerships, clarifying the distinction between 'open' and 'closed' research partnerships. The core distinction here is the degree to which the outputs of collaboration can be appropriated by the partners. In 'open university-industry' partnerships, the outputs of the joint research effort are made accessible to parties other than the partner firm. Research on 'open university-industry' partnerships has only recently begun to develop. Perkmann and Schildt (2015) provide a grounded model of the practices that characterise open university-industry partnerships. They suggest that these partnerships function as boundary organisations that enable multiple goals and facilitate 'mediated revealing' which allows partners to collaborate effectively and distribute outcomes in a manner that minimises risks to the participating firms.

The partnership that forms the basis of the empirical analysis presented in Chapters 5 and 6 constitutes an open university-industry partnership, though is not an 'open-data partnership' in the same way as the Structural Genomics Consortium (Perkmann and Schildt, 2015). The Unilever-University of Liverpool partnership analysed in this thesis constitutes an 'open' partnership since the outcomes of the collaborative research effort are made available to organisations that are not the partners (e.g. other universities and firms). For example, all of the capabilities (such as the HT capabilities in the CMD, the bio-refining capabilities of the MBR, the automated formulation capabilities of the HTFC and the MIF) that were created as an outcome of the collaborative efforts of Unilever researchers and University of Liverpool academics were made available on an open-access basis to any interested 3rd parties. To illustrate, over 80 small firms made use of the high-throughput equipment and analytical

facilities that were established at the CMD (ERDF Audit Report, 2008). This also means that any firms that are interested in the automated formulation capabilities of the MIF can access them, provided they agree payment and booking with the University of Liverpool. Therefore, in principle, there could be Proctor & Gamble researchers, working in the same facility, using the same equipment supported by the same technical support staff, as Unilever researchers although Unilever established the facility through collaboration with the University of Liverpool. The key distinction from the Perkmann and Schildt (2015) open-data model is that it is not the data that are open, but the capabilities that underpin data generation and collection that are open. The key practices they outline such as 'enabling multiple goals' and 'mediated revealing' can be observed within the UoL-Unilever collaboration. Although I do not aim to contribute to conceptualising 'open data partnerships' (Perkmann and West, 2015) it is important to clarify to concept to demonstrate that the case presented here is reflective of the phenomenon. The primary concern of the analysis here is to elucidate the developmental process through which these 'open' university-industry partnerships are formed and re-formed. Despite several calls for research that explores the emergence and development of these particular forms of collaboration (Perkmann & Walsh, 2007; Perkmann & West, 2015; Thune and Gulbrandsen, 2014; Perkmann and Schildt, 2015), there are few studies that have attempted to offer insights into this phenomenon.

The few studies that have proposed process models of university-industry partnership development have either been devoid of theory (Ankrah and Al-Tabbaa, 2015; Philbin, 2008) or have suggested existing theories of alliance development are inappropriate for the analysis of university-industry partnerships (Thune and Gulbrandsen, 2014). Existing process models of university-industry partnership development are 'Life-Cycle' models which, as highlighted in Section 7.3, are limited by their assumptions of rationality and linearity. For example, Philbin (2008) offers a process model of university-industry partnership development that proposes partnerships proceed through phases of terrain mapping (search), proposition, initiation, delivery and evaluation. This model suggests that the process of university-industry partnership emergence and development is fully intentional, controlled by individuals acting rationally to achieve known desired ends. As highlighted in sections 7.2 and 7.3 above, this linear, rationalised process is not reflective of the empirical complexity that was overwhelming in my empirical material. Furthermore, this model fails to adequately account

for the pervasive environmental flux that characterises processual reality. Therefore, there is no consideration of how pervasive environmental uncertainty influences the developmental trajectory of the university-industry partnership. The model thus overemphasises the degree to which partnership development is contingent on managerial cognition.

Another Life-Cycle model is proposed by Ankrah and Al-Tabbaa (2015) who suggest that university-industry partnerships develop through discrete phases of formation, operation and evaluation. Based on a systematic literature review the key determinants of formation are highlighted which then are assumed to define the organisational form and expectations against which outputs are evaluated. This model has a greater emphasis on teleology than Philbin's (2008) model, suggesting that the development of the partnership is contingent on the degree to which apriori defined goals are achieved. Again, this model overlooks the empirical complexity that characterises partnership development by suggesting that the outcomes of university-industry partnerships can be, and are, known before the collaboration commences. However, the arguments about theorising alliance development advanced in Section 7.3 suggests that the assumption about objectives and desired outcomes being determined rationally before the partnership commences is problematic. This model is also problematic because it too fails to account for the pervasive environmental dynamism which is characteristic of a processual world.

Whilst both of the models outlined above are largely devoid of an underpinning theoretical rationale, an alternative is provided by Thune and Gulbrandsen (2014). Thune and Gulbrandsen (2014) explicitly draw on Doz's (1996) model of alliance development to explore the emergence and development of university-industry partnerships. Their analysis is premised on the notion that successful partnerships are characterised by stability whereas unsuccessful partnerships are characterised by instability and exit. Thune and Gulbrandsen's (2014) analysis suggests that the 'initial conditions' of the partnership are highly influential in the early development but that the influence of initial conditions becomes less pervasive over time. Furthermore, they find no evidence to support the notion that alliance learning through repeated interactions yields more positive (stable) outcomes. Most importantly, they suggest that the framework based on stylised 'initial conditions' (emergent, embedded and

engineered) is inappropriate for the study of university-industry partnership dynamics. This is because they find that all of the partnerships that they studied exhibited characteristics of all three types of 'initial conditions'.

Therefore, based on their conclusions and my empirical insights, it can be suggested that established theoretical approaches to alliance development, which conceptualise partnerships as entities that develop through cycles of learning and adaption are inappropriate for understanding university-industry partnership emergence and development. Although Thune and Gulbrandsen (2014) offer an important contribution in by highlighting the significance of environmental change in the formation and development of university-industry partnerships, they fail to fully elaborate on why initial conditions cease to matter over time and how these environmental forces interact with the decisions made by alliance participants. Furthermore, their analysis fails to acknowledge the role that serendipity plays in the development of alliances, which was highlighted by de Rond and Bouchicki's (2004) dialectical perspective. Thune and Gulbrandsen (2014) conclude by suggesting that the phenomena of university-industry partnership development is potentially too complex for theories of alliance dynamics, conversely, I propose that it is theories of alliance dynamics that are not complex enough (Tsoukas, 2017) to offer holistic understandings of this phenomenon.

In response, I offer a 'conjunctive' theory (Tsoukas, 2017) of university-industry partnership development that is attentive to empirical complexity. By reconceptualising university-industry partnerships as event-formations that emerge through the interacting forces of choice, chance and determinism, I offer a holistic account of partnership emergence and development. Through adopting 'the event' as the principal unit of analysis, it becomes possible to analyse the simultaneous influence of these three intersecting forces that all contribute, partially, to the formation and development of university-industry partnerships. I suggest that this framework is more holistic that existing approaches because it incorporates analysis of the role of strategic human action, which has been (over) emphasised in existing life-cycle models (Ankrah and Al-Tabbaa, 2015; Philbin, 2008) with analysis of the role that 'causal backgrounds' (de Rond and Thietart, 2007) play which are addressed to an extent by Thune and Gulbrandsen (2014). Furthermore, analysis suggests and elevated role for

serendipity in the formation and development of university-industry partnerships, an important and pervasive influence that is been completely excluded by existing disjunctive theories that rely on static concepts for explanations.

My model of university-industry partnership development, highlighted in Figure 7.3 in contrast to existing approaches, suggests an 'unowned' process (MacKay and Chia, 2013). Based on the analysis of the Unilever-University of Liverpool case, I argue that the desired outcomes of university-industry partnerships are never fixed and can therefore be difficult to define fully in advance of the collaboration. I also eschew the notion that partnership stability corresponds with success and instability corresponds with failure. In contrast, I highlight that university-industry partnerships are perpetually in a state between stability and instability. Whilst the partnership may appear to be stable and functional (or dysfunctional) there is always the potential for reconfiguration (instability) which arises from the unintended consequences of managerial choices and the perpetual fluxing of environmental conditions.

7.5 Conclusion

In sum, I offer a theoretical account of how open university-industry partnerships emerge and develop, something that is thus far lacking in the literature. Furthermore, my model of university-industry partnership differs from existing attempts to theorise university-industry partnership development by affording analytical primacy to change over entities. By affording analytical primacy to change, I show that university-industry partnerships can emerge and develop through an accumulation of events that are connected by choice, determinism and serendipity. This analysis suggests that, contrary to models outlined above, universityindustry partnerships emerge through a confluence of forces that precipitate the patterning of events. These events, when connected define the constituent elements of the partnership (actors, concepts, materials) and locate them in spatio-temporal terms. Therefore, to answer the primary research question "How do University-Industry strategic partnerships emerge and develop over time?" I suggest that university-industry strategic partnerships emerge and develop through an unowned process of change. Confluences of change brought about by environmental conditions and chance occurrences cause individuals to make certain strategic decisions. These decisions are not about 'the development of a partnership' but are reactions to the situation they are presented with by the changing environment and chance events.

University-Industry partnerships develop as these decisions accumulate, which results in a patterning of events that can be identified as a strategic research partnership

Chapter 8: Concluding Comments

8.1 Introduction

University-Industry interaction has become an increasingly important phenomenon as firms have sought to leverage diverse knowledge sources for innovation and policy-makers have sought to enhance economic prosperity through innovation-based development (Etzkowitz, 2003; Hayter et al., 2018; Perkmann and Walsh, 2007; Perkmann and West, 2015; Siegel and Wright, 2015b, 2015a). The increasing significance of 'university-industry interaction' for innovation has been accompanied by the development of a voluminous academic literature, as illustrated by the review presented in Chapter Two. The literature review presented in Chapter Two highlights a number of significant features of the existing research pertaining to university-industry interaction. First, it shows that existing research is largely empirically driven, whereby most research lacks a clear or obvious basis in organisational theory. It shows that most research has focused on explaining empirically observable patterns of universityindustry interaction by examining the factors that influence the transfer of technology from universities to organisations (usually represented by formal intellectual property rights). Second, as a consequence of this empirical focus, existing research has focused on those aspects of university-industry interaction that are more empirically accessible, neglecting aspects of university-industry interaction that are much more difficult to capture empirically. Perkmann et al (2013) suggest this empirical accessibility is one of the main reasons that research into more 'diffuse' forms of university-industry interaction remains limited by comparison to research pertaining to university-industry technology transfer. Third, the review highlights that the predominant approach to researching university-industry interaction has been to conduct cross-sectional analysis, characteristic of the 'variance' tradition of research (Van de Ven and Poole, 2005). My literature review concludes by highlighting that there is an emerging interest in the alternative forms of university-industry interaction that are more relational (as opposed to transactional) in nature (Perkmann & Walsh, 2007; Perkmann & West, 2015; Siegel and Wright, 2015a).

These forms of interaction, typically characterised as 'research collaboration' are the primary focus of this research. The literature review of research concerned with 'university-industry

collaboration', also presented in Chapter Two highlights some of the key characteristics of existing research. Briefly, this review illustrates that there is still an ongoing debate around the definitional issues of university-industry research collaboration, with some classifying activity based on the type of output produced (Bozeman et al., 2013) and others classifying activity by different 'interaction channels' (e.g. joint research, contract research or consulting) (D'Este and Perkmann, 2011). It also highlighted that the majority of existing work focuses on the initiation and 'success' of *collaborative projects*. Thus existing research pertaining to university-industry collaboration is largely concerned with how different individual, organisational and environmental characteristics influence the likelihood of collaborative projects being established and also how these factors influence the (usually perceived) success of these projects. Third, this review highlighted that there is an emerging interest in a particular form of collaboration, referred to as 'research partnerships' that are not shortterm isolated projects but enduring collaborative arrangements between firms and universities (Perkmann and West, 2015). The review concluded by showing that research in this emerging form of university-industry interaction has focused primarily on conceptual clarification. I drew attention to the few studies that have attempted to explore the practices associated with university-industry research partnerships and the small number of studies that have attempted to understand the developmental processes of university-industry research partnerships. The key insight emerging from this review is that it is important to understand how such research partnerships emerge and develop over time and that existing research fails to offer a theoretically informed account of this developmental process. The notable exception is Thune and Gulbrandsen (2014) who attempt to apply alliance development theory to better understand university-industry research partnership development. This research formed the point of departure for my enquiry. Specifically, Thune and Gulbrandsen (2014) conclude by suggesting that theories of alliance development may be insufficient to enrich understandings of university-industry partnership development, concluding that more research was required on how to theoretically account for the complexity of university-industry partnership development.

This conclusion invited a review of the existing theoretical approaches to strategic alliance development, which is presented in Chapter 3. Through engaging with these theoretical models of alliance development, I was encouraged to think more deeply about the process of

organisation emergence and development, otherwise labelled as 'process research' (Langley et al, 2013). Following this review, it became clear that existing theoretical approaches to alliance development were indeed limited in their capacity to accommodate the empirical complexity of partnership development (de Rond and Bouchiki, 2004). In particular, it became apparent that existing models of alliance development are limited by their underpinning conceptualisation of organisation and change (de Rond and Bouchiki, 2004). The assumptions of constancy, linearity and teleology that underpin process theories of alliance development restrict their analysis to empirical stabilities rather than change, in other words, to the analysis of 'being' rather than 'becoming'. After reaching this conclusion, it became necessary to explore theoretical approaches to change that facilitate the analysis of *the becoming* of partnerships (de Rond and Bouchiki, 2004).

This exploration involved a review of 'processual' approaches to organisation, which is presented in Chapter 4. In particular, I outline the approaches to organisational process theory that are explicitly informed by a metaphysics of becoming. This approach to organisational change, that adopts a processual ontology, was pioneered by early theorists such as Robert Chia, Hari Tsoukas, Robert Mills and has seen a resurgence in the domain of organisational theory. Particularly notable works that have developed processual approaches to organisation, that inform the theoretical approach adopted here include those by Hernes (2014a; 2014b; 2007), Weik (2011), Chia a & MacKay (2013) and Hussenot & Missonier (2015). In order to develop a theoretical model of process that would facilitate the analysis of partnership development, I drew upon the process philosophy of Alfred North Whitehead (1929) who has arguably gone further than any other scholar in the elaboration of a processual metaphysics (Hernes, 2014b; 2007). Through the integration of key Whiteheadian concepts, organisational process theory and theories of alliance dynamics, I attempt to offer a holistic answer to the empirical challenge of university-industry strategic partnership development. The scope of this research, along with a summary of the key findings, theoretical and practical implications are outlined below. I then provide a reflection on the limitations of this research and suggest potential directions for further enquiry.

8.2 Scope of Research

The research presented in this thesis responds to the calls for process research on the emergence and development of university-industry strategic partnerships (Perkmann & West, 2015; Perkmann & Schildt, 2015; Perkmann et al, 2013; Perkmann & Walsh, 2007). Consequently, my primary research question is "how do university-industry research partnerships emerge and develop over time?" In addressing this question, I aim to offer a theoretical basis for understanding university-industry partnership development, something that is distinctly lacking from the existing literature as suggested above. Although the primary concern is elaborating a theory of university-industry partnership development, I also aim to generate novel theoretical insights to existing research that has focused on alliance development processes at a more general level. Thus, my first ancillary research question is "how can strategic alliance development be understood processually?". I attempt to answer this question by integrating insights from process theories of change with theories of strategic alliance development. To resolve this question, I attempt to contribute towards processual theorising of organisational change in the broader sense by using insights from Whiteheadian process philosophy to expand upon current processual approaches to organisation (Hernes, 2014a; Hussenot and Missonier, 2015). Thus my second ancillary research question is "How can a Whiteheadian process perspective contribute towards more holistic understandings of emergence and development (organisation and change)?". Finally, I attempt to integrate these insights from process theory and processual approaches to strategic alliance development to answer the third ancillary research question which is "How can processual understandings of alliance development contribute towards our theorising the emergence and development of university-industry partnerships?"

To answer these research questions, I began with the fundamental issue of organisational change. Specifically, in Chapter Four I outline how Whiteheadian process metaphysics may be usefully incorporated into organisational analysis and operationalised in empirical research. To provide and answer to RQ2 (How can strategic alliances be understood processually?), I elaborate how the emergence and development of a strategic partnership can be understood as a confluence of interacting forces that I identify as choice, chance and determinism (Chapter 5). To address RQ3, I combine the insights from both RQ1 and RQ2 to develop a processual model of university-industry partnership development, that is presented in

Chapter 7. This model (displayed in Fig 7.3) illustrates the interacting processes that underpin the emergence and development of university-industry research partnerships.

The empirical investigation relied upon a single longitudinal case study, a design that is consistent with the aims of process research (Gehman et al., 2018, 2013; Langley, 1999; Langley et al., 2013). The empirical case focuses on the emergence and development of a strategic research partnership between Unilever, a multinational fast-moving consumer goods organisation and the University of Liverpool, a research-intensive university in the North-West of England. The case covers the period from mid-1999 through to mid-2017, during which time the collaboration developed from a personal interaction between two scientists to a multifaceted arrangement involving multiple stakeholders, actors, technologies and interests. At the beginning of the collaboration in 1999 the relationship was considered a peripheral activity for both parties but by the opening of the MIF in April 2017, the partnership was considered the most important external research collaboration for both organisations. As an indication of the scale of the collaboration, the investment in the MIF represents Unilever's largest ever investment in external R&D, which is substantial given the scale of Unilever's R&D global R&D operations. It is thought by senior stakeholders in both partner organisations that this partnership is unique amongst university-industry collaborations in terms of the depth, scale and strategic significance for long-term research efforts.

Data for the empirical study were collected via multiple different means. I spent a substantial amount of time with senior Unilever and University of Liverpool decision-makers who were responsible for developing the partnership over the course of the research. This involved site visits to Unilever R&D and to the Chemistry Department and Business Gateway at the University of Liverpool. This facilitated the development of an understanding about the roles of the different actors and the 'causal background' in which the partnership was continuing to develop. I also conducted numerous semi-structured interviews with the key individuals involved in the collaborative arrangement. This included individuals who were still active participants in the relationship and those who had played a part but had moved on or were no longer involved. I collected a significant amount of documentation that related to various different aspects of the collaboration, which helped clarify the sequence of events, inform

interview questions and identify participants. In combination, these multiple sources of data enabled the construction of a rich and detailed case narrative that formed the basis of the analytical work.

The analytical work itself proceeded in four stages, which began with making sense of the material I had collected and concluded with an abstract theoretical model for organisational emergence and development. First, I created an events-database coding all of the empirical material I had collected to identify specific events that made up the strategic partnership. This produced an initial list of over 350 events, which was still unmanageable in terms of producing a coherent account of the partnership. To facilitate interpretation, I engaged in a visualmapping exercise whereby I created 'maps' of events. This allowed me to identify clusters of events that patterned around underlying themes. Based on this analysis, I was able to identify four broad event-formations around which I could structure my narrative analysis. Narrative vignettes were written for the clusters of events identified within each event-formation which resulted in a comprehensive and detailed case history. Reading the descriptive case history, it became apparent that the existing theories of alliance development based on assumptions of linearity, evolution and teleology would could not adequately explain the dynamics at play without imposing extreme reductions in the complexity of the case. Therefore I went back to the literature to explore theoretical approaches that were not based on such assumptions. Following this literature search, I reread the descriptive case history with processual approaches to change in mind, in particular MacKay and Chia's (2013) unowned process theory of change. For each event-formation, I identified the choices, chance occurrence and causal backgrounds which described the patterning within the event-formation. This enabled the construction of a theoretically informed analytical narrative that describes the formation and development of the Unilever-University of Liverpool partnership, which is presented in Chapter 5. Fourth, to elucidate insights into the process of organisational emergence and development, I recoded the account presented in Chapter 5, paying particular attention to what the events did. This coding was based on the Whiteheadian framework that was devised and presented in Chapter 4. The result, presented in Chapter 6, is an events-based account of organisation and change. In Chapter 7, I outline how both of these analytical accounts can be integrated and outline my Whiteheadian model of partnership development. A summary of the main findings and their theoretical implications is provided below.

8.3 Main Findings and Theoretical Contributions

The findings based on analysis of the empirical material are presented in Chapters Five and Six. The implications of these findings for existing theory are discussed in Chapter Seven. Briefly, the findings of this research are related to three major issues, indicated by the research questions. Firstly, findings are concerned with the fundamental nature of organisation and change and the implications for processual theorising. Secondly, the findings presented in Chapters Five and Six address concerns with theorising strategic alliance development. Thirdly, the findings presented in the earlier chapters are concerned with understanding the development of university-industry research partnerships. Taken collectively, these findings fulfil the overarching research aim, which is to develop a more holistic understanding of how university-industry partnerships emerge and develop over time.

8.3.1 Reconceptualising organisation and change: Towards a Whiteheadian perspective

One of my research questions asks "How can a Whiteheadian process perspective contribute towards more holistic understandings of organisational emergence and development?". One of the key findings of this research is that a Whiteheadian process perspective can enrich our understanding of organisational emergence and development by providing a framework that overcomes the 'being/ becoming' dualism that has obstructed theorising in organisational change (Van de Ven and Poole, 2005; Weik, 2011). Chapter Three highlights that there are two dominant and contrasting approaches to organisational change, each based on distinct metaphysical assumptions. It is also highlighted, in Chapter Four that this pervasive dualism (commonly referred to as the 'being-becoming' dualism) is increasingly recognised as problematic (Bakken and Hernes, 2006; Hernes and Weik, 2007; Weik, 2011) since it inevitably bounds analysis which then limits our theorising of organisational change.

Building on the work of contemporary organisational process theorists (Hernes, 2014a, 2014c; Hussenot and Missonier, 2015; MacKay and Chia, 2013; Tsoukas, 2017; Weik, 2011), I draw upon the ideas of process philosopher Alfred Whitehead to offer a solution to this dualism, which is achieved by elaborating an events-based frame for organisational analysis

(Chapter Four). Whilst other organisational process researchers have proposed events-based frameworks (Hussenot and Missonier, 2015; Hernes, 2014a), there are, to my knowledge, no empirical studies that have demonstrated how a Whiteheadian lens functions to bridge this being-becoming dualism. In Chapters Six and Seven, I find that the being-becoming dualism can be resolved via a Whiteheadian approach by focusing on the agency of events and by elaborating on the functions of prehension. I find that, by foregrounding events and prehension, it is possible to analyse how abstractions (or 'being'-actors, concepts, materials) are constituted through process ('or becoming'-relationality and activity of events), forming a connected whole that is perceived as stable and enduring but is constantly in-formation (organisational meaning structure). Similar to Hussenot and Missonier (2015), I find that prehension is an important and useful theoretical mechanism that helps us understand the formation and development of organisation. However, as illustrated in Chapters Six and Seven, I expand on the particular functions of prehension, which remain vague in existing process theory. In particular, I find that prehension, consistent with Whitehead's original notion, is not an interpretive agentic exercise but is a force that is constitutive of agents and by implication, organisations. Chapter Six suggests that prehension functions in two main ways, one which is constitutive of stability (relationality) and one which is constitutive of change (activity). I find that events create organisational stabilities by connecting to the past and future, which define the elements of organisational meaning structures and locate them in spatio-temporal terms. Furthermore, I find that change is stimulated by prehensions that connect, disconnect and re-connect different elements (actors, concepts and materials) to the organisational meaning structure. Thus, my findings draw attention to the agency of events that is exercised through prehensions which are productive of social, conceptual and material elements that ultimately constitute organisation. This critical insight suggests that a Whiteheadian process framing is able to successfully incorporate both 'being' and 'becoming' within analysis, facilitating a greater understanding of how these two aspects of change are mutually constituted. Therefore, it is still possible to talk of 'organisations', 'actors', 'concepts', 'materials', 'partnerships' and so on without denying or relegating the role of becoming. Conversely, the analysis presented in Chapter Six and Seven shows that these elements of organisation are constantly in the process of formation and reformation as prehensions unfold. These results respond directly to calls by Weik (2011), Hussenot and

Missonier (2015) and Hernes (2014a; 2008) for further research into how an events-based approach to organisation might usefully enrich analysis of emergence and development.

8.3.2 Reconsidering alliance development: Towards an unowned process perspective

Based on the Whiteheadian understanding of organisation and changed outlined above, I developed an alternative approach towards understanding strategic alliances and their development. Specifically, the insights from Whiteheadian process analysis suggested that alliances be reconceptualised as relational accomplishments rather than static, enduring entities. In other words, based on the analysis presented in Chapter Six, I find that alliances are heterogenous assemblages of events, that connect social, material and conceptual elements around a discernible pattern. Such a conceptualisation of alliances is radically different from existing theories of alliance dynamics, which rely on entitative conceptualisations of alliances as composed of discrete and unchanging properties such as actors, resources, environments, organisations and goals (Bell et al., 2006; Bruyaka et al., 2018; Doz, 1996; Gulati, 1998; Kale and Singh, 2009; Lumineau and Oliveira, 2018; Ring and Van de Ven, 1994).

In contrast, I found that these characteristics or properties of alliances are never fully settled but are continuously configured and reconfigured by connections between events. Thus, I found that existing theoretical approaches to alliance dynamics, that are based on observing changes in these fixed properties, were inadequate for understanding the complex dynamics that characterise the unfolding of alliances. In short, I found that these approaches, that attempt to explain alliance development by reference to changes in fixed characteristics were insufficient precisely because the characteristics that constitute 'the alliance' (goals, actors, organisations, resources) are constantly changing. Thus, I propose a model of alliance development that explains how these seemingly fixed characteristics are continuously formed and re-formed, or how *they become*. This model directly responds to a call from de Rond and Bouchiki (2004) who suggested that theories of alliance dynamics that rely upon assumptions of teleology and environmental selection are too inflexible to fully capture the complex emergence of alliances. Through analysing the emergence and development of the Unilever-University of Liverpool strategic partnership (presented in Chapter Five), I found that choice, chance and determinism are important forces in shaping the developmental trajectory of events which then define what an alliance becomes. In so doing, I provide an alternative approach to alliance development to those existing theories that rely on either managerial cognition and learning or environmental selection as theoretical mechanisms that explain alliance outcomes (Das and Teng, 2002; Doz, 1996; Gulati, 1998; Ring and Van de Ven, 1994). Conversely, my model of alliance development suggests that rather than being driven by a teleological process of goal-setting, learning and adjusting or by an evolutionary process of environmental selection, adaption and retention, alliances develop through a sequence of interactions between distributed forces of choice, chance and determinism. This theoretical approach to alliance development, as driven by interacting forces, is similar to the dialectical approach advocated by de Rond and Bouchiki (2004). It is similar in the sense that distributed forces and their interaction are seen as primary divers of alliance development, however my approach differs both in the types of forces considered and the nature of their interactions.

To clarify, de Rond and Bouchiki (2004) suggest that alliances develop through the confrontation of various forces (including, trust/ vigilance, autonomy/control, emergence/design, co-operation/ competition) which are an established catalogue in organisation studies but often refer only to human action rather than permanent forces that all organisations are subjected to (Weik, 2011 p.668). Although de Rond and Bouchiki (2004) suggest that the forces they refer to serve no explicit or underlying purpose, they indicate that it is the conflict between these forces that underpins the development of the alliance. I provide a complementary perspective by starting from the notion that alliances are torn by multiple interacting forces. I expand on their contribution by drawing attention to a different set of forces that are not strictly limited to human strategic action but are attentive to the broader forces that all organisations are subject to (choice, chance, determinism). Furthermore, I suggest that it is not necessarily the *conflict* between these forces but the *complementarity* of these forces that guides the connections between events which ultimately determine 'the state of alliances'. These findings build on de Rond and Bouchiki's (2004) dialectical perspective, which provided an important point of departure for a

processual perspective on alliances but that has received relatively little theoretical attention since (with the exception of Vlaar et al (2007).

The elevation of the role of serendipity in the formation and development of alliances also reflects a novel contribution to theorising alliance development. Specifically, existing teleological and evolutionary theories of alliance development all acknowledge that chance events impact the development of alliances but the role of chance is always subsidiary to either managerial learning (in the teleological approaches) or environmental selection (in evolutionary approaches). Conversely, I show that chance is equally important in guiding the connection of events to the meaning structure as managerial agency and environmental determinism. Thus, the role of chance in explaining partnership development is elevated in comparison with its role in existing theories of alliance development.

Similar to de Rond and Bouchiki (2004) my findings suggest that that neither life-cycle, teleological or evolutionary theories of alliance development are sufficient to account for alliance dynamics. That is not to diminish the importance of human agency nor the importance of environmental, political and economic arrangements in explaining the development of alliances. Rather, it is to recognise that that these influences alone are not sufficient to account for the complex unfolding of alliances. My findings therefore suggest a move towards an 'unowned' perspective of alliance development (MacKay and Chia, 2013) that is mindful of these influences but also recognises their limitations. I highlight that it is *the interactions* between these influences that shapes the developmental course of alliance development, it can be said that the development of alliances is not *owned* in the sense of being under the control of any particular actor or environmental influence. Therefore, following MacKay and Chia (2013), I adopt the term *'unowned'* to indicate the development of alliances is not attributable to any particular stakeholder or force alone, but is a consequence of their complex interaction.

8.3.3 Becoming partners: Towards a conjunctive theory of university-industry partnership development

The finding that alliances reflect heterogenous assemblages of events that are produced and reproduced through the forces of relationality and activity has significant implications for theorising the development of university-industry partnerships. As highlighted above, I find that alliances emerge and develop through the interaction of multiple, distributed forces (choice, chance and determinism) which shape the connections between events that then define what the alliance is. Such an unowned perspective is radically different to existing theoretical perspectives on university-industry partnership development (and to the university-industry collaboration literature more broadly).

As outlined in Chapter 2, much of the existing literature concerned with university-industry interaction has focused on the formal transfer of intellectual property rights through academic entrepreneurship (Perkmann et al, 2013). However, there is an emerging interest in a form of university-industry interaction broadly termed 'research partnerships' (Ankrah and AL-Tabbaa, 2015; Boardman and Bozeman, 2015; Perkmann and Walsh, 2007; Perkmann and West, 2015; Philbin, 2008; Thune and Gulbrandsen, 2014). Briefly, most of this emerging literature has focused on the conceptual clarification of the empirical phenomena. For example, Perkmann and Walsh (2007) distinguish university-industry research partnerships from other forms of university-industry interaction such as 'research services', 'commercialisation' and 'contract research', defining them broadly as "formal collaborative arrangements among organisations with the objective to co-operate on research and development activities" (Perkmann and Walsh, 2007 p.268). Following their comprehensive literature review, Perkmann and Walsh (2007 p.274) draw attention to the lack of research on the organisation and management of university-industry research partnerships, advocating more research on "the strategies firms use to establish and manage universityindustry relationships in an open innovation scenario." In particular, they suggest that larger firms are displaying a tendency to establish longer term research collaborations with universities but we that we know little about how these partnerships are created and managed by these firms (Perkmann and Walsh, 2007).

Despite their call for more research into the emergence and development of strategic research partnerships, a similar call was reiterated by Perkmann and West (2015) in a more recent contribution. In this contribution, a typology of university-industry partnerships is presented, enhancing conceptual clarity around university-industry research partnerships. It is concluded that "more research is needed on *how* and why firms engage in collaborative research partnerships and how they should be structured organisationally" (Perkmann and West, 2015 p.57). Despite the relative lack of attention to the development of university-industry research partnerships, there have been a number of notable contributions that have attempted to elaborate on the process of partnership development (Ankrah and Al-Tabbaa, 2015; Philbin, 2008; Thune and Gulbrandsen, 2014).

Thune and Gulbrandsen (2014) explicitly draw upon alliance dynamics literature to explain the relationship between initial formation conditions, developmental trajectories and partnership outcomes. Based on an empirical study of six research partnerships, they propose that initial formation conditions stimulate distinct developmental trajectories that lead to specific outcomes. For example, they suggest that partnerships formed under 'emergent conditions' develop along a pathway of 'reinforcing good relations' that leads to partnership stability (success). However, in concluding, they suggest that "a complicating factor is that large scale university-industry partnerships typically combine two, or in some cases, all three of the stylised conditions described in the literature" (Thune and Gulbrandsen, 2014 p. 988). Finally, they suggest that these stylised developmental pathways did not always hold and encouraged further research into the development of university-industry partnerships that would test the validity of their assumptions and conclusions (Thune and Gulbrandsen, 2014).

My findings suggest that alternative assumptions need to be adopted if the complexity of university-industry partnership development is to be accounted for theoretically. The unowned process theory of alliance development advanced above and in Chapter 7 suggests that some of the assumptions underpinning Thune and Gulbrandsen's (2014) theoretical model of university-industry partnership development are problematic. Furthermore, my findings suggest that assumptions underpinning other theoretical models of research partnership development, such as those offered by Philbin (2008) and Ankrah & Al-Tabbaa (2015) are equally problematic because they rely on the same underlying ideas of life-span,

constancy and teleology. First, my findings suggest that it is problematic to assume stylised 'initial conditions' that are characteristics of the partnership at formation. My findings suggest that this is problematic because partnership characteristics are never fixed (e.g. actors, concepts and materials) but are only ever provisional. Thus, any attempt to 'fix' partnership conditions is nothing more than an arbitrary decision made by the analyst about which characteristics appear to them most salient. In characterising partnership conditions as 'emergent, engineered or embedded', an artificial solidity (or '*misplaced concreteness*') is imposed on the empirical world that is not fully reflective of the unfolding empirical complexity. This is acknowledged by Thune and Gulbrandsen (2014) who suggest that in actuality, all of the partnerships they examined exhibited characteristics of the different 'initial conditions' to different degrees. Thus, it is unsurprising that they find that alliance conditions cease to matter over the long term and that they fail to adequately account fully for the developmental trajectory of the partnership.

Second, my findings suggest that it is problematic to attribute the developmental course of partnerships solely to the 'alliance conditions', since this overlooks the critical roles played by managerial agency and serendipity in the partnership development process. The attribution of the partnership development trajectory to the 'initial conditions' (alliance characteristics) is also stems from the assumption that characteristics are fixed, which implies that developmental pathways are also fixed. Again, my analysis suggests that the development of university-industry partnerships is not a linear process whereby the outcome of the partnership is determined by the characteristics at its formation. Conversely, my unowned model of alliance development suggests that characteristics are constantly being shaped and reshaped by multiple dispersed forces and it is only by understanding the interplay between choice, chance and determinism we can grasp how partnerships unfold.

Third, my findings suggest that it is also problematic to assume that stability equates to 'success' within university-industry partnerships and instability is synonymous with 'failure', as indicated by existing models of university-industry partnership development (Ankrah and Al-Tabbaa, 2015; Philbin, 2008; Thune and Gulbrandsen, 2014). My findings demonstrate that 'successful' research partnerships, such as the Unilever-University of Liverpool partnership, are not necessarily stable. For example, throughout the course of the partnership there were

multiple changes in personnel (including at top management level), interests, concepts, resources and priorities which, upon reflection, indicate a seemingly unstable set of arrangements. Yet, some elements of the partnership remained consistent throughout the development of the partnership, for example Archer Mills and Peter Blanken were active in the collaboration for over ten years. Thus, my findings indicate that stability and instability coexist, simultaneously characterising university-industry partnerships without any particular implication for 'success' or 'failure'. In other words, stability and instability don't determine the alliance outcomes, they are just merely 'facts' or aspects of university-industry partnerships.

The issues with existing models of university-industry partnership development outlined above stem from the assumption of fixity, rather than change and the prioritisation of 'things' rather than 'process'. Therefore, it is unsurprising that Thune and Gulbrandsen (2014) conclude by suggesting that "university-industry partnerships may be more unstable than the theoretical literature on dynamics of alliances predicts, due to the complexity of the initial conditions and modes of interaction. This is because these theories rely on a 'disjunctive' logic that attempts to reduce empirical complexity by dividing the world up into neat circumscribed entities, thus imposing a degree of simplicity that does not reflect the complex unfolding of university-industry partnerships. Conversely, I find that it is not that the phenomena are too complex, but rather that the theoretical explanations are 'not complex enough' (Tsoukas, 2017). To resolve this issue within the university-industry partnership development literature, I offer a 'conjunctive' theory of partnership development (Tsoukas, 2017) that attempts to account for empirical complexity by focusing on how stabilities are produced through interaction. I find that the interactions between managerial choices, environmental changes and serendipitous occasions stimulate connections between events that form configurations that define university-industry partnerships. In contrast to existing models like those mentioned above and in Chapter Two, my model is capable of incorporating empirical complexity because I do not rely on assumptions about stylised 'initial conditions' or 'modes of interaction' (Thune and Gulbrandsen, 2014). Rather, I suggest that what university-industry partnerships are (or what their 'conditions' are) are a function of their becoming. This becoming is characterised by an interplay of dispersed forces that cultivate configurations of events that constitute the partnership. These event-formations define what 'the partnership

is' at any given moment and the process is never complete due to the continuous interplay between these forces. Thus, university-industry partnerships, no matter how apparently stable or enduring, are only ever provisional, always open to reconstitution as these forces reshape the connections between events.

Considering the three main findings in totality, I believe that I have achieved the overarching aim of the research, which was to develop a better understanding of how university-industry research partnerships emerge and develop over time. Drawing on insights from Whiteheadian process philosophy, I have developed new insights into the nature of 'emergence and development' which has enabled a reconceptualization of strategic alliances. This reconceptualization contributed to an alternative approach to understanding alliance dynamics which opened up new ways of understanding the establishment and development of strategic university-industry research partnerships. In the next section I provide some brief reflections on the limitations of this study and suggest potential directions for future research.

8.4 Theoretical limitations and considerations for future research

The key contribution of this research, as outlined above, is the Whiteheadian reconceptualization of organisational emergence and development. In demonstrating the empirical utility of this reconceptualization, it was possible to develop new insights into the formation and development of strategic alliances and into theorising university-industry research partnership development in particular. To develop these theoretical insights, I relied upon a single longitudinal case study of the Unilever-University of Liverpool strategic partnership. Whilst this approach is consistent with the aims of the research and with process theorising more broadly (as demonstrated in Chapter 4), many still have reservations about the single-case method for generating robust theoretical insights (Flyvbjerg, 2006; Gehman et al., 2018). The main critique levelled at those employing single-case designs is that insights are not generalisable (Flyvbjerg, 2006). Langley (1999) also notes that those employing a narrative approach to process theorising run the risk of producing rich idiosyncratic accounts that are of marginal interest to those not immediately involved.

However, such criticisms are made on the basis that 'context and value-fee' (i.e. disembodied 'objective') knowledge is both possible and preferable to situated practical knowledge (Flyvbjerg, 2006). In consideration of the ontological foundations on which the current research is based and the finding that suggests 'what is' is constantly shaped by connections between events, it would be inappropriate for me to claim that my findings about the development of university-industry partnerships are generalisable to other universityindustry partnerships. Following Whitehead's events-based metaphysics and in light of my findings, I would argue that all knowledge is in a constant state of reproduction through the connecting of events. Whitehead would suggest that any attempt to generalise from this case would be to overemphasise the significance and robustness of abstractions, which I have demonstrated are always in the process of being reshaped (e.g. the actors, concepts, materials that make up 'the partnership'). This over-reliance on abstractions as reflective of the totality of experience is what Whitehead refers to as 'the fallacy of misplaced concreteness' (Whitehead, 1929 p.7-8). It is for this reason that I deliberately do not provide managerial or policy prescriptions. My findings reveal the heterogenous nature of alliances and the complex nature of their becoming, therefore it makes little sense to recommend specific courses of action based on this particular case. Furthermore, my findings draw attention to the limits of managerial agency and causal backgrounds in determining the outcome of partnership formation and development, which also makes it difficult to recommend 'practical solutions' to managers and policy makers about how to cultivate university-industry partnerships.⁴

However, this does not mean there can be no managerial insights gleaned from my analysis. Consistent with the notion of 'theoria' (Zundel and Kokkalis, 2010), I aim to provide an alternative way of viewing the phenomena of partnership emergence and development. My findings highlighting the 'unowned' nature of partnership develop suggest that managers and policy-makers involved in the cultivation of university-industry partnerships should try to develop a sensitivity to and awareness of the dynamic nature of change. They would be

⁴ The futility of offering managerial prescriptions was highlighted by one of the participants in my study who was a senior manager at Unilever responsible for the MIF project. He suggested that if Unilever attempted to follow the same approach to partnerships with another UK university, or even with Liverpool at a different point in time, it would inevitably be unfit for purpose because of the different situations that would present unforeseeable complications.

advised to be mindful of their limited capacity to control the unfolding of partnerships and to develop an attentiveness to the seemingly peripheral and non-linear occurrences that may one day become important strategic concerns.

Another issue with my research relates to my relative distance from some of the events that I report on. I was unable to negotiate access to the meetings of the JSB and the MIF Board, which would have enabled me to develop more nuanced understandings of how events work to define meaning structure elements and to shape the unfolding developmental trajectory. In particular, I would have been able to get a better understanding of the particular salience of events and how they impacted the actions of decision-makers at events. This would have been incredibly insightful and would have enabled the development of a richer narrative account, however it might not necessarily have contributed to a greater appreciation of the functioning of prehension. As Hernes (2014a p.179) highlights:

"one cannot be all the time and one is not at all likely to be there important things take place, moreover it is not given that even if one is there, that the importance of the event is clear to the actors present"

Rather, the significance of events (and thereby the functioning of prehension) is only realised in the connections to other (past and future) events. The "actual agency" of the event is only apparent in light of subsequent developments (Hernes, 2014a p.180). Nevertheless, my inability to negotiate first hand access to the events that I report undeniably detracts from the richness of narrative I present.

In response to the issue of generalisability, I suggest that while I can make no claims about the general development of university-industry partnerships, I can suggest that the mechanisms of relationality and activity are generally applicable to organisational change processes. Furthermore, I suggest that the forces of choice, chance and determinism will all influence the unfolding of alliances in some capacity beyond this particular case (although it may be that some influences are stronger than others in different situations). Therefore, I suggest that the theoretical model of partnership development I offer based on the Whiteheadian analysis of this case could form the basis of future research. Future research

239

could attempt to elaborate further detail on how prehension functions. I identified two modes of prehension, suggesting events work by connecting future and past and by connecting (and disconnecting) different meaning structure elements. Future work could examine on other forms of work performed by events, using these broad modes of relationality and activity as a theoretical point of departure. Future research on alliance development should also attempt to examine the interplay of choice, chance and determinism further and examine their interplay with other forces that could shape the trajectory of events, for example those suggested by de Rond and Bouchiki (2004). Future research pertaining to the 'unowned' process of emergence and development might also be undertaken in the context of 'firm-firm' alliances in which strategic decision-making may play a more significant role. Furthermore, the unowned process model is not limited particularly to alliance development, MacKay & Chia (2013) show that firm demise is an unowned process and here I demonstrate that partnership growth is also an unowned process. Future research could explore different organisational processes, such as small firm growth, new product launches, strategic change programmes, mergers and acquisitions and so on to examine the extent to which the unowned perspective of change holds across different organisational phenomena.

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Appendix

Appendix 1a- Documentary Data Overview

Type of Document	Words/ Pages	Date
Business Plans		
MIF Business Plan 2014-2017	9215	01/04/14
MIF Business Plan 2015-2018	16436	01/04/15
MIF Business Plan 2016-2019	22225	01/04/16
MIF Business Plan 2017-2020	40,723	01/04/17
Minutes of the JSB		
1st Meeting of the JSB	1072	13/11/12
2nd Meeting of the JSB	974	30/11/12
3rd Meeting of the JSB	870	05/02/13
4th Meeting of the JSB	974	15/03/13
5th Meeting of the JSB	635	16/04/13
6th Meeting of the JSB	861	10/06/13
7th Meeting of the JSB	634	02/07/13
8th Meeting of the JSB	1715	16/09/13
9th Meeting of the JSB	838	24/10/13
10th Meeting of the JSB	713	12/11/13
11th Meeting of the JSB	854	21/11/13
12th Meeting of the JSB	819	18/12/13
13th Meeting of the JSB	1062	14/01/14
14th Meeting of the JSB	792	17/02/14

15th Meeting of the JSB	755	10/03/14
16th Meeting of the JSB	821	03/04/14
17th Meeting of the JSB	973	29/05/14
18th Meeting of the JSB	1129	19/06/14
19th Meeting of the JSB	1104	21/08/14
20th JSB Build Update	737	10/09/14
21st Meeting of the JSB	880	07/10/14
22nd Meeting of the JSB	1091	11/11/14
23rd Meeting of the JSB	1525	15/12/14
24th Meeting of the JSB	1154	03/03/15
25th Meeting of the JSB	834	28/04/15
26th Meeting of the JSB	913	11/06/15
27th Meeting of the JSB	1280	28/07/15
28th Meeting of the JSB	1103	15/09/15
29th Meeting of the JSB	1083	18/11/15
30th Meeting of the JSB	1227	14/12/15
31st Meeting of the JSB	830	25/01/16
32nd Meeting of the JSB	664	23/02/16
33rd Meeting of the JSB	1906	31/05/16

34th Meeting of the JSB	1231	27/07/16
35th Meeting of the JSB	1368	07/09/16
36th Meeting of the JSB	1160	18/10/16
37th Meeting of the JSB	915	21/11/16
38th Meeting of the JSB	832	22/02/17
MIF Board Quarterly Report	17927	14/02/16

Other Documentation	Words	Date
MIF SLA and all Schedules	69065	11/04/14
Stage1 Equipment Manifest	5763	01/04/15
MIF Marketing Plan	2371	11/12/15
Stage 2 Equipment Manifest	9734	13/11/15
Expression of Interest in RPIF (Royle)	2794	08/06/2012
RPIF (MIF) Proposal	15826	19/08/2012
RPIF Call	2590	12/05/2012
UoL-Unilever Relationship Agreement	30 Pages	18/11/2012
Key Account Management Update	1304	07/04/2012
WARD Talk at Hestletine	812	15/11/2013
Formulation Engine- Proposed Procurement Solution	3021	16/03/2016
Formulation Engine- Ways of Working Post Supplier Selection	649	23/04/2016

CMD Progress Report- ERDF	477	23/11/2005
CMD Final Progress Report	4605	23/11/2008
CMD Business Plan	18445	31/05/2005
CMD Renewal Agreement	30 Pages	03/05/2011
CMD SLA and Schedules	50 Pages	14/12/2006
EPSRC Proposal- Complex Materials Portfolio Partnership	653	01/11/2004
Proposal for Funding Computer-Aided Formulation R&D at the Knowledge Centre for Materials Chemistry	1163	02/02/2009
NWDA Final Progress Monitoring Report	5891	10/12/2008
RGF2 (Micro-Bio Refinery) Proposal	10962	15/06/2011
MBR Contract	14000 Approx.	
RGF2 Termination Notice	345	17/11/2015
RGF 2 Grant Offer Letter	8697	18/05/2012
Green Industry Innovation Talk	650	01/01/2012
Integrated High-Throughput Formulation Centre Update	1822	13/05/2013
RGF3 Proposal (High-Throughput Formulation Centre)	2856	13/06/2012
RGF3 (High-Throughput Formulation Centre) Offer Letter	8500 Approx.	04/01/2013
McIntyre Industry-Innovation Talk	758	01/02/12
RGF3- Consultant's due diligence report	17000 approx.	13/12/2012
RGF3 Statement of Work	1100 approx.	13/06/2012
Internal case for Integrated High-Throughput Formulation Centre	3655	13/06/12
MBA Dissertation on early years of Unilever Open Innovation- Written by Unilever Director of OI	18,000	Summer 2007
Press Releases and Articles	22 articles	Various

A	р	pendix	1b-	Overview	of	Interviews
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Name	Organisation	Date	Length (minutes)	Transcribed	Number	Informants
WARD	Unilever	2014-08-07	, 80	YES	1	. 1
BLANKEN	University of Liverpool	2014-08-11	. 50	YES	2	2
WARD	Unilever	2014-08-14	20	YES	3	•
WARD	Unilever	2014-08-14	40	YES	4	ł
STEPHENSON	University of Liverpool	2014-08-29	65	YES	5	3
ROYLE	University of Liverpool	2014-10-09	30	YES	e	6 4
BLANKEN	University of Liverpool	2016-02-09	70	YES	7	,
LYLE	University of Liverpool	2016-02-10	50)	8	5
WARD	Unilever	2016-02-29	50	YES	g	
CLARKE	University of Liverpool	2016-03-08	65	YES	10	6
WARD	Unilever	2016-03-09	50	YES	11	
MOSS	University of Liverpool	2016-03-10	30	YES	12	. 7
MCCALL	University of Liverpool	2016-03-10	30	YES	13	8
BLANKEN	University of Liverpool	2016-04-06		YES	14	ŀ
ROYLE	University of Liverpool	2016-04-10	50	YES	15	
WARD	Unilever	2016-04-10	100	YES	16	
ROBINSON	University of Liverpool	2016-04-18	30	YES	17	' 9
WARE	University of Liverpool	2016-04-19	90	YES	18	10
MOSS	University of Liverpool	2016-04-26	60	YES	19	
JONES (ANDY)	University of Liverpool	28/04/2016	5 30	Notes	20	11
DOWDALL	University of Liverpool	2016-05-06	j 70	YES	21	. 12
WARD	Unilever	2016-11-23		YES	22	
STEPHENSON	University of Liverpool	2017-02-12	60	NOTES	23	
NITIN	Unilever	2017-03-14	60	YES	24	13

SAMIRAN	Unilever	2017-03-14	45	YES	25	14
GREEN	Unilever	2017-04-19	55	YES	26	15
JACKSON	Unilever	2017-05-08	60	YES	27	16
JACOBS	Unilever	2017-05-24	60	YES	28	17
WARD	Unilever	2017-05-24		YES	29	
MURRAY	Unilever	2017-05-25	60	YES	30	18
MILLS	University of Liverpool	2017-07-10	75	YES	31	19
CHESTER	Policy	2017-07-12	60	YES	32	20
STEPHENSON	University of Liverpool	2018-02-20	60	NOTES	33	
GREEN	Unilever	2018-03-20	45	NOTES	34	
WARD	Unilever	2018-10-03	90	YES	35	

Appendix 3a- Relationality and Activity- CMD Established

Events/ Narrative Vignettes	Narrative	
	Themes	Theoretical Processes
Jun 99: Archer Mills and Alex Stephenson meet at a dinner in Cambridge University. Stephenson is leading a synthetic chemistry research group at Port Sunlight and Mills is completing a postdoc in Organic Synthetic Chemistry at Cambridge		
"I knew Alex really just, not from Unilever specifically, I just met him at Polymer Conferences, I actually met him when I was still a post-doc in Cambridge. So I knew him before I came to Liverpool a little bit and yeah that's the first contact."	Connecting Actors	
So before I joined Unilever I let ArcherArcher was doing a post-doc in Cambridge and I was asked to go and speak at a meeting in Cambridge and, and as they do with speakers often, they try and entertain them afterwards. So I went for dinner with Archer as a post-doc with his supervisor, and I met Archer properly then. As a complete fluke though, Archer's wife worked at Unilever, in Port Sunlight"		Activity- connected social, conceptual and material elements to the meaning structure
Sep 99: Mills is successful in his application for Royal Society Fellowship- Can go to any institution of his choosing in the UK and selects University of Liverpool to be closer to his wife. "So when Archer got a Royal Society Fellowship, he brought it to Liverpool to be closer to his wife, as you doand when he moved up, he contacted me and I thought yeah well let's get back together and we started talking to each other"- Alex Stephenson	Connecting Actors	

Feb 00 : Unilever SMT launch large scale organisational change programme in an attempt to address flagging commercial performance. 'Path to Growth' entails the concentration of R&D funding, including the move towards 'Open Innovation' "In February 2000, following several years of sluggish performance, the Chef Executive Officer of Unilever announced a new five-year "Path to Growth "strategy. The aim was to rejuvenate the company and restructure its portfolio of food, home and personal care businesses. The announcement was preceded by a significant decline in Unilever PLC's stock price from a peak of 690p in June 1998 to 341p just prior to the announcement. Path to Growth involved a reduction of the company's brand portfolio, the concentrating of R&D and advertising resource onto the company's leading brands, divesting a number of underperforming brands and businesses, boosting product innovation, making new acquisitions and achieving faster growth in sales and earnings"- MBA Dissertation Unilever Director of Open Innovation.	Connecting concepts
<i>Feb 00</i> : Mills and Stephenson begin regular research meetings. Mills provides updates to Stephenson about his latest work and research challenges/ interests. Stephenson provides access to Port Sunlight library and details his research challenges and interests. "we were probably talking to each other for maybe, I don't know two years backwards and forwardsthen we had access to journals at Port Sunlight that he didn't have access to here, he would come over, we would have lunch, talk about the science he was doingI would explain Unilever to him, he didn't need a lot of that because Julie was doing it anyway. But then he would go in the library, spend a little bit of time there and then come back homeand we would do that maybe once every two or three months"- Alex Stephenson "Yeah, initially they weren't connected you know, we were doing these thingsit was out of interacting that I think that is the genesis of it, it was because we were interacting on these projects we got talking about other longer-term things. And part of it is that I just get on with Alex and you know we used to go for coffee and just chat and you know unless at some level you have some sort ofsynergy or, you have got to probably like people a little bitso we were talking about that and basically, long-story short came up with this idea to set up and establish what became the Centre for Materials Discovery. It really was a joint idea, but at that time Alex was working in Unilever and me I was based in the University so I led it, I had to lead it because it was a University-based project but certainly a lot of the thinking came from Alex as well, it was a sort of common idea, "- Archer Mills	Connecting concepts

Oct 00: Liverpool City Region deemed as an 'Objective One' area by ERDF- becoming a priority area for the allocation of the EU's structural funds "That concept grew and the opportunity at that point in time, I think, in terms of the funding landscape was Liverpool was seen as an Objective One area, we could access what they call sort of funding of last resort, which was ERDF and NWDA. And so, we drew up an application for that with Unilever, because you needed to have industrial match, cash fundedso for a pound that you get from Unilever, you could get a pound from NWDA and a pound from ERDF"- Peter Blanken	Connecting material (capital)
<i>Aug 02:</i> Mills and Stephenson develop a proposal for a High-Throughput platform that would be based at the University of Liverpool focused on the integration of high-throughput approaches with conventional bench-chemistry "what we said was actually, you don't need to do 1000 experiments a weekwhat you just need to do is cover the ground that you need to cover faster than you're covering it now and that could be a factor of two, it certainly doesn't have to be a factor of 1000 yeah, you know just 2 would be fine, you know 5 would be greatyeah? So rather than doing one experiment a week, doing two. Rather than doing 10 experiments a month, doing 20 or 50 would be greatSo we put togetherwe followed a process called the BTIA process, which is the Basic Technology for Industrial Application, I thinkwhich was a DTI project structure, where industry and academia got together just like the current TSB programmes, Industry puts some money in, academia puts some money in, the BTIA/ DTI put a load of money in to enable it all and then away you wentand what we said was, we would like to build a platform that did High Throughput research, not High Throughput Screening, which was what Symx was doing, apply conventional chemistry but quicker"- Alex Stephenson	Connecting concepts
"So that was born really of discussions between Alex Stephenson and I predominantly and that came out of kind of shared interest in partly, high throughput methods and automation and so forth but I think more long term just erm, interest in having good facilities really"- Archer Mills	

<i>Feb 03</i> : In-principle agreement to support project reached by Stephenson, Mills and Jack Groves	
"The University was very supportive, the vice-chancellor at the time was Drummond Bone, he was very supportive. the pro-vice chancellor at the time was a guy called Jack Groves, or one of the pro-vice chancellors and a guy called John Saunderseveryone was very supportive, Tyler Henderson was the sort-of more senior person in Unilever, who was Alex Stephenson's boss, he was absolutely on board with it. Everyone was on board, but it took a long time to get it to come to pass because it was just not something that could be funded at the time by any one party"- Archer Mills	
" re-wrote, in essence what Mark had done into a very very different proposition but following a similar format and just presented that at Unilever and said look, 'this is what I want to do' and I think it just came across as so different that I was given a bit of leeway to have a goI only did that for Unilever after Archer Mills and I had already spoken internally here at the University, and we spoke with the Deputy Vice-Chancellor at the time who was at the time, Jack Grovesand Jack was absolutely essential to the success of the whole thingbecause if he had said, it's all very good guys but I am not interested it would have dies right thereso, but he didn't he said actually this is quite an interesting idea, I like that. And we have got a space we could put that in right now, which was a disused bit of the Chemistry Departmentand he said well, are Unilever on for this? and I said well, if I've got basicallyan in principle ok from you then that could swing all sorts of thingsand he said 'oh you've got that, go and get Unilever on board'So I wrote this paper that went round a number of people, but of course in the background, I was explaining to them how the University were already on board yeah? Now that ticked a number of big boxes for our boss at the time, who was being pressurised to really push a culture of complementing, of	Connecting Actors

April 04: Proposal for funding submitted to NWDA.	
"Unilever was customer not a partner, the University had to do that yeah? So a huge amount of effort from the University workArcher Mills, Jack Groves, the Vice-Chancellor at the time Drummond Boneall of them pushing quite hard on local government to free up the vast majority of that nine and half million quid and that went on for a long long time"Alex Stephenson	
"And so, we drew up an application for that with Unilever, because you needed to have industrial match, cash fundedso for a pound that you get from Unilever, you could get a pound from NWDA and a pound from ERDF. And so we, and also the University invested in that and put time in and timesheet and all these things, you build up quite a substantial programme"- Peter Blanken	
 "Project Objectives: The five key aims of this project are as follows: To create a unique Centre for High-Throughput Materials Discovery in the NW. To provide a cross-sector high-throughput materials research and knowledge transfer service for both SMEs and large-sized companies. To operate synergistically with the collective world-leading research activity in materials chemistry in the NW Universities (Liverpool, Manchester, UMIST). To start a new research activity that will contribute to long-term economic growth for the NW region. Project Structure and Funding: This is a 5-year project aimed at establishing a Centre that will achieve financial sustainability after the grant funding has ceased. We propose to fund the project in its initial stages with the support of four key funding sources: ERDF Objective 1 (years 1, 2, 3) NWDA (years 1–5) University of Liverpool (years 1–5) University of Liverpool (years 1–5) University of Liverpool (years 1–5) 	Connected Actors
Jun 04: Concerns about the viability of the project escalate within Unilever R&D "If, when the Vice-Chancellor had met the Head of Lab at Port Sunlight and they hadn't got on, it might have been deadIf Archer had moved to another University it would have been dead. If I had just got promoted or moved out of my job at Port Sunlight, so this was no longer my job to do, that could have killed itthe whole thinga whole load of things had to line upif they'd have wavered too far in any direction during that five year period, it would have died and to be	Connecting actors
fairUnilever'sI was told by the Head of Lab three times in those five years to just let it go. Leave it alone, this is never going to happen yeah? I was told twice, it was killing my career ok?	

and it ultimately did"- Alex Stephenson	
"that's why I leftthat's why I'm at the University of Liverpool, yeah so it's easier to look back on things and see them as being a success but it wasn't essential that I reaped the benefit of thatthe point of building the CMD was not for me, it was for Unilever and for the team of researchers and that's the way it is but ultimately yeah, it kind of killed my careerit certainly wound up a bunch of people to the point where internally the noise around the CMD was all very positive but there was a growing level of negative which just continued to build, all the way to the point where wellit almost died"- Alex Stephenson	
"So from a position of trying to suggest to a worker, that they have to change their place of workyou can't force anybody to do thatthere are issues around that. Unions were on this like a rash because you know what are we saying? Are we now saying that if you don't work there you haven't got a chemistry job? you know that was all over the place, they were really concerned that it might put pressure on people, they were really concerned that people would be working outside of the Port Sunlight home, they would be disconnected from things and all that sort of stuffso all that had to be worked through"-Alex Stephenson	
<i>May 05:</i> NWDA agree to support the project providing an allocation of ERDF as well as NWDA funding.	
"The Centre for Materials Discovery (CMD) received a total of £8.2m grant funding. This consisted of both public and private-sector cash and in-kind contributions. The regional funding streams were ERDF (£1.9m) and NWDA (£1.9m). The public sector funding was provided by the University of Liverpool (£1.9m) and the private sector funding was provided by Unilever (£2.5m). The project commenced in June 2005 and continues through until March 2010, with private sector funds contributing to sustainability continuing until December 2011. The ERDF funding stream for this project completed in September 2007 with regular project reporting completed in December 2008."- ERDF Final Report December 2008"- ERDF Final Progress Report- December 2008	Connected material
" I was quite early in my career and it was consuming a lot of time and I saw a lot of risk actually. And there was one point in, I don't know 2003 or so or thereabouts, where the NWDA said well this can be funded this year, it wasn't clear when it could be funded and I very nearly dropped it as a concept because while I could see the value, it was taking really too much effort and time like a lot of science"- Archer Mills	

<i>Mar 06</i> : Peter Blanken is hired as CMD 'Business Development Manager'- begins to negotiate the legal framework for the CMD with Alex Stephenson and respective legal teams "we recruited them in as part of the ERDF/ NWDA funding. So theyso the application went in for the funding and, so that gave us £10million and that's when there was a job advert for a business manager and I moved from Merseybio and became the Business Manager for the Centre for Materials Discovery, so I joined it a year before it opened and my job really was to look at SMEs because there was talkthere was ERDF funding, so there are a load of economic growth marker outputs that you need to achieve, which were jobs created, net value added to the region, gross value added to the region, net jobs, number of patents filedthere were a whole range of and so that's what my focus was onand when I first arrived, I thought that I was going to turn up to a Centre that was already here, and of course when I got here there was nothing here. So I looked and said right we have got to start from scratch. So I was involved in the decisions about how we set the thing up, how wewhat equipment do we procure and also then became involved in the negation on the Service Level agreement with Unilever"- Peter Blanken	Connecting actors	
<i>Dec 06</i> : Service Level Agreement signed by Tyler Henderson and Drummond Bone. " so you ended up with a Service Level Agreement, and it's interesting that you choose those words. Service Level Agreement, because the majority of Universities, when they talk to industry will say 'oh you need a collaborative research agreement' and a collaborative research agreement deals with all of the research outcomes from joint researchthe Service Level Agreement doesn't touch upon that at all. It talks purely about how much access do I get to that equipment, is that service? What is the maintain downtime? How do we buy I don't know chemicals, how are they supplied? All those sorts of things are then laid out in this Service Level Agreement. How many staff will we have? When will we open? you knowall of that sort of stuff and so, it was myself and Alex Stephenson and Archer Mills, but I guess mostly myself and Alex that negotiated that first Service Level Agreement. And the bit that we focused the majority of the time on, was to unhook the erm the catch, so when the milestones were you knowusually you have a contract with milestones that say 'we will pay X when this is done' because, well what are the milestones for something like this? It's about Service, so at the end of every year, are you satisfied with this level of service etcBut we unhooked the money and put a credit system in, so we made sure you were able to book equipment"- Peter Blanken	Defined meaning structure elements Defined future events	Relationality- defined/ fixed meaning structure elements and defined the temporality of the meaning structure by connecting past and future events

"Can't do that, it's controlled access to an open access facility...just because it looks like it's not being used today, doesn't mean it's not being used tomorrow and that it's in a set-up phase or whatever. And so we put this system in place that enabled controlled access through credits to be run...and that's what was set up in the Centre for Materials Discovery, so Unilever would have you know a month's view ahead and they could book this this this and this and that was then locked in and the University would book X,Y and Z and that was then locked and you would do this on a monthly, or I think it was a three-monthly rolling basis. And so, that contract is very very different that what you would see in a normal research contract"- Peter Blanken

"Unilever has a Service Level Agreement ok? So and the SLA took probably close on two years to put together. So from initial concept to moving in was a five-year process...so it was 2002 to 2007. ...The SLA, which was hammered out really...so this is when it gets to legal and you get all the big guys involved and that impact that Mark was talking about was actually quite hard at times because it's very specific now yeah? and in a contract like an SLA you are planning for failure, so you know you are already in the frame of mind that everything has gone wrong yeah? And the legal team at Unilever was very clear, the SLA needs to be that robust because when it's signed you are gonna put it in the draw and you are never going to open it...If you're successful, you'll never look at that SLA again. It is only there for failure yeah? but what the SLA does very clearly is it defines a number of governance issues which absolutely places the governance of the facility in the University's hands. As a major user, and again not exclusively, Unilever would expect all partners to have the same provision...there is a regular meeting between Unilever and CMD management to talk about issues that are arising"-Alex Stephenson

"If there is a conflict, there's a conflict resolution part of the SLA which escalates the problem... it also asks for information about the longevity, sustainability, future strategy and it has the opportunity, as a company to suggest things that it would like to see change."- Alex Stephenson **Dec 02**: Mills and Stephenson's proposal is rejected by BIS. Feedback on the concept is positive but the costing of the proposal was highlighted as highly unrealistic

"we asked for two and a half million quid, exactly the maximum amount that we could ask for...the reviewers comments came back as 'wow this is cool but two and a half million quid isn't enough'...so we didn't get any money out of the system because in general it was decided that you couldn't do it with two and half million quid...So we stopped, we re-grouped after about a couple of weeks and re-planned the whole thing."- Alex Stephenson

"Why did I stick with it?... well I genuinely nearly didn't to be honest. I mean I, you know I was quite early in my career and it was consuming a lot of time and I saw a lot of risk actually. And there was one point in, I don't know 2003 or so or thereabouts, where the NWDA said well this can be funded this year, it wasn't clear when it could be funded and I very nearly dropped it as a concept because while I could see the value, it was taking really too much effort and time like a lot of science. I mean I was getting, I was demonstrating in undergraduate labs and getting phone calls from them, you know the sort of Finance Director from the North West Development Agency and I had to pop out from you know teaching to take the call and I was trying to get my research group off the ground and it nearly collapsed under its own weight and...I would say the main reason I stuck with it, it was partly I felt that Unilever were not about to just pull the plug on it, although of course one can never be sure with those sorts of things. But I had some confidence that the people in Unilever, if they were able to would support it. Of course you know, in industry, ultimately things can change that are outside of your control but I...I sort of assumed best endeavours as they say and I thought that there was genuine commitment from Unilever"-Archer Mills

"The external funders who knows...those guys do whatever they do but you know...and then the University, well Drummond Bone and Jack Groves, they were always very...I mean that made a big difference at the time actually, Drummond Bone particularly. He basically said look "one way or another we'll do it, if we have to, we will fund the whole thing". And I am not sure I completely believe that, but I was...I was sure he wanted it to happen."- Archer Mills

Defined concepts and actors and trajectory of future events

Narrative Vignette/ Event	Narrative Themes	Theoretical Process
Dec 06 : Organisational Re-structuring at Unilever separates scientific and administrative leadership/ management		
"Basically, they restructured so that there was a separation between the scientific kind of technical leadership and the managerial responsibilitywhich meant that I could still be involved in the scientific direction of the CMD but I had no line management responsibility for the people who were going to be in there"- Alex Stephenson		
" let me tell you about the job I had when I was first interacted in this sense with Liverpool yeah? So That would have been in 2006.He now works for the University, Alex moved into a different role in Unilever at that point so I was looking after the group and actually the contract for the CMD had been signed, the CMD was due to open at the end of December 2006. If you like I kind of came into that group to lead it and we had about 11 months to get ready to occupy what was then a really big project for Unilever. You know I forget the actual funding but you know, for us it was a big investment"- Daniel Jacobs	Disconnected actors	Activity- Reconfiguring meaning structure
Jan 07: Alex Stephenson becomes full time academic member of staff at the University of		elements
"that's why I leftthat's why I'm at the University of Liverpool, yeah so it's easier to look back on things and see them as being a success but it wasn't essential that I reaped the benefit of thatthe point of building the CMD was not for me, it was for Unilever and for the team of researchers and that's the way it is but ultimately yeah, it kind of killed my career"- Alex Stephenson		
"Alex Stephenson, always had a sort of an academic bent to him because even when he was at Unilever he was publishing regularly, which is unusualand I think that, it was always pretty obvious that what he wanted to do was somehow one day move from one establishment to the other"- Arnold Royle		

Appendix 3b- Relationality and Activity- Relationship Expands

Feb 07 : New Lead for High-Throughput Science appointed and located at Port Sunlight (Dennis Green) "So I was in a Discover team leading 'Everyday Dirt and Tough Stains' which was a cleaning project and already prior to thatSo high throughput if you like started in the Vlaardingen Lab in the NetherlandsSo that was all going on so my project was well used to using microtite plates to do cleaning studies because the Vlaardingen team took that, shoved bits of cloth into the bottom of a microtite plate and basically ran the chassis and cleaning assays. So high throughput was kind of well ingrained within the Laundry category area. But my project moved anyway, so this is the serendipity point I guessThe project moved and I stayed in Port Sunlight and the AH who was my boss said 'Do you fancy running the high throughput science team?"- Dennis Green	Connected actor	
Nov 08 : Sir Jacob Richards becomes new Vice-Chancellor at the University of Liverpool following departure of Drummond Bone "The announcement of Sir Jacob's sudden departure from his post as UWE's vice-chancellor - after just 16 months - followed a similarly hasty appointment at Liverpool, where he has been a council member since 2005. The position was advertised in the first week of June with an application deadline two weeks later on June 15. UWE officially announced Sir Jacob would go to Liverpool less than a month later on July 6, just a day after he informed the board of governors of his resignation"- Guardian article "Sir Jacob Richards has announced that he is to leave the University of the West of England, Bristol (UWE) to become the next Vice-Chancellor of the University of Liverpool. He has been appointed to succeed Professor Drummond Bone, who is due to retire in September 2008. The exact date when Sir Jacob will leave UWE has not yet been agreed."- University of West of England Press release July 2007.	Disconnected actors and connected new actors	
Dec 08: Prof. Arnold Royle appointed PVC for Faculty of Science and Engineering following departure of Jack Groves "the driving force behind all of this was really Archer Mills from the academic side and Peter Blanken was deeply involved in it from a support side. I was involved in it as, at that point, I ceased to be Dean, so I became PVC for Engineering and Science in 2012 and so I must have done it but this was my job when I was the PVC for partnerships"- Arnold Royle	Disconnected actors and connected new actors	

Dec 08: CMD achieves funding targets quicker than anticipated	
"The Centre continues its activity in accordance with the business plan and scheduled activity outlined within this document. Both industrial and academic programmes of research continue to be project managed and delivered by CMD. We have enjoyed some success in leveraging a substantial fund to facilitate the setting up and delivery of the Knowledge Centre for Materials Chemistry (KCMC), which has received a positive funding decision from the NWDA. A fund of £11.2M, with £2.8M from NWDA, £2.7M University contributions, £2.7M from industry and a further £3M from other grant income. We continue to look for new business and have hosted over 201 individual visitors to the Centre during this period. "- CMD Progress Report Dec 08	Disconnected actors
Jan 09: Archer Mills becomes Head of Department for Chemistry following promotion of	
Arnold Royle	
"Of course what Archer Mills did, he did all of those things and he became Head of Department and set up the Centre for Materials Discovery and IOTA."- Peter Blanken	Connected actors
Was the co-author of the Faculty of Science and Engineering Strategy 2010-2013 which was published in March 2010	
Jan 09: Peter Blanken who was the Business Development Manager at the CMD is	
promoted and becomes Director of the University Technology Transfer Office (Business	
Gateway)	
"Our BDM Peter Blanken has been promoted within the University to Head of Business Gateway with effect from the 5th January. A brief handover period of one month has been arranged. Whereby Peter will work 50:50 split on the two posts. During the handover period some of the BDM responsibilities will be shared out between the existing administrative staff. Peter will continue to support the Business Development activity for the Centre in his new capacity within the University and will continue to bring new leads to the project. "- Final Progress Report NWDA- December 2008	Connected actors
Aug 12: Peter Blanken moves back to his role as Director of Business Gateway following	
submission of RPIF proposal	
"So if I'm honest, what actually happened, we were successful in getting announced by Osbourne and we were getting you know the money. Then there was this internal negotiation with our academics but my role was over at that point, I stepped back. I was back into business gateway, I had spent my time putting a proposal together, mainly because it happened over summer and the guys who should have been doing it	Disconnected actors

were on holiday so I had to do it. I rolled my sleeves up and I got on with it and I knew Archer so we just did it. So, I knew how to structure it and I knew what it was about but then they recruited, they put an advert out for a programme manager and they recruited someone from business gateway and off they went to theirso fine back to business gateway, got into other stuff with LV and other proposals that we were working on and then came back, probably about 3-4 months later and said right where are we up to, what's going on I haven't hear much?"- Peter Blanken		
Nov 12: First meeting of the Joint Strategy Board- collectively decide to commission		
feasibility study with a budget of 300k		
"It was agreed that a formal agreement would need to be drawn up between UoL and Unilever to set out the spend plan of the £300k design budget and the associated commitment of both parties. Steve Dickson and Jonathan Murray would liaise to establish a formal agreement via their legal teams."-Minutes of JSB November 2012		
"It was agreed that a flag would be raised with HEFCE at the end of the feasibility study in April. The feasibility study would determine the best options and would inform the Service Level Agreement (SLA) between UoL and Unilever. The SLA would be likely to closely reflect the SLA drawn up for the Centre for Materials Discovery (CMD), with some additional references, including, for example, access to car parking by Unilever colleagues.	Connected actors	
The feasibility study would also need to include options for travel arrangements for Unilever staff, including any cost implications for car parking facilities. Transport solutions for Unilever staff were essential in order to make Liverpool as accessible to staff as Port Sunlight and would need to be resolved by the Board. It was agreed that Unilever would review data from the CMD users to assess car parking requirements and that the two sustainability offices at UoL and Unilever would be linked together to assess travel plan options."- Minutes of JSB November 2012		
Dec 12: Relationship Agreement signed by Elliot Murray and Sir Jacob Richards- Drafted		
Defore RPIF submission.		
"Although yet not formally announced, the University and Unilever have also established a Partnership Agreement. This Agreement will help administer our current contract research activities as well as enabling a more efficient project commencement for new contract research projects. A formal launch and ceremonial signing of the agreement is scheduled for the 12th December 2012."- PRIF draft proposal	Connected actors and new conceptual element	
"we drew up a strategic partnership agreement with Unileverand that still runs, so we have a strategic partnership group or committee. This was tying the two organisations up so that we would meet frequently to talk about opportunities that have come through. That was prior totrying to think of the timing, it		

probably was after the MBR but before the MIF. And we had a formal signing between the VC and Elliot Murray on it. Now, the fanfare all about it was a strategic partnership and what it was about, it brought a governance structure together which had senior people from the University who could start talking about oh well what is it that we want to do?"- Peter Blanken		
Feb 10 : First collaborative brainstorming workshop between Unilever researchers and University academics.		
"The University and Unilever held a facilitated open workshop to identify synergistic areas of interest. Over 60 people attended, approximately 50:50 split between both organisations. Three sessions were run in parallel: Challenge 1- Water, Challenge 2 –Energy Efficiency and Sustainability, Challenge 3 – Health and Well-being. Areas of significant interest were then pursued on a case by case basis. Some of which are identified in the section above. Peter Blanken has regular monthly contact with Dr Henry Pizzorno, Open Innovation Manager at Unilever R&D and Dr Daniel Jacobs, Director Structured Materials & Process Science Ingredients to discuss collaborative activities and opportunities. A further workshop with senior members of each organisation is scheduled for October 2011"- Business Gateway Key Account Management Update	Connected concepts	
Jan 07: Decision to Move High-throughput from Vlaardingen to Port Sunlight "So I was in a Discover team leading 'Everyday Dirt and Tough Stains' which was a cleaning project and already prior to thatSo high throughput if you like started in the Vlaardingen Lab in the NetherlandsSo that was all going on so my project was well used to using microtite plates to do cleaning studies because the Vlaardingen team took that, shoved bits of cloth into the bottom of a microtite plate and basically ran the chassis and cleaning assays. So high throughput was kind of well ingrained within the Laundry category area. But my project moved anyway, so this is the serendipity point I guessThe project moved and I stayed in Port Sunlight and the AH who was my boss said'Do you fancy running the high throughput science team?So leadership had already made a call that actually we were going to focus. We closed Homecare Discover in Vlaardingen and moved the High Throughput facility that was there to Port Sunlight and Sarah had basically done that. So there was already a Homecare leadership view that high throughput was valuable."- Dennis Green	Defined material elements and defined future trajectory of events around the development of key OMS element (High- Throughput)	Relationality- reinforcing pre- existing meaning structure elements and defining the temporal trajectory of the meaning structure

Jan 07: High-throughput made a strategic priority for Port Sunlight site	
"There was a decision made to focus all of the laundry design work into either Bangalore or Port Sunlight and so that meant that all of the high-throughput capability came across to Port Sunlight and was established thereSo that was a strategic decision by Unilever to focus Homecare into Port Sunlight and along with that came the High Throughput capabilities for appraisal that had been established in Homecare. So, you know the robots that are now going into the Materials Innovation Factory, that were appraising substrates so looking for stains in colour and so onthey all came across to Port Sunlight around that time. And Port Sunlight continued to extend the High Throughput capability. So, the group that is now headed by Barney Jackson was basically established and set up to drive that."- Elliot Murray	
"Claire McIntyre was the head of lab and also the head of Homecare DiscoverSo she sort of had sort of a dual hatwhich was quite niceand she had sort of called out that basically Hight Throughput was going to be a way of workingit was a differentiator for Port Sunlight albeit that it was only really applied in Homecare. At that time people were saying well what we were very mucheach lab had its own sort of role and Lab almost had authority at that time to sort of Lab comes before Category to some extent. So Claire was really setting down what was the vision for the Port Sunlight lab, what were the capabilities that Port Sunlight was going to excel in so anyway I took over the high throughput science team"- Dennis Green	
May 08: Perception of the Port Sunlight site and Chemistry changes	
"but the psychological advantage was huge for the individuals that got engaged what they found was that by moving away from where they had been going for the last ten or fifteen years of their lives, actually was a hugely invigorating for somefor want of a better word, it was quite exciting and I would say that for a lot of them, just the idea of new, you know new skills, new challenge, a different way to deliver, a different way to be viewedpsychologically within Unilever, what we found happened with the CMD is people didn't talk about the Unilever chemistry group, what they talked about was delivery from the CMD yeah? So in a weird sort of way, we rebrandedwithout even knowing we were doing it, we totally rebranded the chemistry output from within Unilever"- Alex Stephenson	Defined High-Throughput as a mode of working as a key conceptual element of the Meaning Structure
" Actually, you know in the first two years we had some really big successes and we found that it speeded up how we did workwe approached our chemistry and our science differently"- Daniel Jacobs	
"What you always find I think, is there is some element of the core of the vision that gets delivered that's important and then there is other benefits that accrue from it. So one of the things that we had not, I don't think, really expected was that actually it made us very attractive as a partner to large global chemical	

companies because all of a suddenI mean just the very fact we had invested in a chemistry facility, they went 'oh god they can probably do it themselves' so that opened them up to more collaboration yeah? so that was really interesting, so that actually helped us open some doors and actually we got some technologies into the marketplace because we had a programme in the CMD which we kind of let you know the concept of it be known to a partner, actually what they did was they drove the price down in their, because they could already provide this material but the reason we were doing it ourselves was to try to get a cheap way to do itSo we had a successful project but actually we never used our own intellectual property, we just you know theySo that was, I don't think we would have ever expected something like that"- Daniel Jacobs		
" We got lots of benefits by having the experimental officers there that were experts in the kit rather than the chemistry and actually that became a very creative pairing. Our guys who were of a mindset of this is 21st Century, the way to do chemistry and then a load of what I would call kit engineers who were very creative about you know we have got this kit but we can bespoke it to do thatSo we got that really sort of thing. And we had you know, what I think, our first 2 or 3 years, we already had 2 or 3 big technologies which were very close to market, if not in the market. Which actually is quite you know, for Unilever that's pretty fast movingnormally we have an innovation and we might have to cook it for 3 years before we go into yeah, we are definitely going to launch to market and then we have got factory build-ups and stuff. So we started to see the sort of benefits in speed and we saw patent numbers increasing and actually what we saw is we became a more attractive place for you know for recruitment, so you know people wanted to come and work with us, we bought in a lot of new guys who now have gone on to much bigger and better things in Unilever which was part of that as well"- Daniel Jacobs		
Dec 08 : CMD achieves funding targets quicker than anticipated "The Centre continues its activity in accordance with the business plan and scheduled activity outlined within this document. Both industrial and academic programmes of research continue to be project managed and delivered by CMD. We have enjoyed some success in leveraging a substantial fund to facilitate the setting up and delivery of the Knowledge Centre for Materials Chemistry (KCMC), which has received a positive funding decision from the NWDA. A fund of £11.2M, with £2.8M from NWDA, £2.7M University contributions, £2.7M from industry and a further £3M from other grant income. We continue to look for new business and have hosted over 201 individual visitors to the Centre during this period."- CMD Progress Report ERDF	Reinforced the conceptual element of the OMS- in this case the operating model.	
"I think it outperformed what we thought we would do, oh yeah absolutely, I do think it outperformed in many different ways. I think that, you knowyou know, it's got two tracks, there is the commercial track and then there is the academic track and if you look at both of them, the success in both of those areas		

really, youif it have been probably half as good as what has happened you would have still thought it was a success but it really did and I think thatyou know, it also created a new paradigm for working with industry, you know co-locating with industry which you know, that's not a trivial thing and so you know, when youwhen the government started to hear about it, they got very interested in what it might be possible to do and then you know, Unilever took products to market and then we got high, very high quality papers because we had a market lead, because we could have the market lead because of the robotic equipment, we could do stuff quicker"- Arnold Royle		
to the deadlines and new, more ambitious targets were agreed.		
Mar 09: Unilever scientists working at CMD deliver new product to market, evaluation of CMD shows doubling of patent per researcher and increase in materials discovery speed by a factor of 10		
"The partnership that Unilever had built with the University of Liverpool around the CMD was part of a broader partnership strategy that brought University of Liverpool assets into a fully commercial end-to-end innovation ecosystem. This development meant that core Unilever activities that were carried out in the CMD, and completely new ways of designing chemistry experiments, became a material factor for some of Unilever's biggest commercial chemical suppliers. The acceleration that followed this connection of CMD – Unilever – Chemical Supplier – Market was highly impactful. One particular innovation, which was created before the MIF was built and operational, was put together by a team of Unilever scientists in the CMD and the R&D scientists of a key Unilever supplier outside the UK. This innovation moved from a back of the envelope invention disclosure made by a Unilever scientists in the CMD, to a full Unilever product launch in the UK and France, in less than 2 years"- E-mail- Mark Ward	Connected the Meaning Structure (partnership) with future Unilever innovations (R&D pipeline)- Defining the temporal trajectory of the Meaning Structure (i.e. partnership would be implicated in future	
""Impact of the CMD: • 10x Speed of research	innovations)	
 Supports a large R&D pipeline across six product categories 2x Output per researcher 		
• >10 innovations delivered to market already		
Typically, we can synthesise 200+ materials, screening them in 10,000 formulations in the same time		
traditional methods allow 20 materials to be made and screened in 400 formulations"- Presentation- Mark Ward to Praxis Unico, May 2015		

 Sep 08: Mills gets a Chair at the University of Liverpool- His academic output and impact has increased following the establishment of the CMD Mills' publication output doubled between 2006-2008 (from 9 papers per year to 23 in 2008). He also authored the Faculty of Science and Engineering 2010-2013 Strategy along with other department heads. 	Reinforced social elements of the OMS- Mills was intertwined with the future of the meaning structure.	
Mar 10: Contract negotiations for the extension of the CMD are opened ""Re:CMD Phase II: Since the New Year the University has demonstrated its intent to strengthen the existing relationship with Unilever through the recent Innovation day. There is a clear desire from both parties to build upon the success of CMD. Continuing the spirit of the Innovation day the University has conditionally provided a contribution to support CMD phase II. We are therefore in a position to revise our model and offer"- Letter from Peter Blanken to Daniel Jacobs and Edward Gordon	Defined the temporal trajectory of Meaning Structure- CMD projected to continue for another 5 years- reinforced conceptual and material elements	
 Nov 10: Unilever CEO Paul Polman launches new Unilever Strategy- 'Unilever Sustainable Living Plan'- premised on the doubling of growth without any environmental impact "Development of HTT is critical to the achievement of Unilever's Sustainable Living Plan ('USLP'). This involves the doubling of Unilever's turnover whilst maintaining (effectively halving) its environmental footprint by 2020. In order to do this Unilever is likely to need to reformulate the whole of its HPC product range, something that is only likely to be possible through the use of HTT"- RGF Audit Report "Nevertheless, Unilever is publicly committed to deliver against its R&D strategy and the Unilever Sustainable Living Plan. As set out in section 8, this would appear to be further supported by various statements in the Group's Annual Report for 2012. On this basis, the RGF Project is considered important to Unilever and Management have clearly communicated their commitment and their desire and motivation to 'make the RGF Project work'. In this context, and subject to being able to demonstrate the continuing longer term operational and strategic benefits of the RGF Project, it would not appear unreasonable that Unilever would provide additional investment to support cost overruns. Management concur with this view"- RGF Audit Report Dec 10: Large Unilever research programme termed 'Disruptive Sustainability' launched focused on the replacement of oil-based materials- Long-term ambition is to re-formulate all HPC products "Unilever intends to initiate a major programme (known internally as Disruptive Sustainability) to identify renewable materials that can displace petrochemically derived materials in household and personal care (HPC) products. This programme will look to source biomass feedstock from non-food competitive sources 	Defined the temporal trajectory of Meaning Structure- conceptual element (sustainability) was defined and linked to future Unilever R&D activity	

(e.g. beet pulp, straw, switch grass, lignin, starch, agricultural waste and waste streams from crop processing facilities), break down the contents of the feedstock into chemically useful and processable materials (monomers) and reassemble these materials into chemicals (typically polymers) which display useful performance characteristics in Unilever products." RGF Proposal		
Apr 11 : Daniel Jacobs develops proposal for RGF- Decides to locate the proposed MBR in Liverpool rather than Warwick		
"The programme was originally conceived to take place using the CMD centre at Liverpool, but without the proposed micro bio-refinery expansion. It was intended to use Warwick University for the generation of the bio-monomers but Warwick does not have the appropriate equipment and facilities to match the capabilities of the current CMD centre. It became apparent that the creation of a high throughput micro bio-refinery linked to the CMD could provide a significant benefit to the programme."- RGF Proposal	Defined temporal trajectory of Meaning Structure- Connected pre-existing meaning structure elements (Conceptual and Material- HTT synthesis/ characterisation and CMD with proposed research programme	
Feb 12: SM outlines proposal to develop 'end-to-end' High-Throughput and starts development of RGF3 proposal		
"One manifestation of the e-science agenda is the vision to make our entire R&D high throughput R&D. This is not a new theme and many elements exist already. And from what we know and have done already ourselves the benefits are in quality and quantity of leads as well as in pure speed However, the challenge I would like to express to the group is that to date there is no example of a true end to end High Throughput R&D capability. Parts of the process such as in silico modelling, high throughput polymer synthesis and characterisation have been done successfully, but the bottleneck then shifts somewhere else, to formulation, to substrate assay, to performance evaluation, to scale up etcWe have a vision to get HT across the whole R&D chain but there are real challenges"- Claire McIntyre Talk at N8 in Feb 2012		

Apr 12: Sir Jacob Richards decides that a proposal should be developed for the Research Partnership Investment Fund (proposal development)

"I remember talking to the Vice-Chancellor about this and he was very enthusiastic about it and I brought this up at an SMT in that summer and told him that logistically it would be a problem because Archer was out in California, Colt Douglas was involved in it as well, he was definitely involved in it as well, he was...and so...we sort of agreed that the proposal would be written and we had some meetings between Peter, Me the Vice-Chancellor, definitely someone from Unilever. At first it was a bit sort of how the hell can we get Archer to work on board with doing all this? because he was going to have to do most of the bid writing...and what we tried to do was to simply to support him, that's really what we tried to do and so it really was Archer's lead on it but I would say that myself and the Vice-Chancellor of the University and Peter were very instrumental and it was really, it was really of amazing importance that we tried to get that [?]. Because Jacob being there meant that there was gravity, that this was something that was really important, so I would say that I think that...I mean, it's not that Jacob was a massive key player in this doing the teleconference but simply because it gave it a certain...an urgency, it gave Archer the feeling that he had buy in at the very top of the University. And all these things...you know, the nuance of it was really really important and so, the thing got written over, in double quick time..."- Arnold Royle

"Jacob Richards, who was the Vice-Chancellor at the time...and he actually used to chair HEFCE, so you know it was a HEFCE...His view was well you know there might be bids that are already strongly aligned, in position but we have got to have a go you know and we don't know that, that's just speculation...he said we would be crazy not to have a go." - Archer Mills

"Jacob had given his full support at the very start, with a phone call with me. Business Gateway had identified three potential UKRPIF submissions. But I supported only one, and gave that recommendation to Jacob that there was only one game in town big enough to deliver this... A bigger CMD with Archer Mills as PI"- Peter Blanken

"well what, this is sown up, this is stitched up, someone down in the golden-triangle has already got this sorted out...blah de blah...and Jacob, who was the VC at the time said, no we're putting one in, what will it be? and I just well...well hmmm, really high risk would be to go with one of those models like GSK or Pfizer or whoever it might be, they have got a tonne of research programmes, you know a series of them and we say there it is and we have maybe two of those partners and we pull them together and we say there's our proposal. So all of a sudden, well what is it, what's the model of working? Why is it you're using these as leverage or match into your HEFCE? So...and then of course you would have to have an agreement with each one and...so...I simply said the only one that I can think of from this University would be with Unilever

but that's a long shot to go in there and say can we have £20million and match it with our £11millionso the sort of news came back, instruction came backdraw something up around that, so we did"- Peter Blanken "Now at the time, the Vice Chancellor of the University, Sir Jacob Richards, he was meeting with myself and Claire McIntyre who was then Head of Lab for Port Sunlight on a fairly regular basis and he alerted us that this had come about and that you knowhe was a prior sort of head of HEFCE himself, so he knew that organisation and he knew how that worked and what it was trying to doThey came up with a very good proposal"- Elliot Murray	
Aug 12: RPIF proposal submitted	
"Vision: a world class open access shared equipment facility and research hub which serves the long term strategic business and research needs of Unilever Plc and the University of Liverpool, focused on innovative collaborations in disruptive sustainability, strengthening the impact of the UK research base, stimulating global R&D, and thereby promoting economic growth in UK Plc. Rationale: builds on a pre-existing strong partnership between Unilever and the University of Liverpool, (submitted to the Wilson Review as University of Liverpool Case Study: for exploiting research/Innovation capability of Business and Universities through collaborations) and servicing the economic/research needs through the provision of state-of-the-art analytical facilities and unique high-throughput formulation platforms, national in reach, strongly connected to the N8 grouping, and exploited as an extended network of both industrial and academic researchers. The project scope will be phased and structured: stimulate global R&D and innovation collaborations Phase 1: State-of-the-art measurement capability through expansion of the Centre for Materials Discovery (CMD), focusing on joint academic/industrial interests, based on a planning exercise conducted in Q4 2011; Phase 2:Establishment of a unique High Throughput (HT) Formulation Centre to respond to a growing global market for formulated products, analogous to the highly successful CMD activity which focuses on high throughput synthesis. This centre would provide an open-access physical hub to both Unilever researchers, N8 groupings and the wider UK academic base.	Defined Meaning Structure Elements (Concepts, Actors and Materials) and linked them to particular future events in a timescale for implementation- defining the temporal trajectory of the Meaning Structure
Research in materials chemistry and science at the University of Liverpool is internationally recoanized, and	

has been supported by back-to-back 5-year flagship EPSRC-funded grants in Materials Chemistry and developments in the pre-existing industry/academia CMD activity. Identified as a strategic growth area both locally and nationally, UoL is investing £10m (over the next 3 years planned in facilities) to support worldleading research that also underpins other institutional strengths in manufacturing, materials engineering, energy, and medicinal chemistry. This new development will further enhance research facilities to create a world-leading hub for materials research, and also serve to further deepen the long-term partnership between UoL and Unilever through shared infrastructure and R&D—a central part of the institutional commitment to the N8 partnership. By closer engagement of academics with industry, there is scope to develop an entrepreneurial approach that would enhance current groups and research strategies thus demonstrating impact through our research."- RPIF Proposal

The proposal also outlines the business case, funding requirements, project management details and timescales

Narrative Vignette/ Event	Narrative Themes	Theoretical Process
Narrative Vignette/ Event Feb 13: Decision by R&D Leadership Team (Unilever) to re-appraise business case-financial investment clarified "Of the £20m investment from Unilever that had been articulated in the bid, £15.5m had been earmarked as capital, £4.5m for on-going costs, supported by an additional £5million in-kind contribution. However, misunderstanding around the last two categories had meant that there was an assumption that only £15million of cash contribution was required to support the bid. This has created a financial shortfall of £5million, which had caused immediate issues with short term cash flow. Recurring revenue costs, including staffing and infrastructure costs, would also need to be incorporated into Head of Terms. These costs had been estimated at £911k per annum, however, no overhead had been included in this costing. UoL would need to clarify the costs of running the facility in order to accurately inform the Head of Terms and to determine how costs will be apportioned between partners. It would also be important to clarify with HEFCE the start and end date of the project, in terms of the length of the co-investment period. At the end point of the co-investment period the terms between partners would be open for negotiation. UoL flagged the issue of the limited cash flow available to meet the capital requirements as set out in the University's capital plan, including MIF. Clarification of this would be sought at the next meeting between Finance Directors at UoL and Unilever"- Minutes of the JSB "Unilever were committed to undertaking due diligence to support a business case for financial investment. There would need to be an outline business plan created to provide evidence of wider financial support from external partners and to help discussions at Unilever to firm up financial options for cash flow. The financial projections from partners and other extern	Defined material elements of the Meaning Structure- clarifying the capital implicated in the meaning structure	Relationality- reinforcing pre-existing meaning structure elements, defining meaning structure elements and defining the temporal trajectory of the meaning structure
"Unilever were committed to undertaking due diligence to support a business case for financial investment. There would need to be an outline business plan created to provide evidence of wider financial support from external partners and to help discussions at Unilever to firm up financial options for cash flow. The financial projections from partners and other external funding schemes would need to be scoped out in order to demonstrate a plausible business plan and support a case for Unilever investment"- Minutes of JSB- Feb 2013		
Feb 13: Unilever Research Group leaders express concern about the MIF project-		
feel their autonomy over their budgets has been compromised by Senior		
Management commitment of R&D expenditure to the project		
"they came up with a very good proposal and we hit a bit of a problem inside Unilever in that er [laughs] there was no obvious mechanism to fund it and in the end we bit the bullet and committed that we would actually displace some of the funding that was being used on internal R&D to enable this to happen and build the business case to justify that. It is a classic case of turkeys voting for		

Appendix 3c- Relationality and Activity- MIF Project Established

Christmas, if you would have asked the people on the ground did they want this think, they would have all...'by the way you have got to reduce the number of temporary people in the organisation, you don't spend as much on capital, you have to sacrifice some of your discretionary spend to enable this...' they would have all said we don't want that. So I think there is a big lesson there in that to get through some of these structural changes that are big and difficult, you...there is no way you can do that from a bottom-up, you have got to get an executive decision made, turkeys don't vote for Christmas. So and that came back to haunt us really.- Elliot Murray

"You know, when the original business case was dreamt up in 2012 and by the time we got into execution, people looked at it and thought that doesn't make sense any more. There sometimes is a challenge because, you know let's say for sake of argument we felt that we could reduce the number of temporary resources in our organisation by 30 people because we would be automating what they would be doing in the Materials Innovation Factory. By the time it came to start to pay for the Materials Innovation Factory, the categories had found ways to get those people out of the organisation anyway."- Elliot Murray

" So you can't go right well we are not paying anything until the thing's open because you know the government said you know that's not part of the deal you know, you need to be in there to start with so...the big challenge really was... you know to start paying before you had it...and people were going 'Christ! you know I will have shelled out six million before I am even in the door'...So that was I think probably the biggest challenge you know, was ok fine, so we can see in year five that actually it's a very positive business case but actually at the beginning you have got this massive great big, basically you have got to invest up front to get the payoff later but, you know shareholders don't like that sort of cashflow profile for a business. It's much more usual for a University to invest in a facility and then get the cash coming in later from students...so that I think was probably, without going into loads of detail, I think that was one of the biggest hurdles because everyone was going 'so basically you're asking me to give you a load of my budget' you know and it wasn't...although we're all Unilever, there was different parts of the business that were serviced by it, so we were looking to...'right, there is X amount from you and Y amount from you' and we put it together and those people were in different places, they were more or less risk averse"- Daniel Jacobs

"but you know, the real one was...well...all of them were saying well for the first year and a half of my investment, what you're telling me is that I've got extra cash going out but no efficiency increase or productivity increase to compensate...you know so I am just more expensive than I used to be. So that was the single biggest thing...in essence we ended up...we had to get that really signed off at, if not board level, as close to board level as you can get without being on the full board you know. So that I
think was a major challenge and you know continued to be a challenge because what we found is that as we got more into it, we went 'oh actually we don't really want that, but actually what we do need to do to maximise the value is this'when the original bid went in, we weren'twe hadn't assumed any additional capital spend beyond the money we were going to invest"- Daniel Jacobs "Because everyone absolutely got the fact that you know this is , when it's up and running but if we could have found a way to make that kind of cash injection disappear up front then everyone would have been like 'well this is a no-brainer we'll just get on with it' but that was the single biggest one"- Daniel Jacobs		
Apr 13 : Peter Blanken decides to become involved in the MIF project after becoming concerned about the apparent lack of progress since September 2012.		
"we had formed this thing called the Joint Strategy Board and we got some representatives from Unilever, some representatives from the University, senior representatives from the University and they were meeting probably every four to six weeks and they were all talking about the blooming building. So I looked at some of the minutes and it wasok building, building related, building relatedwhere's anything about what we're gonna do? So I spoke with some of the people who were in there and said right, this really needs to get up and running, what are you doing about it? and they said oh well we're going to have the conversations. So I looked agin eight weeks later and nothingstill buildings and I just went, this thing is absolutely in danger of falling over completely after us securing the funding, we are nowhere near securing Unilever. So who is negotiating all of the agreements, we've found a location to put a building, we've got architects giving designs of buildings everyone's going oh well this is fantastic but the nuts and bolts haven't been done yet. So I had a word with my line manager then who was Director of Partnerships and Innovation, Richard Clarke and said I need to get involved in this, second me over half the time"- Peter Blanken "I was seconded over half the time and that's when Mark Ward and I sat down and said Right, how are we going to do this? We need to have this type of agreement; this type of agreement and we're starting off saying this is a collaboration. It is a negotiation, Unilever have the Joint Strategy board and who were talking about buildings, that have positioned things and used that as a negotiation, unbeknownst to our academics and some of our senior staff. They were agreeing certain things that were in minutes and Unilever were using that as a negotiation bit'The University were completely ungware that that was happening. So when I then got involved I said right what have we	Defined the social elements (actors) of the meaning structure- Blanken who had been a key social element in past iterations of the Meaning Structure became a key social element in the Meaning Structure again.	
got here? What's been sort of agreed already, pilot floor and some principles basically, nothing detailed but some fundamental principles had been set out at that point, none of which actually		

caused a problem. Lookbut that's when we sort of said right let's separate these things our and let's start focusing on what is this dealand that's where I think a very health point of view between the two organisations, Mark and I happened, mainly because our senior stakeholders said we're doing it. So we sat in a room and said well the decision has been made, it's not our decision but we are doing it we have just got to say doing what exactly and how does that doing it work? So we then became the architects of drawing that up. Basically writing the operating manual of how this thing will work"-Peter Blanken		
Apr 13: Mark Ward asks his line Manager Elliot Murray if he can assume project		
leadership responsibility for the MIF project following a failure to recruit a project manager internally.		
"We get to 2013, January 2013 and at the end of 2012 my boss Elliot Murray said to me look, these guys are gonna build this Materials Innovation Factory, they need help to develop partnerships, can you help them do that? The key person driving it from the Unilever side was a guy called Daniel Jacobs, who is still around, you can go and talk to him. Paul got a new job starting January 1st or February 1st, 2013, right? And I volunteered to Jon that I would lead the whole thing. He said 'don't be daft you can't do that'so between January 2013 and about April 2013, I was getting frustrated that i could see this was a massive thing that we had committed to do, but who was driving it on from Unilever's side right? And, the way I saw it, we letmy description of it was we were 'snoozy-cruising', right? we were justtime was going on, there is a time element of these grant awards, time was going on and we weren't doing anything. "- Mark Ward	Defined the social element (actors) of the meaning structure- Ward became a central actor in the Meaning Structure.	
"At that point we got the final sign off from the RDLT (Research and Development Leadership Team) that we were actually going to commit to this fully and then I We were looking for a project leader to do it. Nobody stepped forward, so I ended up appointing Mark Ward to do it"- Elliot Murray		

Jun 13:The University of Liverpool Senior Management Team decided to increase the University contribution to the project by £6m so that the full technical ambition outlined by academics in the design process could be realised. "One of the things, the first things I did when I looked at the project was, I looked at the scale of the building and said hang on a minute, there are three floors in this and I work out what Unilever is going to get out of it and we are not going to get enough, so they went and made it a four floor building, so the University had to go and find more money to do that. That was a fairly big"- Mark Ward "Stage C report (feasibility) complete by end of w/c 17th June; however there is still some work to do on how the academic space will be configured. To reflect the expanding aspiration of the building the University are exploring increasing their financial contribution to the build. This will result in 11300m2 building."- Minutes of JSB. "University have increased their financial contribution to the build by £6million. This will translate into a 11300m2 building. Although a significant uplift in the project, the building cannot accommodate all the academic aspirations and requirements described during the Stage C feasibility process, as a consequence decisions need to be reached on what is included in the build. ACTION AC/JM to facilitate discussions that set the academic space. Now that we have some clarity on the final budget need to profile the cash-flows and discuss with HEFCE"- Minutes of JSB	Defined Material Elements of OMS (in terms of the actual physical infrastructure) which were expanded by decision of UoL SMT.	
Jul 13: Royle and Murray agree to expand the remit of the JSB to include decisions related to the RGF projects (MBR & HTFC) "Although several of the projects (MBR and formulation) are being managed and developed by the same team in Liverpool – taking into account how all the projects will sync together, there is a lack of oversight by this board of these and the other UoL/UL projects (radiolab, UMPF etc). It was agreed that these other joint projects will be folded into the remit of the MIF JSB."- Minutes of JSB "MBR project brought to the JSB to test idea of sharing resources between the projects (as discussed prior to meeting between JM and JPC) and to ensure we were getting best value by taking a more strategic view of the portfolio of work. This principle was endorsed by the board and in fact could help with drawing down HEFCE monies. However need to be aware that although an eminently sensible approach it has the potential dilute investment into the MIF new build project which already has a very tight budget, need to focus on overall capability."- Minutes of JSB	Defined conceptual and material elements of the OMS- Brought past conceptual and material elements into the consideration of the future conceptual and material configuration.	

"Completely different issue to the MBR, problem here is that the budget set for this refurbishment was always strongly suspected - by all parties - to be at odds with what is actually required. We were hoping by taking a very cost sensitive, minimal approach to the development we could still bring the project on budget however for a variety of reasons – notably asbestos removal – the budget is approx. £20000 over the £50000 limit. Again a series of actions needs to take place to see what is possible ACTION JM to report back to the JSB. Accepting the same principle as for the MBR we should look at this project in the round."- Minutes of JSB	
health of things like CMD, MBRwere they running alright? you know they have got their own governance structures though but is there anything we need to be aware of organisationally right?"-Peter Blanken	
Aug 13: Intensive SLA workshops with Mills, Blanken and Ward develop draft of SLA	
"SL and MR to break this task down into various blocks of detail and develop the various aspects of the heads of terms before involving respective legal teams"- Minutes of JSB	
"Feedback from the Unilever senior team is that – to reduce risk for both parties, the earlier we can get the entire suit of agreements the better. So far, we were targeting the end of November for an MoU, which we now have the first draft. We should aim to see if it is possible to complete the main SLA by 3rd December (co-incident with a visit by Geneviève Berger). Fall-back position is the MoU to be ready by this date. Suggestion is that within the next week need to set up a series of day/half day meetings, working up what need to be covered in the SLA ACTION MR/SL to set up w/c 28/10/13."- Minutes of JSB	Defined social and conceptual elements of the Meaning
"Now many of the concepts that were in there formalised up, made into a better governance structure, came from the CMD SLA. Not all of them but quite a lot of them. So basically, I took the decision that the only way that we could create a document that was a proper SLA in the time together we had was, if we co-created it. Because typically what you find in legal negotiations is 'I'll make a draft, I'll send it to you, you'll get your word processor open, you put track changes and then you will make changes and they call it 'red lining', you put the red lines through it and send it back to me and say 'well thanks a lot Mark, very kind of you to send it I've put in the issues that we have, Clause 12, scrub them, Clause 13substantiatewhatever'. Now, that's fine so typically these things go with legal negotiations, problem is it goes slow right? So basically, what I did, and we can probably	Structure
re-construct when that was but from late 2013 through into about February 2014, I basically sat with Mike Dowdall and Peter Blanken, mainly at the University of Liverpool and we sat there and we wrote	

the document together"- Mark Ward

"I was seconded over half the time and that's when Mark Ward and I sat down and said Riaht, how are we going to do this? We need to have this type of agreement; this type of agreement and we're starting off saying this is a collaboration. It is a negotiation, Unilever have the Joint Strategy board and who were talking about buildings, that have positioned things and used that as a negotiation, unbeknownst to our academics and some of our senior staff. They were agreeing certain things that were in minutes and Unilever were using that as a negotiation because they weren't aware because it was like 'this is how you're doing it; I presume this is the negotiation bit'...The University were completely unaware that that was happening. So when I then got involved, I said right what have we got here? What's been sort of agreed already, pilot floor and some principles basically, nothing detailed but some fundamental principles had been set out at that point, none of which actually caused a problem. Look...but that's when we sort of said right let's separate these things our and let's start focusing on what is this deal...and that's where I think a very health point of view between the two organisations, Mark and I happened, mainly because our senior stakeholders said we're doing it. So we sat in a room and said well the decision has been made, it's not our decision but we are doing it, we have just got to say doing what exactly and how does that doing it work? So we then became the architects of drawing that up. Basically writing the operating manual of how this thing will work"-Peter Blanken

"So the timing of that, of him getting it through was important. I remember the same sort of thing happening with the MIF as well.... That ok we have got the funding through but we haven't got the Service Level Agreements in place and the AfL and all the other stuff and there was a real...all of a sudden a pressure came both from the University, I you know we haven't got the agreements, pressure on "Why haven't we got the agreement let's get them done" so I start that. And, but there was a palpable sort of a pressure on the Unilever guys to get it done because there could be a change in the board, there could be a change in the support, there could be a rejigging of that board or a rejigging of staff or plans at Port Sunlight that could just go..."You know what I'm not having that...so you could, there is always, once the thing is landed doesn't mean it's done until it is actually signed. So there's a period of time where everyone needs to pull to get together and get over that final hurdle... and until that is done, it isn't a given"-Peter Blanken

"when it came to doing the SLA for the MIF, I think...I think I knew how we had structured the SLA, therefore I knew what needed to be covered. I also had an idea about what else we needed to include in it because it's bigger and...but we then left the SLA and said let's start from scratch...I had done it twice, so it was in my head. Mark Ward hadn't done that and so what we decided to do was, let's do

this from scratch, let's sit in a room together, rather than getting legals involved and let's draw this thing up together, let's write it and then we go back to our leaders and say this is what we want to do. And that was far quicker and more productive doing it that way, rather than me writing in isolation, passing it backwards and forwards because you lose everything"- Peter Blanken	
"on the screen, Peter is typing away and we'd say well how's that going to work?'well we're gonna have to have a board, well that's going to look likehow are we going to do the resource allocation and what's that gonna look like? and what's that gonna look like? and that' and we just crunched as much as we could into the core document and many of the appendices. So that's how we did it, so we built upand we got to a point and I probably won't be able tomaybe if I look through my emails I'll find itI got to a point in about February 2014 when I thought we had enough meat on the bones to now negotiate, so I basically emailed Peter and said look Peter, I think we are in good shape now to begin a negotiation, so I am gonna change my tune from, co-creating a document that we can have a chew on, to chewing on it, yeah? and so what, so what I did then wasbecause if we had not done that pre-work, we would have never have just had enough material to really, because we had to literally create it from scratch"- Mark Ward	
"the slow way of doing that is I write my version and send it to you, you comment and the quick way is basically sit down and say right we need to get out, on the table, what is everything going toso it's kind of you are co-creating. Our lawyers are typical in-house lawyers, would never have allowed me to do that"- Mark Ward	
Sep 13 : HEFCE drawdown deadline meant the project could not incur a further 2- month delay without losing money	
"Consultations with UoL special projects team have been ongoing and have identified several areas for improvement on the programme. One issue they have identified as a risk is the ability for the build works to draw down all the HEFCE money by March next year. This risk has been highlighted to HEFCE who think it should be ok as by that stage the money will be off their books and in our accounts, and as long as this is supplemented by a good narrative as to why there is a delay in spend, it shouldn't be an issue. However they did highlight that this doesn't mean zero risk – there is always the chance of an unexpected treasury audit and there are unforeseen implications associated with change of government. Therefore spend profile should remain an item on our risk registrar and every effort should still be made to spend as much of the HEFCE money as possible before March 2015"- Minutes of JSB	Defined the temporal trajectory of the Meaning Structure. Meant that specific expenditures had to be made before certain dates.

concerns about project risk	
"Delegation from UoL visited HEFCE to ratify revised budget profile, extension of project to seven years and use of their funds primarily for build. Very positive meeting, proposed changes where fully accepted and in fact comment was made on the headway Liverpool is making on this project and our positive engagement with HEFCE. The MIF project is currently being cited as an exemplar of the fund – we could get political capital out of this (Ministerial visits etc). One item raised was the rigidity of their March 2015 deadline for expenditure – this was confirmed as the deadline we have to draw down the £11million of HEFCE funding. Using the current spend profile this means we cannot incur more than an additional 2 months delay (see attachment at the rear), if we do delay beyond this the project effectively loses money to the tune of £1million per month. It therefore goes without saying that the project plan cannot slip – deadline for the Stage D work to complete is Oct 15th all efforts need to be made at both sides to ensure this is achieved"- Minutes of JSB	
Feb 14: Agreement to Lease and Lease Signed	
"The SLA Heads of Terms, Lease and Agreement to lease have all been signed – a significant milestone for the project. The considerable effort made by all contributors to the agreements was noted."- Minutes of JSB	
"Mechanisms have been put in place that in the event that there are material changes in the building they can be addressed by referring to the board. UoL have agreed to cover the costs if UL walk away before 2019 as a consequence of building not being complete by Dec 2017 longstop. Essentially agreements are ready to sign – need to check that dates currently quoted are longstop, not actual targets"- Minutes of JSB	and and d them to vents in a ementation-
"So there's a lot happening behind the scenes between that date and the signature of the erm agreement for lease which is February 18th 2014. Andeffectively, in shorthand, what was happening in Unilever was a er, a senior level er due diligence on whether this was a project that Unilever could buy into. And the people that were driving that were essentially Elliot Murray with me supporting that activity. So that was a series of meeting with our most senior leadership team in R&D er kind of knocking off points of contention, knocking off risk factors, knocking off diligence that we had done	oral leaning
auring that process. Sounds great but we need to understand thatright now we understand that, what else is gonna happen? How are we gonna get value from this? What's the business plan? What's the business area for dains this? What's the Baturn on Investment? So in actual fact, if you look st	

that...Unilever internally did not decide that it was definitely going to do this until about November 2013. Then between November 2013 and February 18th, 2014, I was negotiating with Peter two documents. The agreement for lease and the Service Level Agreement. And up until the signature of the Agreement for Lease, neither the University nor Unilever were committed to this project. So until you have a signature on a piece of paper, the deal is not done"- Mark Ward

"the Agreement for Lease was the important first thing because that was the contract that captured the liabilities and the risks around the building process, so from signing that to when the building was built, so before we could get any service level from them...that was the, that's the important and difficult contract. Because that's all to do with building law and contractor and sub-contractor liabilities and insurances and all the rest of it. So we kind of got them going on that and that and we had to put in a number of, or I felt obliged to put in a number of...you know...what felt like quite tough commercial mechanisms in that contract....that I came up with in order to protect Unilever's interests in this project...and there were two in particular, which were quite difficult to negotiate because, again, the interface between the commercial organisation and an academic organisation"- Mark Ward

"I did two things...and then you end up getting into defining things...One was the practical completion, so that is the day when that this is a building trade defined term, that is not well defined...but anyway, that's practical completion...Practical completion is when the main contractor hands the building over to the University, so that is a crucial time in the project right? So what we put in to the contract was that, if practical completion had not happened by the end of 2017, Unilever could walk away from the project, with minimal costs. So in other words, we pre-agreed what cost we would take, perhaps it was £1million/ £1.5 Million...a faction of what the overall amount and basically, if at the end of 2017, the University or the Main Contractor had not completed 'practical completion' we could walk away with no penalty, right? That's hardcore that because what that's saying is, you thought you were getting twenty-odd million pounds off Unilever, you've gone and built the building, took on the liability from that and you have got to banked on getting money from HEFCE, oh by the way...if you haven't done it, you don't get the £20 Million off Unilever and you don't get the money off HEFCE...right...that is like a super hardcore slap around the face for the University that"- Mark Ward

"now this is where you get this bleating 'oh well I thought we were partners'...but how could we go into an open-ended building project that might last 15 years...if there is no end to it, when does it end. So you have to have a, it was called a building long-stop date or something, and it basically says...'if you have come to that point, we have the option to walk away, not the obligation' right? It's up to us. So that was the chunky part of that Agreement for Lease. The second thing is.. how do we mitigate the risk that we pack all our equipment up right? thinking the building is going to be finished on a certain date and the building isn't ready?...right...so the mechanism I put in there was...the University were going to give us 3 month's notice of the practical completion right? So what I had said is look, you have got this long-stop date where if you hit that all bets are off or we can choose to have all bets off, our choice...so that's non-negotiable, that's in our hand. Then the second thing is entirely in your hands, which is you tell us when you think that you're going to be ready for us to move in. Right, because as soon as you tell us that, our risk reduces considerably because I have put in there a liquidated damages clause, and a liquidated damages clause, you have to agree up front...so you don't...so they tell us on the 1st January...1st March, they are not ready to go, whatever that is...1st April, they are not ready to go...damages start to be paid"- Mark Ward

Jun 13: Business Case re-appraisal in Unilever- highlights the need for a full-time Managing Director who would oversee business development and strategy- ensuring the MIF facility is sustainable in the long term. This position was not identified in the proposal- Peter Blanken assumes the position on an interim basis

"Managing Director: Due to the nature of the work required in the next 6 months, UL would like the interim MD in post before Feb 18th, 2014. Job spec in place need to progress ACTION XX to speak to XX – acceptance that we are at the behest of the job market, however aim to get this person in post asap."- Minutes of the JSB

"I put in there and said look 'we need a board of directors, we need a business plan, we need a Managing Director, you Peter or whoever gets the job, which is distinct from an academic Director because we need a commercial face here, someone we can work with who is going to give us the service, right?' So, if Archer is the Academic Director, he's not going to give us their service right, he is their person that is going to bring in the grants and make it brilliant, but whose the service, we need that"- Mark Ward

"the third thing is that we would constitute a board and the fourth is that we would have executive decisions that reported to the board and there are two of them; the managing director, Peter and the Academic Director, Archer. But the board of directors of the MIF is the entity that makes all of the decisions about the MIF so that we have got other structures for day to day decision making but in the end any dispute, any argument, any trouble anything that goes on goes to the board. Right, the board, so Peter's role and this is all described in the SLA, Peter's role as the Managing Director is to present to the board a business plan every year, right...here's the business plan and the business plan is a proper business plan right? What they're doing, what they're about, what's the staff, what's the IT, what's the budgets, how have they done this, what business are they going to make."-

"It was agreed that a Managing Director position would need to be created that was dedicated to business development and to oversee the financial sustainability of the MI. This appointment would need to be an interim position in order that the MIF business plan could start to be assessed without any commitment of a permanent post. There may be a possibility of seconding someone internally into this role – either at UoL or Unilever. The role would require someone with experience of running Research & Development centres. It was agreed that colleagues would be approached informally to gauge level of interest."- Minutes of the JSB

"we have got a managing director, you know? In the CMD we had a lab operations manager which

Defined the conceptual (organisational) elements of the Meaning Structure. Recalled past conceptual elements (open access- dual organisational structure) and defined the organisation of the MIF project. This also connected SL to the future development of the Meaning Structure by defining his role in the Meaning Structure more explicitly. was a senior sort of technical person but in the MIF we have got a managing director and a lab operations manager and a tiered structure as well you know. We have got different...it was a rather flat grading and you know approach to the CMD but in the MIF there is more of a spectrum of different grades, different roles...again and there is a managing director...I that it probably the single most important thing because you have got to have somebody who is accountable for the whole thing and it can't be you know 15% of and academics time, it has got to be person. So, you know, Peter of course is excellent at that role, so having somebody who is able to do that is maybe about the most important aspects, single most important aspect I would say."- Archer Mills

"you know he was the head of the University Gateway when we did the CMD but when the job came up in the University for the MD for the MIF, he applied for it and because of the work he had already done on the CMD, he was head and shoulders the best candidate. So got the job and of course that suited Unilever brilliantly because he, he knew us well, we had a lot of time for him, he understood the model intimately etc. so I think those two people from the point of view of the, you know Unilever looking at the University, they were pivotal whilst everybody else changed around them"- Elliot Murray

Apr 14: Service-Level Agreement Signed by Leonard Hart and Jacob Richards

"Good proaress has been on the main body of the SLA legal document and the multitude of associated schedules (now up to Schedule U). Sense check of where we are suggests we are about 90% there with most of these schedules good to go or with only minor mods required (e.g. adjustment of some of the stage gate dates). BMSA (FM services related document) may need some modification – we've had an initial discussion and amendments have already been made, now waiting for some consultancy advice back from UL. The main item appears to be SLA main body – UL legal counsel, Victoria, has suggested that as a services contract the agreement is not currently in the right place e.g. too many reasonable endeavours. To counter this there needs to be some recognition that this isn't a purely commercial relationship and we shouldn't default to a bare commercial approach. MR understood this position and made it clear that UL also want to see the agreement signed asap, however to protect UL he has to go through the process of receiving advice from legal counsel before he can recommend to internal UL legal personnel. This was understood. Victoria has committed to sending a marked-up version of the agreement by next Wednesday – if there is any possibility of bringing forward that would help, as discussed previously we cannot go beyond the 28th April without the project being delayed. Ordinarily we would have been comfortable with this - problem is the impact of the Easter holidays on seeking approval from senior stakeholders at both sides. Of course this will also depend on the scale of Victoria's comments and how they will materially affect the contract. ACTION SL to check availability of UoL legal for a review of Victoria's feedback next Wednesday, AC/RM/JM/SL/MR pencilled in to be available Thurs/Fri next week for possible face to face meetings."- Minutes of the JSB-April 2014

"On our side it was Myself, mainly myself and XXXX from the Legal Firm who did the negotiations for all of that. Then I had an internal senior council who acted as a peer-reviewer of whether that contract was sensible or not. So that was the Agreement for Lease, now I couldn't really contribute a lot to that, it's all stuff you can...The Service Level Agreement was completely different, so the Service Level Agreement had to be a document that...so, I had made a decision, myself, on behalf of Unilever, up front that there are basically two routes into making those kid of agreements, one is you, you catalogue all the possible ways things can go wrong and work out what's going to happen. That's really stupid I think, I think for small projects that works, for big projects it doesn't work. So what you do is you say 'well we've imagined all of the possible scenarios and if A happens, this is going to happen, B, C, D, E, F, G....' Like when you run something as big as the MIF over so many years, you can't do that. I decided up front that what we needed was a clear governance structure to the activity and my prejudice was that the cleanest governance structure you can get I think, the simple governance but well-defined government of a limited company in the UK. Right? It is very clear what it is right? The Shareholders have a role, the Directors have a role and the you know, how you run the

Defined Meaning Structure Elements (Concepts, Actors and Materials) and linked them to particular future events in a timescale for implementation- defining the temporal trajectory of the Meaning Structure whole thing has a role. That for me is super clear governance and that was my prejudice that I wanted that for the MIF. Now, the University were not happy to do that and I understand why not...because that would make that like a Joint-Venture, a separate legal entity from the university and they were not happy to do that."- Mark Ward

"that's how we did the SLA right? and the SLA I think is er...so the key thing with SLA is that is describes governance and there is some wrinkles on that and there was some negotiation around that."- Mark Ward

"we gave up reluctantly because it felt uneven that. Now, I do understand all the arguments but it still felt a little bit uneven. So that was one of the crunch things...the so the other thing the SLA does is describe the payment schedule, which is important and we had to rejig how we thought about that payment schedule a couple of times, to make sure it was in line with tax advice and with what the government wanted. We...we kind of enshrined in that SLA, the Open Access Area and the way that worked...and we kind of, Peter and I instituted this kind of idea that there was a third party at the negotiation table who wasn't there, which was the UK taxpayer"- Mark Ward

"So when I then got involved, I said right what have we got here? What's been sort of agreed already, pilot floor and some principles basically, nothing detailed but some fundamental principles had been set out at that point, none of which actually caused a problem. Look...but that's when we sort of said right let's separate these things our and let's start focusing on what is this deal...and that's where I think a very health point of view between the two organisations, Mark and I happened, mainly because our senior stakeholders said we're doing it. So we sat in a room and said well the decision has been made, it's not our decision but we are doing it, we have just got to say doing what exactly and how does that doing it work? So we then became the architects of drawing that up. Basically writing the operating manual of how this thing will work"- Peter Blanken

"So the SLA, although it is a legal agreement, a lot of it we've pushed back into the appendices which is the first business plan the code of ethics, health and safety, all the sorts of operational stuff, the access agreement, the whole, everything about how you actually, the two organisations will work. And we then lifted some of the main stuff into the agreement of the SLA which was about governance structure, dispute resolution, all that sort of stuff, the hard and fast needles but the majority of it we kept in the non-legal part which was about how we are actually going to do it. The operating manual"- Peter Blanken

Dec 12: Daniel Jacobs promoted as part of another restructure of R&D- no longer formally responsible for the management of the relationship with the UoL. "Daniel Jacobs is moving to a more programme facing role as Director of Unilever Discover - Hair, and will now become a key user of the MIF to deliver his development projects. Paul has been involved with this project from the get-go and it was recognised that the MIF wouldn't have happened without his input. There was a unanimous expression of thanks for Paul's efforts and wishes of good luck for his new role"- Minutes of the JSB "I remember because I was really heavily involved in getting the original grant and doing everything in the original diligence in the business case and then I moved roles, I went and worked in Home Care for a couple of years and you know, I wasn't so involved in it and actually it was a discussion I had had at the time. I said look 'I have been so involved in this for the best part of 18 months, I don't think I can see it as dispassionately as others couldI said to Elliot Murray, who at the time was kind of leading on the MIF. I said I don't think I can do an implementation job of something that I have put my heart and soul into bringing the vision and the grant and stuff with the University of Liverpool, I think you need someone with a dispassionate view on it.' and he said No, no no just turn it overand I said Jon honestly, this is what I am telling you from my experienceso anyway we did make that decision and it was a good one because actually what the MIF looks like today is notthe OAA is exactly as I envisaged it pretty much. Not you know, some of the kit might be a bit different but the principle of how it operates and that it's a facility that we can use, that the University can use and other external partners can use and it's all data managed and whateverexactly as I'd thoughtThe bit I'd never really had in the way that we have actually done it is the University can use in other external partners can use	Disconnected actor	Activity- Reconfiguring meaning structure elements
Jan 13: Decision by JSB to co-ordinate partnership event that would showcase the MIF to potential 3rd party investors		
"Unilever were committed to undertaking due diligence to support a business case for financial investment. There would need to be an outline business plan created to provide evidence of wider financial support from external partners and to help discussions at Unilever to firm up financial	Connected new actors	

options for cash flow. The financial projections from partners and other external funding schemes would need to be scoped out in order to demonstrate a plausible business plan and support a case for Unilever investment."- Minutes of JSB

"It was agreed that N8 representatives should be included in a Partnership Engagement Event that was being planned. The Partnership Engagement Event would be by selected invitation only. Possible attendees included Chairman of the Technology Strategy Board. It was agreed that the VC would be asked to approach the Chairman to attend the event. BP had been identified as a potential partner and were already involved with UoL at a senior level. BP were increasingly outsourcing research and were likely to increase this activity in the form of post-doctoral positions which would fit well with the Materials Innovation Factory (MIF) engagement model. Unilever had identified a set of strategic innovation partners. Discussions were underway internally on how these partners might be targeted to attend the Partnership Engagement Event. It was agreed that around ten potential partners should be invited to this event to ensure a targeted and select group of high-ranking attendees. A number of engagement models would need to be assessed in order that a clear proposition could be developed ready for the Partnership Engagement Event. Options included using post docs as a mechanism to draw in partners, and the creation of adjunct academic positions at UoL to allow access to facilities. A clear service level agreement would need to be created to outline the parameters around access to facilities. The Partnership Engagement Event had a financial objective, which was to start to engage external investment to mitigate any financial risk associated with the business case for MIF."- Minutes of the JSB

"Unilever were committed to undertaking due diligence to support a business case for financial investment. There would need to be an outline business plan created to provide evidence of wider financial support from external partners and to help discussions at Unilever to firm up financial options for cash flow. The financial projections from partners and other external funding schemes would need to be scoped out in order to demonstrate a plausible business plan and support a case for Unilever investment."

Jan 13: Mark Ward (OI Director) becomes involved in the MIF project by coordinating the partnership event for 3rd party investors- Partnership event takes place

"Forty invitations had been sent out to potential attendees. The Group was requested to review their contacts to identify any additional high-ranking attendees. Mark Ward would also follow up contacts from Liverpool Enterprise Partnership and Technology Strategy Board. It would be important to ensure industry representation at the event; commercial messages would need to be refined to ensure a

robust proposition to potential third parties. "- Minutes of the JSB	
"Event held on the 3rd June – 30 external attendees, very good feedback received and many useful discussions held throughout the day. Since the last JSB, including activity at the partnership event, we have engaged with several industrial potential collaborators, specifically"- Minutes of the JSB	
Jan 13: Project Management position for MIF advertised internally within Unilever	
R&D- no applications and position remained vacant	
"we realised that we needed a Unilever project leader to drive all of this. Now I am trying to decipher whether, we did quite a lot of work, still with Daniel Jacobs in the driving seat up until around May 2013. At that point we got the final sign off from the RDLT (Research and Development Leadership Team) that we were actually going to commit to this fully and then I we were looking for a project leader to do it. Nobody stepped forward, so I ended up appointing Mark Ward to do it"- Elliot Murray	
"SoI think people don't and probably still don't see the role of building future capabilities as important asyou know if you're are out try and drive yourself a career in R&D in Unilever, you get most credit if you deliver big innovation projects to market. So, this wasn't like that, this was by any definition; a huge, ambitious and difficult project but the perception in Unilever was 'look if it goes wrong, I am going to get caned badly. If it goes well, it is still not as valuable to me as if I have been seen to deliver a big innovation programme into the market'. So the relative perception of value in people's heads about doing these sorts of things, it does, they are differentWe still suffer from that, I, you know I run an open innovation capability and its actually quite hard to attract people into it. So anyway, Mark was in my team and I freed him up to do it. He did a brilliant job of negotiating the whole package of the lease, the agreement for lease, the service level agreementyou know he has obviously told you the various elements of it. But also, doing, I think this was hard work, his absolute best to rally the organisation to actually input into what the content of the Materials Innovation Factory would be"- Elliot Murray	
Jun 13: Ward and Blanken decide to prioritise the negotiation of a legal framework	
for the MIF project.	
"We get to 2013, January 2013 and at the end of 2012 my boss Elliot Murray said to me look, these guys are gonna build this Materials Innovation Factory, they need help to develop partnerships, can you help them do that? The key person driving it from the Unilever side was a guy called Daniel Jacobs, who is still around, you can go and talk to him. Paul got a new job starting January 1st or	Connected concepts

daft you can't do that'... so between January 2013 and about April 2013, I was getting frustrated that I could see this was a massive thing that we had committed to do, but who was driving it on from Unilever's side right? And the way I saw it, we let...my description of it was we were 'snoozy-cruising', right? we were just...time was going on, there is a time element of these grant awards, time was going on and we weren't doing anything. "- Mark Ward

"Feedback from the Unilever senior team is that – to reduce risk for both parties, the earlier we can get the entire suit of agreements the better. So far, we were targeting the end of November for an MoU, which we now have the first draft. We should aim to see if it is possible to complete the main SLA by 3rd December (co-incident with a visit by Geneviève Berger). Fall-back position is the MoU to be ready by this date. Suggestion is that within the next week need to set up a series of day/half day meetings, working up what need to be covered in the SLA "- Minutes of JSB

"we had formed this thing called the Joint Strategy Board and...We got some representatives from Unilever, some representatives from the University, senior representatives from the University and they were meeting probably every four to six weeks and they were all talking about the blooming building. So I looked at some of the minutes and it was...ok building, building related, building related...where's anything about what we're gonna do? So I spoke with some of the people who were in there and said right, this really needs to get up and running, what are you doing about it? and they said oh well we're going to have the conversations. So I looked again eight weeks later and nothing...still buildings and I just went, this thing is absolutely in danger of falling over completely after us securing the funding, we are nowhere near securing Unilever. So who is negotiating all of the agreements, we've found a location to put a building, we've got architects giving designs of buildings everyone's going oh well this is fantastic but the nuts and bolts haven't been done yet. So I had a word with my line manager then who was Director of Partnerships and Innovation, Richard Clarke and said I need to get involved in this, second me over half the time"- Peter Blanken

"Decision not to proceed with Heads of Terms but to go straight into the development of all the necessary agreements to support the centre. Initially the list is as follows: Master agreement – explaining the overall governance of the MIF, strategic vision. Building agreement – detailing building liabilities, what UoL will deliver etc etc...Lease and licence SLA – detailed operational contract, levels of service, credit system. Suggestion that initial focus should be on the first agreement and draft of first three documents should be generated by UoL and the SLA by UL. This should be decided after initial discussions between teams at both parties. There is a negotiation team at UL consisting of MR/SG (procurement) and their subcontract legal firm (Pinsent Masons). ACTION SL and UoL legal team to mirror this, initial action for UoL to speak to UL lawyers -

both teams need to work towards the Master agreement as a first step. Timeline – complete the whole set of documents by 28th November. Up until this point we are still both progressing this project at risk – in recognition of this and to support cash flow UoL require the £225k committed by UL at a previous JSB to support current activity ACTION MR"- Minutes of JSB		
Jun 13: Mark Ward appoints external legal counsel to the project in order to speed up the negotiation process "Yeah and the slow way of doing that is I write my version and send it to you, you comment and the quick way is basically sit down and say right we need to get out, on the table, what is everything going toso it's kind of you are co-creating. Our lawyers are typical in-house lawyers, would have never have allowed me to do thatpeople didn't know what I was doingeven if they did, I would have said well that's why I am doing itbecause time was of the essence right?"- Mark Ward	Connected actors	
Jun 13: Blanken and Ward restructure the JSB- sub committees are established and decision-making for the OMICs component of the project is separated from the rest of the MIF. "OMIC's- Due to its separate physical location and the very different nature of the work in this part of the project a separate credit management and operational regime is to be put in place. The MIF budget will cover the purchase of a new item of equipment and support the recruitment of a new FTE, but UL will have access to results generated across a range of equipment and staff as part of a wider offer from the Centre for Genomics Research. As a consequence it makes sense to manage this part of the activity using existing CGR structures. To reflect this a separate SLA has been produced, and is currently being reviewed by both parties ACTION MR/SL. Another element to support the OMICS activity is the development of new open plan office. Plans have been drawn up and agreed – initial schedule was for this to be ready by June 2015, however latest plan is for this to be ready end of July."- Minutes of the JSB	Connected actors and concepts	

need to be reflected in the main SLA."- Minutes of the JSB	
"To speed up decision making at UoL on detailed project delivery some delegated responsibility to a Project Control Group for the build – to be chaired by SD, other project activity covered by an operations board at UoL consisting of AC, SL, JM (discussion outside the JSB meeting between SD/SL/JM suggested both TM and JM and should be involved with both of these two teams to ensure all activities are co-ordinated). Archer will funnel inputs from the theme leads within the academic team into the operations group. Unilever in the process of a re-organisation, details of points of contact at UL to mirror the above will emerge shortly"- Minutes of the JSB	
Jun 13: The external legal counsel appointed by Ward defined the legal framework	
"Normally speaking, we would use in house solicitors and our head of the legal function decided that we weren't going to do that because the in house solicitors didn't have the skills in property law and building law and all the rest of it. So they insisted that we use external council, which was a brilliant decision. That was a crucial decision for the progress of the project that. We appoint an external legal company to act on our behalf to write the contracts and help negotiate the contracts. So We worked with an outfit called City Legal Firm, which are a really highfalutin city legal firm. An I basically structured the kind of the deal about what we needed them to write, so it was the Agreement for Lease and the Lease which was part of that really and the Service Level Agreement. And, so they appointed a solicitor called XXX, who did all the legal work, all the draftingwhich ended up being very very broad, yeah very considerable amount of document pages to do that."- Mark Ward	Connected Concepts
Jun 13: Changes in Senior Management Team at the University of Liverpool- Arnold	
KOYIE IS promoted to Provost. Brad Moss IS made PVC for Science and Engineering. "As newly appointed Provost, Arnold Royle would like to remain involved in the MIF but raised the possibility of potentially yielding the Chair of the JSB to Prof Brad Moss, the newly appointed executive Pro-Vice chancellor for Science & engineering. Consensus was that given Arnold's significant input into the project to date, a better approach is for Arnold to retain the chair and Ken is invited to attend."- Minutes of the JSB	Disconnected actors/ connected new actors
"So the proposal for RPIF had been approved and the project was going ahead. So it's a very very big project for the faculty, for the university so in my new role then as head of the faculty became involved in this project, it's such a big project. Also, because I'm the budget holder for science and engineering and the way that the MIF Finances sits in the University Finances I've taken a close interest in how to budget for some of the elements before the project before the doors open"- Brad	

Sep 13: Ward and Royle agree that the MIF will constitute 'a school' in the organisational framework of the University and will be governed by a MIF Board consisting of 3 Unilever and 3 UoL representatives at senior level.		
"Proposal that the MIF is elevated to be a constituent element of the Science and Engineering Faculty (similar to CTL) – see attached org charts. This would mean the MIF would exist as a separate cost centre in the faculty. AC pointed out that this is an operational structure; initially there would be no academic line reports in the MIF. Proposal well received by UL. The overall direction of the MIF would be governed by a board structure illustrated in the attachment. NH queried the requirement for the Head of School, particularly given the elevation of the MIF out of a particular school structure (note: this was suggested as a consequence of the chemistry department being the main customer of the MIF, particularly if a significant equipment set is moved into the MIF from the chemistry department, how additional customers are represented on this group needs some thought)"- Minutes of the JSB-Sep 13		
"I decided up front that what we needed was a clear governance structure to the activity and my prejudice was that the cleanest governance structure you can get I think, the simple governance but well-defined government of a limited company in the UK. Right? It is very clear what it is right? The Shareholders have a role, the Directors have a role and the you know, how you run the whole thing has a role. That for me is super clear governance and that was my prejudice that I wanted that for the MIF. Now, the University were not happy to do that and I understand why notbecause that would make that like a Joint-Venture, a separate legal from the university, joint venture and they were not happy to do that."- Mark Ward	Connected concepts and actors	
"Yeah, that would be a separate legal entity. So I basically said 'look, that's my benchmark for governance because it is super clear', we didn't get there, but what we got to was a clear governance that is within the structure of the University, in factthey have the casting vote on everything, but has some of the components of the governance of a company, so it has a board of directors, it has a business plan"- Mark Ward		
"The MIF board is three people, three of the VPs from Port Sunlight and our ePVC for faculty, Director of Operations and Academic Director and I report to that Board. So that's started, in fact we have got our second AGM in May. So, yeahit's been running for a year."- Peter Blanken		

Appendix 3d- Relationality and Activity- MIF Redefined

Narrative Vignette/ Event	Narrative Themes	Theoretical Process
Aug 14: 'E-Science' group established to explore the computational infrastructure required for the MIF- Consists of Blanken, Ward, Mills "Several discussions have taken place between UL and UoL staff and there is now a significant team looking at what's required for the MIF. This team will meet monthly to review progress. As yet there appears to be no show stoppers on the basic infrastructure, looks like for security purposes the network into the UL floor can be partitioned "virtually" rather than via a separate physical link. On e-science UoL have visited Port Sunlight to get an appreciation of the benefits of the various systems – next step is to tease out how these benefits could be translated to UoL, meeting arranged next week to discuss"- Minutes of JSB	Re-definition of connections. Already connected actors arranged in a new way (e-science team)- created a new macro decision-making body (e- science team).	
Aug 14: Archer Mills and Colt Douglas submit a proposal for an EPSRC 'Programme Grant' focused on the integration of computational and experimental methods for High-throughput Materials Discovery. "This Programme Grant will tackle the challenge by delivering the daily working-level integration of computation and experiment to discover new materials, driven by a closely interacting team of specialists in structure and property prediction, measurement and materials synthesis. Key to this will be unique methods developed by our team that led to recent landmark publications in Science and Nature. We are therefore internationally well placed to deliver this timely vision. Our approach will enable discovery of functional materials on a much faster timescale. It will have broad scope, because we will develop it across materials types with a range of targeted properties. It will have disruptive impact because it uses chemical understanding and experiment in tandem with calculations that directly exploit chemical knowledge. In the longer term, the approach will enable a wide range of academic and industrial communities in chemistry and also in physics and engineering, where there is often a keener understanding of the properties required for applications, to design better materials. This approach will lead to new materials,	Connected new conceptual element	Activity- Reconfigured Meaning Structure elements through connections and disconnections.

such as battery electrolytes, materials for information storage, and photocatalysts for solar energy conversion, that are important societal and commercial targets in their own right"- EPSRC Programme Grant Application	
Nov 14: First MIF appointment - technical support staff Martin Gerrard- hired to aid procurement process. Jon Ware was hired to lead procurement in Automation in March 2015.	
"I am a technical support supervisor, so currently my role is to determine the requirements of the essential and desirable equipment to be within the Open Access Floor of the Materials Innovation Factory and when it starts operation, I will be responsible for maintaining and ensuring the delivery of the service on a small subset of that equipment"- Martin Gerrard	Connected Actors
"The project has a new starter – Martin Gerrard on the 13/10, employed to aid the equipment procurement process and will become one of the staff supporting the open access area once the MIF is open."- Minutes of the JSB	
in engineering Mike will lead on automation development"- Minutes of JSB	
Dec 14: Chancellor George Osbourne announces the 'Sir Henry Royce	
Institute, a £200m research institute focused on 'Advanced Materials'	
based at the University of Manchester.	
"In the Autumn Statement in December 2014 George Osborne announced as part of the funding for scientific Grand Challenges an investment of £235 m to create the Sir Henry Royce Institute for advanced materials. There are 16 areas grouped into four themes – Energy, Engineering, Functional and Soft Materials – critical areas to underpin the government's industrial strategy, and will underpin economic growth within UK Plc. The institute will drive collaborations between academia and industry, to commercialise the UK's world-leading research in this field. The Royce should be considered as the precise shape, form and funding of the Royce Institute becomes clearer following the general election "- MIE Business Plan 2015.	Connected Material Element (capital)

Jan 15: Mills, Blanken and Ward meet as the e-science team and together re-articulate the technical ambition of the MIF. Meeting of the 'E-Science' group sharpens focus on computational aspirations-Establishes the concept of 'Computer Aided Materials Science'

"Colt and Archer were putting together the Leverhulme proposal. I wasn't involved in that and Unilever wasn't involved because it's a blue-sky thing. I knew they were doing it right? And Arnold Royle was around and about then right? And they talked about this functional materials design and you know this idea of Computer Aided Design right, for chemistry, so it was all in the air at the time that kind of idea. So we sat down and thrashed away at this. I said 'right look guys, here's my start...world' s leading centre for computer aided materials science' right? And then 'Ohhh what does that mean? I said look foraet about it, what it means is if we define it like that. I taught them a little bit about how Unilever does claims. If we define it like that, we are going to claim that and then we are going to make it happen.. make it so right? Then you get into what the metrics, how you know you are world-class...it doesn't matter about any of that because its...we can't have a vision that says you know, the North-West of England's leading Centre or the UK ... It has got to be the world leading centre for materials science. So what that's about is, if you take the analogy of computer aided design and computer aided manufacture to computer aided materials right? Now I knew that the Leverhulme Centre was kind of working at a higher level again on that conceptual idea. So what do you need to do that? Well you need to have a kind of seamless connection of experiments and theory, robotics, data analysis and all the rest of it..right, this idea of kind of a 'hooked up' system. That's when we did it"- Mark Ward

"The second thing I talked about, roughly at that time was this idea of what I call the MIF operating system... and I had a long conversation with Archer and Peter and they thought I was smoking something. What I said...if you look at how operating systems work like Unix, they have got a set of design principles and one of the key ones in modularity. So you have a bunch of modules and what you do is you allow the user the freedom to connect the modules up to do something right? So I said conceptually, what we really need is an operating system for MIF because if you can do that, then you can then make that to people outside of it. Right, so the base level of what you need in order to give people access to this from the outside of Liverpool is that operating system right? And I said so what you need to do is think about how you

Connected conceptual element (Computer Aided Materials Science)

modularise all the processes in the MIF"- Mark Ward

"I mean I wrote/ led this Leverhulme research centre for functional materials design bid...it wasn't predicated entirely on the MIF but certainly having a space where you can have the large team in one place was a big part of it. Having the things like the formulation engine, one of the ideas is sort of algorithmic evolution of functional materials. You can't do that without certain tools"- Archer Mills

"MIF IT provision can be broken down into two strands of activity: Supporting IT infrastructure (Wi-Fi heads, data points, switches, how UL will access their systems from the first floor). After many months of discussion it's looking like UoL responsibility can be distilled down to providing internet access to UL staff; downstream of any data points and wi-fi heads. This position is still to be finalised by UL ACTION MR to confirm. E-science – strategy to deal with efficiently generating and corralling the data generated in the MIF open access area. This is intimately intertwined with the "computer aided science" concept articulated in the equipment procurement process."- Minutes of JSB December 2014

appointed Professor Janet Beer as its next Vice-Chancellor. Professor Beer will be the

"Meeting organised for the 10th December at UoL, the original plan was to talk through the lists worked up by both parties to explore areas of common ground. Preliminary discussions between the UoL and UL technical teams have identified some good areas of overlap, however although the bottom up approach of consulting with users has resulted in good list of potential equipment that would fulfil some of the requirements for open access area, there appears to be little that differentiates the MIF. Therefore to complement the equipment lists worked up on both sites it was agreed that we also need to augment the list with a more "visionary" portfolio of capabilities and a distinct strategic direction for the MIF open access area. ACTION *MR/AC/SL* to discuss prior to the meeting on the 10th December and re-purpose this meeting as appropriate."- Minutes of JSB- November 2014 Feb 15: New Vice-Chancellor, Janet Beer, starts at the University of Liverpool following retirement of Sir Jacob Richards. Arnold Royle departs as Provost. Disconnected actors "Professor Janet Beer will be the University's next Vice-Chancellor, after successfully leading Oxford Brookes University since 2007. The University of Liverpool has

University's first woman Vice-Chancellor and one of only three in the elite Russell Group. She will join the University on 1 February 2015, taking over from Professor Sir Jacob Richards who is retiring after six years as Vice-Chancellor"- University of Liverpool News- July 2014. "SoI don't work at the University any more rightand there's a reason for that. If Jacob would have still been in the Vice-Chancellors Chair, we would be cracking on with this" Arnold Doulo	
Mar 15: 1st 'Equipment Report' is completed and submitted to JSB. Ward, Blanken and Mills decide that the Stage-Gated process outlined in the SLA should be abandoned to develop greater clarity about how the MIF technical ambitions could be realised materially. "The visionary element of the equipment piece is centred on the concept "computer aided science" where a supporting IT infrastructure, coupled with automated "make" capability forms the backbone of the MIF open access area. This vision, coupled with an appropriate balance of specific equipment requests, has been articulated in the stage 1 report, due to be submitted on the 7th Jan. After the submission of the stage 1 report, the idea is to present the rationale to the UL teams ACTION JM/SL/MR to arrange a suitable meeting time. Immediately after this meeting MR (or designated colleague) will present their UL's feedback on the report. UoL will review any comments or suggestions from UL taking account of the budget implications and make necessary revisions to the Stage 1 report. This process will be repeated until agreement is reached and the stage 1 report signed off. In the unlikely event there is a failure to agree this will be taken to the first board meeting in March."- Minutes of JSB- December 2014 "Stage 1 report issued to Unilever on the 7th Jan, however there are still areas of uncertainly – particularly around the robotic dispensing concept, and associated supporting IT infrastructure which together account for a significant proportion of the budget. There also a need for a joined-up discussion between the two parties on why particular pieces of kit have been chosen sides and how they align with current capabilities and forecast requirements"- Minutes of the JSB- March 2015	Connected concepts

Mar 15: Ward commissions piece of work by Unilever researcher (Patricia Lyle) to identify gaps in the existing HT infrastructure/ capabilities- Includes Unilever internal platforms; CMD; MBR; HTFC. This gap-analysis will be used to inform the purchase list for the MIF and to avoid duplication of capabilities. "To aid this process UL have recruited Patricia Lyle to produce a capability matrix on what is available at both UL and UoL and see how this sits with proposals and forecast need. Patricia will liaise with UoL/UL staff where appropriate."- Minutes of JSB- March 2015 "Archer had it in his head but he couldn't explain it to anyone right? I did a piece of work, I paid for a consultant to do piece of work and that consultant employed Patricia Lyle to do that piece of work to actually describe how the different scales of formulation and different unit operations needed to be and that was the foundational document, in my opinionArcher might disagree with thisthat became the formulation engine, right? So that's a pretty deep kind of commitment to the thing"- Mark Ward "Formulation engine (modular robotic system) – there has been lots of very productive discussions between the UoL/UL technical teams – target for specification is by the end of the month "- Minutes of JSB	Connected actors	
Mar 15: Barney Jackson appointed Programme Director for the MIF in Unilever- becomes formally responsible for integrating Unilever workflows with the MIF technical capabilities. "So I was brought into this role nearly 2 and a half years ago, as what was called the Materials Innovation Factory Programme Director. So that basically meant, whereas Mark was kind of, had very much been the lynchpin in creating the SLA between the two organisations, had been doing a lot around the original design and was at the heart at the kind of the relationship part My job was kind of to take almost like the actual building, the fitting out and the deployment of the R&D programme into the buildingso my role was far more a programme role whereas Mark's being in OI is not really about category programmesSo that's kind of where I came inso at the start basically I got introduced to the main players both at the University and at	Connected actors	

Unilever and I very much took sort of Mark's, sort of followed Mark's lead on a l this stuffand then over time Mark has kind of gradually taken more of a back s as really his part, which is more around the sort of contractual stuff has kind of completed."- Barney Jackson	ot of eat been
"Two new members have joined the JSB: Barney Jackson – MIF programme direct for Unilever, who will work closely with Mark as the MIF is in the development p and take overall operational responsibility for Unilever when open"- Minutes of	ctor hase JSB
Apr 15 : Equipment Budget refined- 'Formulation Engine' defined a key Material Element	s a
"The MIF Directors delivered the Stage 1 report on the 7th January 2015 accords the schedule, with the intention of identifying the MIF Purchase List C that the University will procure with £7.1m of capital budget for equipment to be located within the Open Access Area (OAA). As agreed in the SLA, it contains the initial II scientific equipment for procurement with nonbinding suppliers estimates of cos based on knowledge and/or quotes, plus a statement of how the purchased equipment will deliver the desired scientific capability, taking account of any do equipment (In-kind List A and B). Both parties met for a face-to-face meeting to discuss the content of the stage 1 report on the 13th January. Following the feet received from Unilever (15th January) it was agreed by both parties that we wo step outside of the stage gated schedule to perform a 'deep dive' into existing capability to satisfy ourselves there was no duplication or capability. The brief of activity was to create a matrix of 'MIF modules', versus the scale at which they This matrix will then provide the basis for a gap analysis of current requirement. the foundation to develop a road map to fill those gaps (which may be simple purchases or require a research project) in order for the MIF to fulfil its long-tern vision. In parallel, the VP for Open Innovation, the MIF Programme Director and MIF MD visited XXXX to review their new modular approach to automation with "FlexiShuttle" system and scoped out the possibility for XXXX to become a MIF collaborative partner to deliver elements of CAMS and the modular approach to formulation, analysis and measurement. Both parties met for a face to face on to 23rd April to discuss the MIF Equipment Manifest. The profile of the budget was agreed. The MIF team are drafting the 'Want' statement that describes the tech requirements of the 'Formulation Engine' taking data from existing capability in	ng to st of t, hated lback ld Connected concept f this vork. and n the their he nical MBR,

CMD etc. This will be shared with Unilever and discussed in a face to face on the 7th May. "- MIF Business Plan 2015	
Jul 15: Prof. Arnold Royle leaves the University and Brad Moss becomes Chair of the JSB and MIF Board following departure of Arnold Royle	
"I chair the Joint Strategy Board, which is essentially driving the delivery of the project. I also chair the main board [The MIF Board] which, which provides the sort of ultimate governance for the project"- Brad Moss	Disconnected actors
"so at that time, I wasn't the Dean of the Faculty, Brad Moss was and so in terms of decision making, for resources, Ken was making the decisions not me, I sat on the Strategic Board during that time, so that was 2014 and at some point in 2015 there was a switch and then Ken got in and I was off that board. I mean I was still on some, the working group, the one where Unilever and Ourselves just got together just to bat stuff around, more operational, I was on that board. I remember talking about publicity and various other things but I was you know; I was doing other stuff at that point."- Arnold Royle	
May 15: Mark Ward makes offer to the University of Liverpool JSB members to license Unilever's proprietary software for the management of High-Throughput workflows (called FLOW/EMS)- This would create a new software programme (code-base) that would be termed 'para-dime'	
"One recent change is an offer by Unilever to licence their IT data management software to the MIF. This would potentially provide additional leverage for future funding calls. This offer requires senior UL approval and follow up technical discussions on how to create a standalone UoL version of the software"- Minutes of the JSB "but the licensing, which is much later on, you should have as a little chapter. Seriouslyhonestly, I would take them out because that is absolutely uniquehonestlyI'll tell you it is absolutely crazily unique that bit and that was not part of the plan. It was part of my plan but it wasn't part of the Universities plan"-	Connected material Element (software)

"A key decision reached in July 2015 was the donation of Unilever's EMS & FLOW data management system for use within the MIF. This is a welcome development which allows the MIF to build upon Unilever's +10 years of experience in this area and will provide consistency across many of the equipment platforms to be housed within the MIF. Despite clear advantages, donation of EMS & Flow is not without associated development costs. By way of an example FLOW was designed for all Unilever users to have access to constituent formulation ingredients; the concept of segregating the data for multiple-tenancy and multi-user operation was not required within the Unilever environment. For FLOW to be used in a shared lab, with several potential third part collaborators, this was a development which clearly needed to be addressed for day one operation. There are several other issues which were also identified as priority features or amendments summarised below, however, a fundamental first step was to test whether an incidence of EMS & FLOW can reside and operate within the University's existing infrastructure and IT environment. A trial in November 2015 demonstrated a fully working incidence of the EMS & FLOW software suite, clean of any Unilever data, had been successfully installed within the University IT environment. The demonstration using robotic platforms located at the Liverpool Science Park was a successful proof-of-principle. This successful first step was followed by a detailed two-month gap analysis designed to highlight the key areas of software development required before Para DIME[®] would be capable of being deployed in a multi-tenancy, multiuser environment. The output of this scoping exercise highlighted the following areas to be addressed, resulting in a usable system available for testing by July 2016"- MIF Business Plan- April 2016

"Yeah, so yeah Unilever had...I mean there are a number of things that Peter realised that he was going to need if he was going to make this A) a highly effective and efficient operation but also you know, professional and the ability to you know, drive an automated booking system for equipment was one of them. The second thing was an operating system and a data capture system for the high throughput equipment and what I mean...you know what Unilever had done we worked with XXXX to build a high throughput operating system and data capture system for high throughput data that was operating across all of our machines you know. Because the thing you get if you work with individual high throughput machinery providers is that they will provide their own...or you end up designing one bespoke for one bit of kit and...you know that is obviously not areat so...I mean all the high throughput data captured in the same format and using the same operating system made a huge amount of sense."- Elliot Murray

"So we didn't realise it at the time, and when Peter looked at the options that were out there, it turned out that Unilever's system that had been designed for exactly this worked with, was way better than anything else on the market. We had invested several million over a number of years to get it to a point where it was you know running our high throughput systems so it became a simple point then, well why on earth wouldn't we just license that to the Materials Innovation Factory? and we did that at no cost to the MIF...what we got in return was the ability to access any improvement that the University may make to that operating system, you know because they are constantly upgrading it...that was really beneficial for us, it means that you know any of our systems get upgraded as the University invest in the thing, really they've managed to avoid a £5m investment in their own right. There is a massive amount of value created for the University there. So I think that that was the first major benefit, we get the upgrades. The second thing is that, all the data that is captured into the Materials Innovation Factory is in a system that is compatible with high throughput data. That means that when we bring, you know we are going to start to use the MIF with our partners and our suppliers. When data is collected, I mean obviously there is going to be confidentiality in the data we file and all the rest of it but should our partners wish to share the data with us, it is in a format that we know and love right [laughs] so it makes...any work that is done in the MIF is done in a format that Unilever immediately knows and recognises and can work with, that we don't have to do any translation or data cleansing or...there is no ambiguity there, so that is of benefit for us as we bring our partners in and our partners use the MIF"-Elliot Murray

"we raised grant money on an RGF grant, we took all of the bloody flack that goes with those grants and built JEFF and donated it to the university right...for free...it's not even part of our obligation, because we met the obligation through the software, right? so all of our intellectual effort, thought leadership, engineering expertise, all of our knowledge about formulation, all of our knowledge about how to build a modular robot, all of the software, hardware, we managed the project, the guys who we had chosen, XXXX, built it, we got it going, we de-risked it, we've integrated it with our software management system, we've built expertise on it and we have given it to the University for anyone, including our direct competitors to use on day one. That is a

pretty close collaboration that. But the problem is theso forget about research projectsthat, as a way of sharing intellectual asset base, that is unbelievably close, rightlikewise with the high throughputlikewise with our input into the plan and the formulation enginethat formulation engine was conceived in my head and I had to convince Archer Mills and Peter that that's how it needed to look"- Mark Ward Dec 15: JSB collectively 'decides' to withdraw their participation from the developing LCR 4.0 proposal (that became Sensor City). "BIS – University enterprise zones, details to be announced imminently – agreement between John Moore's and UoL that we should go for this. SL already picked up this."- Minutes of JSB "Original MIF accelerator plan for a doctoral training centre no longer made sense with re-apportionment of ERDF funds so plan for LCR4.0 MIF is to create an Automated Materials Discovery Centre as a theme within the MIF using the same managerial oversight, but physically located and staffed within the existing CMD part of chemistry (current CMD contract expires end of next year). This would give an opportunity for a refresh of the current facility and would also require some new staff to manage SME assists etc. For the funding to work will need UL's contribution as a match. ACTION SL to laisse with MR on the shape of the bid and what is required from UL."- Minutes of the JSB "Recent contact with RGF monitoring officers suggests it may be necessary to continue the MBR so it fulfils the terms of the grant. LCR 4.0 proposal now doesn't look like it's providing a good fit with what we are trying to achieve with the AMD concept. Capital has been reduced and this will come with many strings in terms of assists etc. may be a distraction. SL trying to see if there is a way of adjusting (Update, after the meeting it has been decided to withdraw the MIF from the LCR 4.0proposal)."- Minutes of JSB	Disconnected material element (capital)	
Innovation Factory- Notice of project termination served by Blanken to Murray.	Disconnected material element	
"Recent contact with RGF monitoring officers suggests it may be necessary to continue the MBR so it fulfils the terms of the grant"- Minutes of JSB		

"As set out in the Micro Bio Refinery (MBR) service level agreement between the University of Liverpool and Unilever (effective from the 17/10/13); it was recognised by both parties that additional funding from Unilever to the University would be required to continue the project beyond 16th October 2016. Pursuant to clause 14.7 no formal agreement has been reached between the parties on how the project will be funded post 16th October 2016 and as such the project will suffer a short fall in funding to the extent that it will no longer be economically viable to continue. As a consequence, and pursuant to clause 14.4.1 of the agreement, it is therefore necessary for the University to issue this formal notice that intends to terminate the MBR Service level agreement on the 16st November 2016. Of course it is fully recognised that there is a desire from both parties for the MBR project to continue, and discussions on how to fund the MBR post October 2016 are ongoing. However accepting that at this current time no firm agreements have been reached it is necessary for the University to issue this formal notice of termination."- Letter from Blanken to Murray- Termination notice of MBR

"No funding for MBR access, contract to terminate in October. Under the existing 3rd party access we identify the Services we will offer to UL and staff to access various pieces of equipment until Dec 15th, after which we would expect all UL materials to be removed and staff vacated from the MBR areas. This is to provide an opportunity to wind down the UL activity and will be at no extra cost. Post this date we propose a Pay as you go model is proposed for access MBR equipment. For any prospective research projects, under the Relationship Agreement UL can place a research contract which Tony which can be separately costed. In essence, and as far as the monitoring officer is concerned, access to the MBR is maintained just accessed under different terms. ACTION MR/SL need to work on the various agreements to make this possible asap as the MBR agreement ends formally on the 16th November (lease is already up)."- Minutes of the JSB

Dec 15: Brad Moss reaches an informal agreement with his counterpart at the University of Manchester that the UoL will become a part of the Sir Henry Royce Institute "List of equipment earmarked for purchase using Royce funds – funding likely to become available in Q1 2017, no reason to suspect this now won't happen however should wait until formal agreement between Royce partners in April 2016 (this may be optimistic, need to manage expectations)"- Minutes of JSB	Connected actors (Royce Governance Board) and Material Elements (Royce Funding- capital)
Dec 15: HEFCE sign off the Audit for the MIF project having discharged the RPIF Funding "The project was audited by an external consultant working on behalf of HEFCE. The auditor looked at the management, governance and finances of the project. Initial, verbal feedback was positive – obviously we will need to wait for the final report which we've requested from HEFCE. It was suggested that this would be a useful document to share with the MIF Board ACTION JM to share if made available by HEFCE"- Minutes of JSB "UoL have received the formal HEFCE audit report. No recommendations or observations reported, which is an excellent result. Project complimented on its management regime, governance and financial oversight."- Minutes of JSB "In advance of HEFCE auditing the first tranche of UK Research Partnership Investment Fund projects, two pilot audits were conducted to develop the audit process. The MIF was chosen as one of these pilot audits. The audit was conducted by an independent consultant on HEFCE's behalf on the 11th September 2015, with a HEFCE higher education policy advisor also in attendance. The figures presented were accurate at the time of writing aligned with the previous BP v2. The audit assessed project control, financial oversight, governance and checked that the overall aims of the project as outlined in the original bid are being adhered to. Finances were audited in some detail, with a selection sample project invoices cross-checked against the University financial systems. The project passed the audit with extremely positive feedback and the University was complimented on its robust arrangements for the management and oneration of the MIE project. In particular maintening involvement	Disconnected Actors (HEFCE)

good practice. No recommendations or observations for improvement were made which is a very positive result. We will continue to providing quarterly reports as scheduled (Table 4) to HEFCE for the Initial Period as part of the funding obligation."- MIF Business Plan 2016		
Jun 16: Nine MIF Academics recruited- the requirement for a 'Formulation Chair' is lost due to the skillset of the 9 Academic appointments		
"Professor Hall who headed the OMICs research area within the MIF has left the University, on good terms, in April of this year. The MIF Team quickly appointed Professor Christiane Hertz-Fowler as our lead academic. Christiane had previously worked closely with Neil and indeed Unilever as the Manager of the Centre for Genomic Research Functional and Comparative Genomics on lead on the MIF OMICs Facility Credit Access System to accelerate stakeholder access to this facility ahead of the main MIF Opening Date. Professor Hertz-Fowler is also Deputy Head of the Institute of Integrative Biology (IIB) in which the MIF OMICs facility is located and administered. The University remains committed to strengthening its own research base with 10 new academic appointments spanning areas in Chemistry, Engineering, Physics, and Computer Science aligned with MIF activity. The University has used best endeavours to recruit on two occasions to the Chair in Automation/Formulation vacancy and on both occasions failed to appoint even with reasonable offers made. The University will rethink its approach for further attempt to appoint to this post or one similar to it that will be our research lead within the MIF. The nine other academic vacancies have been advertised with interviews planned for June 2016." MIF Business Plan 2016	Connected actors	
Dec 16 : Some CMD equipment- the items that were still relevant for		
was donated to the Materials Innovation Factory . CMD contract not		
renewed	Disconnected material elements (CMD equipment)	
"During 16/17 the University provided secure space to Unilever within the CMD and in MBR offices. Both are physically and organisationally co-located, and will remain in the Chemistry Department. Their use, along with access to equipment and associated services. were adverned by agreements that have now formally ended.		

MBR - December 2016 CMD – December 2016 The University provided extended periods of access to both facilities to enable both parties to conclude further discussions and arrangements for 2017 onwards. The two facilities remain separate from the MIF, so that they formally fall outside the scope of this Business Plan. Whilst the initial plan was to harmonized structure for both partners, governed under the structures outlined within the SLA. However, Unilever indicated to the University in December 2016 that it no longer wishes to continue with the CMD under the existing terms or newly outlined Automated Materials Discovery Lab under the umbrella of the MIF terms. Unilever identified a subset of the total equipment that it wished to continue accessing located in both CMD and MBR. The University were clear in their response, to ensure that no misunderstanding about what this change would result in. This is summaries below: The University recognised the request as a clear step away from the CMD model and therefore, not running a sustainable centre or a stand-alone laboratory. Unilever identified a number of 'Core' items that it wished to see reside in a serviced lab, these items are currently within the MBR/CMD laboratories: GPC; NMR; UV HPLC; IR/UV Kruss Tensoimeter. All other equipment within was requested to fall under a 'pay as you go' model. Access to existing Unilever private labs within the CMD and ancillary spaces, with refurbishment (to be reviewed and agreed) were also part of the request. The University have been able to accommodate this request. The physical relocation of these items of equipment helps to delineate MIF controlled areas, that fall under the MIF SLA and its governance, the aim of this suggestion is to remove any uncertainty or grey areas. " MIF Business Plan 2017		
Nov 15: Procurement and further Technical specification of Formulation Engine begins "The MIF team are working on the User Specification requirements for the Formulation Engine and the Reformatting Module."- Minutes of the JSB "The MIF team are working closely with the 2 selected suppliers who are currently working on design studies prior to final selection on the 5th Feb 2016. Three way confidentially agreement now signed enabling UL staff to attend meetings with suppliers – in an advisory capacity."- Minutes of JSB	Connected actors (Formulation Engine supplier)	
"The University of Liverpool (UoL) as a 'buyer' will place a procurement contract with XXXX the 'seller' for the design and build of the Formulation Engine. The procurement		
contract will set out the terms of engagement, with the provision that UoL may from time to time involve third parties in support of the design and system build phases of the procurement process. Under this arrangement, Unilever (UL) will be able to provide technical consultancy to support the procurement process. However, UL will not be involved in discussing or reviewing any commercial terms relating to the project. For the avoidance of doubt, these include financials, payment schedules, delays by the seller, cancellation of the contract, subcontracting, indemnity and insurance, warranty, waiver etc. Commercial terms will be agreed and reviewed between XXXX and UoL. Technical Working Group: A Technical Working Group will be formed which will consist of both UoL and UL representatives working together with XXXX .The Technical Working Group will oversee the design and build of the Formulation Engine, ensuring that it will ultimately meet technical requirements of key stakeholders and remain flexible and adaptable to future needs."- Internal Procurement Plan		
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Aug 14: Peter Blanken formally appointed as the MIF Managing Director on a permanent basis following formal recruitment process "MIF was established as a new Institute in the Faculty of Science and Engineering in the University of Liverpool, with Unilever integrated into the leadership and governance processes. Operational leadership is provided by Dr Peter Blanken, a full time, non-academic Managing Director reporting at Faculty level within the University and also accountable for the delivery of the SLA"- MIF Business Plan 2015 "MD-It was noted that after many discussions around the recruitment of the MD, Peter has now been appointed – with an official start of 1st Aug. This is a very positive step for the project"- Minutes of the JSB	Defined actors	Relationality- reinforcing pre-existing meaning structure elements, defining meaning structure elements and
Sep 14: Technical design report signed off and Contractors appointed by the University of Liverpool's Project Control Group "Stage D report due for publication next week – hard copies to be circulated, each party needs a process to sign off the report as this will form the basis of approval to proceed to Stage E and that all the essential elements of the design are acceptable (NB Signature of Stage D is in itself not legally binding, but will form an important schedule of the Agreement to lease contract, signature of stage D is to show acceptance of current build design). Any changes post Stage D sign off will incur delay and financial cost. ACTION RM/JM for UoL, MR to cover UL"- Minutes of JSB	Defined material Elements	meaning structure

"Stage D building signoff-Report signed – discussion around the quality of the design and the excellent work of the design team against aggressive timescales. At the time of writing these minutes the building is now out for tender, meeting to be held in the forthcoming weeks with all bidders in the same room at the same time, each explaining their vision for the project"- Minutes of JSB		
"The design team has been through a robust exercise to score each of the tender returns and probing the finances to identify the reasons for the differences between the various tender figures. Key points are: XXXX and YYYY both invited for interview – out of the two the XXXX team inspired more confidence – demonstrating a better understanding of the project. At a second interview the XXXX team again effectively demonstrated their knowledge and approach to the job."- Minutes of Project Control Group Meeting		
"The consensus around the table was that XXXX was the best option and that we should proceed on this basis. In terms of formalising this agreed approach with UL, a technical sign-off of the tender report would add little value due to the significant technical detail contained within. The best approach was a sign off by Jon/Mark on a revised report issued by Tony capturing the final position combined with these minutes." Minutes of the Project Control Group		
Sep 14: Memorandum of Understanding for HTFC signed by Murray and Dowdall. Agreement on the specifications of the robotic platforms that will be built and purchased		
"JM attended last formulation centre monitoring visit with BIS. Still waiting for contract to be signed between UL and the science park, but despite this the project is progressing very well. One outstanding action is to complete the MOU between UL and UoL"- Minutes of the JSB	Defined material Elements	
"To facilitate the recruitment of HTFC/MBR technician posts, JH signed the MOU. Need to chase up the MBR lease with UL legal"- Minutes of the JSB		
"we raised grant money on an RGF grant, we took all of the bloody flack that goes with those grants and built JEFF [Robotic Platform] and donated it to the university rightfor freeit's not even part of our obligation, because we met the obligation		

through the software, right? so all of our intellectual effort, thought leadership, engineering expertise, all of our knowledge about formulation, all of our knowledge about how to build a modular robot, all of the software, hardware, we managed the project, the guys who we had chosen, XXXX, built it, we got it going, we de-risked it, we've integrated it with our software management system, we've built expertise on it and we have given it to the University for anyone, including our direct competitors to use on day one"- Mark Ward		
Oct 14: Procurement Workshops held with Unilever Client Group and		
Academic Leads Group to develop more detailed equipment proposals		
"A team of six had been identified to manage the procurement process. Equipment priorities had been identified and there was consensus between UoL and Unilever where any overlaps had been identified. It was agreed that an update on the prioritised equipment list would be ready for the next meeting of the Group. UoL now has leads for each of the category areas, who have been tasked with generating options. This is to be reviewed w/c 13/10 with a view to circulating to the whole department for final comment by the end of the month. Early in November we should then be in a position of having a draft of UoL option to be discussed with UL. Some of the options already incorporate significant discussion between UoL/UL and we should hopefully be able to reach agreement relatively quickly – other areas may need some further debate and discussion. MR suggested that we need to set aside some half day sessions to work through the options"- Minutes of JSB	Defined material Elements	
Feb 15 : Capital Works project (Building) falls behind schedule due to contractor supply chain issues- UoL dispute with contractor begins "XXXX have reported they are 2wks behind schedule, UoL thinks this is probably more like 3wks. This can be attributed to difficulties associated with severing the services between the Muspratt and the rest of chemistry. Meetings with XXXX to be held to discuss bringing back on programme – including weekend working, longer hours etc UoL to consider paying costs associated with this as the delays, in the main, were in the result of the poor state of the building records prior to demolition. The good news is that the site hording line is now established, XXX will have their site accommodation established by end of the week and despite the delays the building is	Defined material Elements	
now separated from the lecture theatre and demolition can commence. The water main diversion is no longer on the critical path as it can now be isolated; however		

some clarity is required regarding on who is actually going to do this work United Utilities or XXXX"- Minutes of JSB	
"AB reported that XXX are currently working to a Practical Completion date of 01/10/2016. There has been a further two-week slippage which from this date due to XXXXs own issues on availability of site items within their supply chain. XXXX's Operations Director who deals with such issues has initiated a programme of extended hours to catch up on this lost time."- Minutes of JSB	
"UoL currently in dispute with XXX on the cause of the delay which they are pinning on a lack of mechanical and electrical plans; however they appear not be progressing pieces of work for which they do have the appropriate plans. It is also the case that the sequence of some of the mechanical and electrical work packages has been brought forward by XXXX as a consequence of their delays on the construction of the concrete frame. This is being pursued at Director Level with both parties (ACTION AB), the issue highlights that to maintain their margin XXXX will attempt to push back the reason for any delays onto UoL, particularly given the substantial costs per week they will incur for late delivery of the project."- Minutes of the JSB	
May 15: Mills and Douglas's EPSRC programme grant application is successful- awarded £5m to support research in computational High-Throughput Materials Discovery.	
"The hard fought EPSRC programme grant was awarded to Mark and Archer – congratulations offered to Archer; this is very good news for the project."- Minutes of JSB	Defined conceptual elements
Jan 15 : Blanken commissions IT consultants to explore software options that would enable the realisation of the Computer Aided Materials Science ambition- software that would enable secure data collection and storage from the equipment that would be located in the MIF.	Defined material Elements
"This vision – although compelling to both parties – still requires some more definition to get to a point where we can be comfortable ascribing costs and timelines. We have agreed to undertake a feasibility exercise to explore some of the	

options and help provide a project scope (UoL Computer services department and PB. This will be necessary to aid the apportionment of the equipment budget (£7.1M). One possible output is to trial an approach in an existing Lab e.g. MBR. During this exercise we need to be mindful of the obligations to deliver the SLA – i.e. there is a minimum level of IT infrastructure required to allow the OAA to function when the MIF opens."	
May 16: Elliot Murray and Archer Mills sign off the report on	
equipment proposals- creating a defined list of capabilities and	
equipment that will enable their realisation. Stage-gated procurement	
process re-commences.	
"Standalone analytical kit – top 10 pieces of kit identified and listed both at UL and	
UoL – meeting to discuss overlap and define purchase list to be held on the 30/6	
ACTION SL/AC/MR/NM"- Minutes of JSB	Defined conceptual and material elements
Following public procurement, we placed an order with XXXX on the 28th April to	
design and build the Formulation Engine for the MIF. Stage Gate 3 Report for the	
procurement of analytical equipment is in draft and due to be issued in May. This	
document describes the purchase scenarios based on our formal public tender	
process. Once agreed, orders will be placed for each line item of equipment and	
specification identified within this document. The Directors do not anticipate any risk	
In delivery schedules for analytical equipment aneda of the MIF Opening Date."- MIF	
Nov 15 : 'Proof-of-Principle' test of Unilever Software indicates that it	
would be possible to use the FLOW/EMS Software in the MIF	
"XXXX has started a proof of principle exercise, installing a separate entity of	
Unilever's EMS/Flow software onto UoL infrastructure"- Minutes of JSB	Defined concentual and material
"A trial in November 2015 demonstrated a fully working incidence of the EMS &	elements
FLOW software suite clean of any Unilever data had been successfully installed	
within the University IT environment. The demonstration using robotic platforms	
located at the Liverpool Science Park was a successful proof-of-principle. This	
successful first step was followed by a detailed two-month gap analysis designed to	
highlight the key areas of software development required before Para ∞ DIME [®] would	

be capable of being deployed in a multi-tenancy, multiuser environment. The output of this scoping exercise highlighted the following areas to be addressed, resulting in a usable system available for testing by July 2016"- MIF Business Plan 2016		
Sep 15 :Mills and Douglas develop a proposal for a Leverhulme Grant. The proposal was to establish a Research Centre for Functional Materials Design based on the integration of computer science and chemistry. The underpinning idea was to develop 'closed-loop materials discovery' which combined artificial intelligence and high- throughput chemistry to discover new materials at a rapid pace. "Mark and Archer were putting together the Leverhulme proposal. I wasn't involved in that and Unilever wasn't involved because it's a blue-sky thing. I knew they were doing it right? And Arnold Royle was around and about then right? And they talked about this functional materials design and you know this idea of Computer Aided Design for chemistry."- Mark Ward	Defined conceptual and material	
leading centre for computer aided materials science' right? And then 'Ohhh what does that mean? I said look forget about it, what it means is if we define it like that, I taught them a little bit about how Unilever does claims. If we define it like that, we are going to claim that and then we are going to make it happen make it so right? Then you get into what the metrics, how you know you are world-classit doesn't matter about any of that because itswe can't have a vision that says you know, the North-West of England's leading Centre or the UKIt has got to be the world leading centre for materials science. So what that's about is, if you take the analogy of computer aided design and computer aided manufacture to computer aided materials right? Now I knew that the Leverhulme Centre was kind of working at a higher level again on that conceptual idea. So what do you need to do that? Well you need to have a kind of seamless connection of experiments and theory, robotics, data analysis and all the rest of itright, this idea of kind of a 'hooked up' system. That's when we did it"- Mark Ward	elements	

"I mean I wrote/ led this Leverhulme research centre for functional materials design bidit wasn't predicated entirely on the MIF but certainly having a space where you can have the large team in one place was a big part of it. Having the things like the formulation engine, one of the ideas is sort of algorithmic evolution of functional materials. You can't do that without certain tools"- Archer Mills		
"The MIF Academic Director was successful in his application for funding to create a Leverhulme Research Centre (LRC) for Functional Materials Design in the University of		
Liverpool. LRC will create a design revolution for functional materials at the atomic		
Abdullah University for Science and Technology (KAUST) and Imperial College. LCR		
will fuse chemical knowledge with state-of-the-art computational capabilities in a		
multidisciplinary team, revolutionizing our ability to develop new, high value		
materials such as superconductors and synthetic, multicomponent analogues of complex biological structures that catalyse important chemical pathways. The hub		
and spoke Centre will gain added value from being housed in the MIF, with cutting		
edge facilities and computational infrastructure. The Leverhulme investment will		
allow us to co-locate the necessary interdisciplinary team of world-class researchers		
In Chemistry, Computer Science, Engineering, Physics, Management and Environmental Sciences, building a long-term, critical mass activity with the explicit		
remit of tackling the core design challenges. LRC will be located on the 2nd floor of		
the MIF building and those associated with this centre will be within the MIF		
community opening up the chances of collaboration and sharing of new		
understanding within that community. The LRC programme commencement date is		
September 2016."- MIF Business Plan 2016		
May 15: 1st Annual Meeting of the MIF Board- 2nd Business Plan		
reviewed and signed off.		
"This paper provides an overview of the current Materials Innovation Factory (MIF)		
financial position, and spends profile, based on records held on the University's	Defined actors, conceptual and	
financial system 'Agresso' as at 31st December 2015, with predicted outturn for	material elements and linked them	
2016/17 and projected budgets until December 2019. The paper includes the	to future events	
Directors and the MIF Finance Manger's commentary for any significant variances.		
April 2016-2019 and submitted to the Board for approval		
DECISION(S) REQUIRED		

The Board is asked to approve: The MIF Directors recommendation to pro-rata the	
REC for pre-paid rent and pre-paid access fee over the period of 2020-25. Should the	
Board agree this principle, a full REC calculation and proposed payment profile	
including the application of this discount for 2020-25 will be provided. The Directors	
believe this recommendation to be the most desirable from the MIF's sustainable	
operation. The re-profiled payment schedule recognising agreed pre-payments	
towards 2020-2025.	
The Board is asked to acknowledge: The financial impact of the revised Practical	
Completion date, in particular the addition £562k of costs borne by the University.	
An estimated £1,554k in access fees and £200k in rent, will be deferred as Unilever's	
pre-payments for the subsequent years (2020-2025) based on the revised Practical	
Completion date. This amount will form part of the Restricted Expendable	
Contribution (REC) as agreed within the SLA. There is no indication as at 31st	
December 2015 that MIF's Other Operating Expenses will exceed the agreed budget	
of £281K, as stated within the WIF Forecast 1."- MIF Board Minutes	
Oct 15 : FLOW/EMS Software is valued independently at over £4m. This	
reflected nearly all of the in-kind contribution that had been agreed in	
the SLA.	
"One specific comment made by the HEFCE representative present during the audit,	
was a compliment on our mature approach to dealing with in-kind contributions.	
Both he and the auditor were encouraged that in-kind contributions were to be	
achieved by valuing tangible equipment assets, rather than subject to the vagaries of	
counting staff time. We need to look at the EMS/Flow as an in-kind contribution –	
specifically how this could be valued. "- Minutes of JSB	
	Defined Material Elements
"So we didn't realise it at the time, and when Peter looked at the options that were	
out there, it turned out that Unilever's system that had been designed for exactly this	
worked with, was way better than anything else on the market. We had invested	
several million over a number of years to get it to a point where it was you know	
running our high throughput systems so it became a simple point then, well why on	
earth wouldn't we just license that to the Materials Innovation Factory? and we did	
that at no cost to the MIFwhat we got in return was the ability to access any	
improvement that the University may make to that operating system, you know	
because they are constantly upgrading itthat was really beneficial for us, it means	
that you know any of our systems get upgraded as the University invest in the thing,	

really they've managed to avoid a £5m investment in their own right. There is a massive amount of value created for the University there. So I think that that was the first major benefit, we get the upgrades. The second thing is that, all the data that is captured into the Materials Innovation Factory is in a system that is compatible with high throughput data. "- Elliot Murray

" It was not part of the MIF no; it was not part of the plan. I saw the opportunity but it was never part of the plan. In fact, one of the reasons I thought it was interesting was that, we had this commitment of in-kind contribution of £2million and actually, that was...so our original plan was that we thought the equipment would cover for that and that became quite fraught for other reasons and actually in the end, the software valuation that the university had...made...no it exceeded that. I think it was £4.6 million, I think. So it ended up that we had covered our in-kind contribution to the project by doing that software license and gave us a bit of headroom. But that was unexpected bonus at the end of the kind of thing."- Mark Ward

"Unilever's contribution of £22M has been readjusted to include £7.1M capital contribution towards the MIF build costs, £2M of in-kind donations, which have been valued at £4.6M (market valuation of FLEX), £8.4M towards MIF running costs during the Initial Period and a £4.5M prepayment of rent and access fees to be used in the subsequent period"- MIF Business Plan 2017

"As part of the due diligence around the transfer of assets, the University at its own expense commissioned an independent valuation of the asset, reviewing FLEX Source Code, Materials and Unilever Documentation in addition to Software Cross-Licence terms. Clear View IP Ltd were commissioned to provide this independent valuation, which would form part of evidence required to HEFCE for industry partner coinvestment. Appropriate methodologies in accordance with recognised Intellectual Property valuation principles were deployed to arrive at a justifiable and evidenced valuation range. The aim was to assess what was actually spent by Unilever on the developing the software but to arrive at a justifiable market valuation of the software using the most efficient and cost-effective scenarios of re-development. Clear View IP used three classic valuation methodologies: Cost, Market and Income approaches with customisation to suit this unique scenario. The resulting assessment of valuation lies in the range of £1-13M. Further, using most likely/efficient scenarios and equal

weightings amongst the 3 approaches, the valuation was calculated at £4.66M for the software system."- MIF Business Plan 2017	
Sep 16 : Royce Board Agrees governance structure concordant with the MIF Governance Framework	
"During 2016/17 the funding profile of the MIF has been modified to reflect inclusion of capital and revenue grants obtained as part of the partnership with the Sir Henry Royce Institute. The origin of this funding is BEIS, following Osborne's announcement in 2014, which was released to the EPSRC to manage its effective distribution. The uplift to the MIF accounts due to this funding totals £4.7M, in the Initial Period"- MIF Business Plan 2017	
"The Sir Henry Royce Institute will, in the Initial Period, contribute a total of £10.8M of which £10M is to be spent on capital items for use within the Open Access Area, and the remaining £0.8M of revenue will cover consumables and staff costs for additional members of the Technical Team for the initial period. NB The revenue stream from the Royce extends past the initial period until March 2022, giving a total revenue stream from the Royce of £1.8M for the term of the initial Royce funding as agreed within their Governance Structure. "- MIF Business Plan 2017	Defined material elements and linked them to future events
"Now when the Henry Royce Institute came into being, we took the opportunityor the University took the opportunity, to figure out how to form an arrangement with the Royce Institute to get extra funding which paid for additional equipment, and a little bit of additionalI think there were, there was the additional List there and a few other bits and pieces that we felt were useful for example, for visualisation. So that was negotiated with the Royce Institute, so a chunk of Royce money came into it as well which was beyond the original scope and Unilever fully supported that and in fact, we did our very best to move the initially frosty negotiations between the Royce Institute which was led out of the University of Manchester and the University of Liverpool. It was a tense time"- Elliot Murray	
"So the University was very very unimpressed with that, and then secondlythe concept was hatched that the Royce Institute would have a physical location, a building in Manchester affiliated to the university but would have a hub and spoke	

model so then a number of the other major Centres would be taking responsibility for elements of advanced materials, so I think Cambridge, Sheffield, Leeds, Liverpool, there is probably one other ...Imperial I think. But all set up to, were all asked to contribute or be partners to it in return for funding. So it was £10m, £10m-£20m, depending on which university would receive funding. Now the other tension that came about was... Liverpool had a pretty clear view of what they wanted to do with the Royce money and that was not initially a view that was shared with the Leadership of the Royce, so they felt that the Royce leadership at the time were being just, you know 'it's our way or you don't get the money' basically. Now, so that was the sort of negotiation thing that we helped smooth out. We got a guy called Phil with us who was acting as the head of the Royce to come to Liverpool, we shared with him the model, we shared with him how Unilever contribute to....that really helped unlock things and away we go...."- Elliot Murray

"Royce update-Project needs a clear governance structure and decision making process, agreed by partners. Partners are being asked to commit to terms for which they have had limited input. UoL keen to be a key player in the project and wish for it to be a success, however clear ground rules need to be agreed to maximise the opportunities presented by the Royce ACTION KB/AC."- Minutes of JSB

"Royce-As set out in the paper to the board UoL proposal is for a capital contribution to supplement the MIF equipment base, coupled with provision to cover some of the running costs. This has been pitched so that it doesn't interfere or dilute the current MIF operating model and governance structure. Proposal was approved by the University's Senior Management Team and agreed as the best way to proceed. This will now be reviewed by the Royce team, with a decision likely in December – dependent on whether clarifications are sought. Detailed final agreements to be discussed in January, all being well. UoL have discussed the proposal with XXXX. XXXX (Chair of the Royce Strategic Facilities Advisory Board) is visiting later this month. The MIF Board approved the Royce paper put forward by the University"- Minutes of the JSB

"Professor Archer Mills is the Champion for Chemical Materials Design within the Sir Henry Royce Institute. We have identified a broad range of science programmes and materials types that will be supported by the Royce@Liverpool. For example, the Formulation Engine will support the high-throughput, automated formulation of a

huge range of products for applications in sectors such as Home & Personal Care, Agrochemicals, Coatings, and Pharmaceuticals. A significant sub-set of the capability of this platform is aimed at soft matter type problems (e.g., emulsions, dispersions, high shear mixing), but it will also be possible to create 'formulations' for hard materials (e.g., solid dispensing of oxide precursors, catalyst supports etc.). Allied with that, the equipment in the Royce@Liverpool will support research into a number of specific materials classes, such as: Polymers, Porous materials, thin film, thin film disposition and bulk analysis, biological materials, catalysts and organic materials – e.g., flow chemistry equipment. This will all be underpinned by more basic materials design capability that is relevant across all of these materials classed (Scientific Data Management System, API's, computational clusters, Virtual Reality Laboratory). The potential application space of the materials enabled above is large and relevant to SHRI e.g., optical properties of polymers, organic and inorganic materials with applications in solar fuels, photovoltaics/solar absorption, transparent conduction, thermoelectricity, in addition to the basic core materials characterisation that these facilities will provide."- MIF Business Plan 2017	
Sep 16: Formal Opening of the OMICs Facility- Peter Blanken becomes	
member of CGR	
"New office space in Centre for genomics research has been handed over – need to follow up on some snagging issues ACTION JM/NH/CHF. Still on course for a	
commencement of service I the 1/1/16 – subject to the letter of variation, discussed previously."- Minutes of JSB	
"OMICS – SL now on the Centre of Genomic research steering committee,	Defined material elements and linked them to future events
(for regulatory reasons, acting to slow project down). Successful formal opening a month ago." Minutes of JSB	
"OMICS Update- It was reported to the JSB that the MIF OMICs Facility and the Credit	
Access System is now in its 2nd quarter of operation. CHF has frequent operation meetings with SL and MN. The OMICs team have hosted many VPs at the facility and	
will be visiting PS/Colworth in the coming weeks to raise profile of capability."- Minutes of JSB	

Jan 17: MIF Practical Completion	
"The flagship asset of the MIF will be a four storey, 11,600 m2, £40.6M building designed by Fairhurst Design Group Ltd met Practical Completion on the 23rd December 2016. The buildings main atrium provides the 'wow factor' whilst the utilitarian laboratories look clean and futuristic. Whilst there are post completion works still remaining the MIF Team moved in during January, Unilever colleagues started to move in from the 1st February and University colleagues are scheduled to move in from August 2017."- MIF Business Plan 2017	Defined material elements and linked them to future events
Apr 17:MIF Opened and Lease activated	
"The MIF Team worked hard to achieve the MIF Opening Date of the 13th April 2017. A major achievement was met with the sign-off of this milestone. Further roll-out of installed equipment which will form part of the MIF Equipment Manifest has been agreed and shared with the MIF community, with another round of procurement underway to ensure Royce funded items are delivered, operational and available to MIF User community within the next 12 month period."- MIF Business Plan 2017	
"The University of Liverpool and Unilever have four executed agreements: Agreement for Lease (AfL) signed in February 2014; Service Level Agreement (SLA) signed in April 2014; The Lease signed in February 2017; Software Cross-Licence Agreement signed in September 2017. The University was obliged to meet three Condition Precedents described within the AfL before the agreements were binding. These conditions were met in January 2015. Under these agreements the University acts as a property developer (AfL), a research services provider (SLA) and a landlord (Lease). Now the Lease is signed the AfL falls away and the interaction between Unilever and the University is governed by the SLA and the Lease during the initial term, until December 2019. Unilever and the University have the option to extend in 2019 beyond this term."- MIE Business Plan 2017	Defined material elements and linked them to future events

Sep 16: FLEX agreement between UoL and Unilever agreed and signed		
""Flex agreement between UL/UoL has now been agreed and signed, agreement with XXXX also signed an agreement to maintain and develop the code."- Minutes of JSB	Defined conceptual and material elements and linked them to future events.	
"The Flex Handover Date was October 21st 2016. On the FLEX Handover Date the Software Cross-Licence Agreement executed on the 14th September was enforced. On execution, FLEX V1.0 source code was transferred to the University and used to create the first version of FLEX."- MIF Business Plan 2017		
"The design integrity and quality of the FLEX Master Version is ensured by the senior representatives of the University and Unilever (the MIF Managing Director and the Unilever MIF Programme Director) agreeing the strategic direction of the code base and by the appointment by the University of a Joint Design And Requirements Authority (JDART). The activities around the FLEX workplan for JDART will be set and monitored jointly by the MIF MD taking account of inputs from the Para-DIME Planning Group."- JDART Overview		
Jun 15: Technical Definitions of 'Formulation Engine' established "Formulation engine (modular robotic system) – there has been lots of very productive discussions between the UoL/UL technical teams – target for specification is by the end of the month"- Minutes of JSB		
Jul 15: User Specification of Formulation Engine Defined	Defined material elements and linked them to future events.	
their combined technical and commercial offering. From these two meetings several modifications to the original concept were proposed and these changes are outlined here.		
• New aeveloped concept proposed which increases module capacity and is shown schematically in Figure 3; Subtle redesign of layout allows housing of fixed chillers & electrical panels underneath consumables store; Removal of third robot from raw materials handling bay and extending processing bay robot allows increase capacity from 8 modules to 11 modules for no change in cost or footprint; It is possible to		

increase the footprint from 8m -> 10m to allow four further bays (i.e. 15 module capacity) for additional cost and potential impacts on laboratory layout; An offline docking station would allow an additional 4 modules to be used outside of the main machine for additional cost; Option to include additional pH measurement capability within the consumables area included with associated cost; Modification of XYZ processing module to include single channel septum piercing needle, minimising the need for the separate liquid handling module."- Formulation Engine Technical Review

Nov 15: Procurement and further Technical specification of Formulation Engine begins

"We had a short-list of potential suppliers for the formulation engine. After a rigorous scoring exercise we have now selected 2 suppliers who are currently working on design studies prior to final selection on the 5th Feb 2016. Any monies required to complete the design study have been capped to maintain a fair procurement process"- Minutes of JSB

"The University of Liverpool (UoL) as a 'buyer' will place a procurement contract with Supplier (LabSupplier) the 'seller' for the design and build of the Formulation Engine. The procurement contract will set out the terms of engagement, with the provision that UoL may from time to time involve third parties in support of the design and system build phases of the procurement process. Under this arrangement, Unilever (UL) will be able to provide technical consultancy to support the procurement process. However, UL will not be involved in discussing or reviewing any commercial terms relating to the project. For the avoidance of doubt, these include financials, payment schedules, delays by the seller, cancellation of the contract, subcontracting, indemnity and insurance, warranty, waiver etc. Commercial terms will be agreed and reviewed between LabSupplier and UoL. A Technical Working Group will be formed which will consist of both UoL and UL representatives working together with Supplier. The Technical Working Group will oversee the desian and build of the Formulation Engine, ensuring that it will ultimately meet technical requirements of key stakeholders and remain flexible and adaptable to future needs. The process to deliver the Formulation Engine will be split into the following phases..."- Formulation Engine Ways of Working